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Workshop Change: Ashley Ross is replacing presentation of *The Moderating Role of the Millennial Generation on Polarized Climate Change Politics* with the following paper.

**Capital Assets and Rural Resilience:
An Analysis of Texas Communities Impacted by Hurricane Harvey**

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Table of Contents

Abstract	2
Paper	3
Endnotes	24
References	25
Tables & Figures	30
Reviewer comments	37

Note: This paper has received a revise and resubmit to the *Journal of Natural Resources Policy Research*, special issue on Effective Management of Natural Disasters: Conceptual, Empirical Issues and Case Studies. The authors would like to workshop ideas for revisions in response to the reviewer's comments. Therefore, the original submission as well as the reviewer's comments are included in this file, in the order indicated in the Table of Contents. The authors plan to use their time at the IPPA IWPP to solicit feedback on revisions to the paper.

Abstract

This study examines what may make rural disaster resilience distinct from urban disaster resilience. It approaches the study of disaster resilience in terms of adaptive capacities – framed as human, social, physical, financial, and natural capital assets – and adaptive processes of collaboration and improvisation. Data from 108 household interviews in four Texas communities affected by Hurricane Harvey are analyzed. The findings indicate that, in general, considerable human, physical, and financial capital needs are evident in all cases post-disaster. Housing and recovery process issues were particularly acute in rural communities. Rural communities were also distinct in that they rely most on community action, driven by social and natural capital ties, while the urban case exhibited greater reliance on government assistance. Social capital ties, directly associated with the agriculture community, were revealed as drivers of community response and recovery in rural communities.

Keywords: disaster resilience; rural; Hurricane Harvey; social capital; natural capital

Natural disasters are not respectful of geographical or jurisdictional boundaries; they wreak havoc on all in their path. Disaster damages, however, are not equally felt across communities as some are better prepared for disaster events and have greater capacity for disaster recovery. One divide evident in disaster resilience studies is between urban and rural communities. Rural communities have been found to have less capacity for disaster resilience (Cutter, Burton, and Emrich 2010, 1-22; Ross 2014) and slower recovery (Horney et al. 2012, 183-193; Saenz and Peacock 2006). Despite this, scholarly and popular attention is predominantly focused on urban areas. This was acutely felt by residents in rural communities impacted by Hurricane Harvey in 2017. Reflecting on this, one rural resident (R1) said in an interview conducted for this study: “The attention that gets paid with a city the size of Houston is a lot because there's a lot more people, which in a way makes sense. It's great, but also in the same mindset, just because we're a smaller city doesn't mean we need less help.”ⁱ

This study seeks to advance our understanding of the dynamics of rural resilience by systematically analyzing rural disaster resilience from a capitals approach. We ask: *Are there specific capital attributes of rural societies that define the way resilience emerges in their community? What implications does this have for the study of resilience and the development of disaster policy and emergency management strategies?* Using a mixed-methods approach, we analyze four small towns affected by Hurricane Harvey – three rural and one urban. Analyzing data from 108 household interviews, we find that all the communities had considerable human, physical, and financial capital needs post-disaster. However, housing and recovery process issues were more prevalent in the rural cases. Further, in terms of recovery processes, the rural cases relied more on community action, driven by social and natural capital ties, than the urban case, which relied more on government assistance. The implications of these findings point to the need

to refine measures of social and natural capital in rural communities, including assessment of small town and rural identity as it may drive (or at least reflect) the accumulation of these capital assets. The findings also suggest ways policies and programs can better support rural communities recovering from disasters. These include adjustments to processes and programs related to insurance and government aid to ensure communities maintain their social fabric and sense of place as well as better facilitation of contractual services for rebuilding.

Disaster Resilience in Rural Communities

While rural communities shrink in population size (Cromarite 2017), they continue to provide valuable goods and services for the rest of the United States. Rural communities, through the agriculture products they generate and related industries, contribute 5.5% of our national GDP (United States Department of Agriculture 2016) and 11% of the nation's employment (United States Department of Agriculture 2018); 20% of our nation's manufacturing capacity is located in rural America (Helper, Krueger, and Wial 2012). Beyond this economic benefit, rural communities are the stewards of our nation's natural resources. While only 15% of the national population, rural areas comprise 72% of the land mass of the country (Cromarite 2017). Over 23 million acres of rural land in the U.S. is enrolled in conservation programs to restore wetlands and to protect wildlife, pollinators, and tree habitats, all of which provide critical ecosystem services (Farm Service Agency 2017). Therefore, the ability of rural communities to be resilient – to thrive in the face of adversity – is important not only for their own survival and prosperity but also for the well-being of the entire country.

Rural communities are more vulnerable to disaster impacts and are disadvantaged when it comes to disaster planning, preparation, and recovery (Horney et al. 2012, 183-193; Saenz and

Peacock 2006). Rural populations have higher incidences of socioeconomic vulnerability than their urban counterparts, with lower incomes (USDA Economic Research Service 2017a) and aging populations prone to higher rates of chronic disease (Jones et al. 2009, 123-139). Further, the geographic remoteness of most rural communities complicates the logistics involved in hazard mitigation as well as disaster preparation, response and recovery. As a result, most rural areas rely on volunteer emergency responders and nonprofit and/or faith-based organizations during and after a disaster event for assistance (Horney et al. 2017, 56-65). Studies of community and social capital in rural settings have found that social networks are critical for disaster recovery in mobilizing human and financial capital (Onyx and Leonard 2010, 381-397) and leveraged for information and learning (Falk and Kilpatrick 2000, 87-110).

A Capitals Approach to Disaster Resilience

Resilience is fundamentally concerned with the adaptation of complex systems to disturbances (Walker and Salt 2006). To examine resilience in a manner that isolates the factors and processes linked to adaptation to disasters, we approach resilience from a capitals perspective (Mayunga 2007, 16; Cutter et al. 2008, 598-606; Peacock et al. 2010; Flora, Flora, and Fey 2004). Specifically, we integrate sustainable livelihood capitals into Ross' (2014) model of disaster resilience. Ross defines disaster resilience as the “set of capacities that imbue a community with the strengths needed to respond, cope, and recover from a disaster event as well as a process of collective action enabled by these capacities to adapt to the post-disaster environment” (Ross 2014, 28). As shown in Figure 1, five capital areas, co-opted from the sustainable livelihoods framework, comprise the set of adaptive capacities that are developed in the mitigation and preparedness phases of disaster management. While the sustainable

livelihoods framework is aimed at identifying pathways out of poverty to sustainable development (International Recovery Platform 2010), the five livelihood asset areas “can serve as an important source and checklist for other approaches aimed at identifying susceptibility and coping capacity of people to hazards of natural origin” (Birkmann 2006: 22). We adopt them because they set up an interconnected asset framework shown to be particularly relevant to the assessment of rural community capacity (Chambers and Conway 1992).

[Figure 1]

The five capital components that comprise adaptive capacities in this model are: human, physical, financial, social, and natural. Human capital refers to skills, knowledge, and good health; physical capital is comprised of basic infrastructure and producer goods; financial capital refers to financial resources that support households and communities; social capital is comprised of the social resources upon which people draw; and natural capital includes natural resource stocks as well as the producer goods tied to the use of these resources (International Recovery Platform 2010). Human capital is the building block of the asset pentagon. It is necessary, but not sufficient, for accumulation of the other four asset areas. All of the asset areas are interlinked and may affect the others.

When a disaster strikes, a community’s adaptive capacities enable its members to engage in adaptive collective action that is characterized, in response and short-term recovery, by improvisation and coordination that connects available resources with needs. As the recovery progresses, the adaptive process is focused on engagement of the community in decision-making and the emergence of policies and programs that translate social learning into formal institutions (Ross 2014). These recovery policies and associated outcomes feedback into the adaptive

capacities of a community, ideally enhancing capital assets the community may collectively draw upon when facing future disturbances.

Evaluation of rural assets across human, physical, financial, and natural capital paints a picture of constrained capacity for resilience. At the same time, rural communities have characteristics that may contribute to their ability to respond to and recover from disaster events. These attributes are primarily concentrated in the area of social capital. Broken down by capital area, we observe the following trends in rural communities in the United States:

Human capital. In comparison to their urban counterparts, rural communities have: an aging population (Glasgow 2000, 611-631); higher rates of age-adjusted mortality, disability, and chronic disease (Jones et al. 2009, 123-139); lower levels of health insurance coverage (US Census Bureau 2016) and access to health facilities (McEllistrom-Evenson 2011); and lower levels of educational attainment and household income (Brown, Weber, and Wojan 2013).

Physical capital. While much of America's infrastructure is aging and in need of replacement, there is a current presidential effort to invest in roads, bridges, and public work facilities in rural communities (White House 2018). There is also a need for communication infrastructure in rural areas. Thirty-nine percent of rural residents lack access to broadband, compared to only 4% of urban residents (Federal Communication Commission 2016). Housing quality is also an issue; 5.8% of homes outside of metro areas are moderately or severely substandard, a rate higher than national averages (Housing Assistance Council 2012b). Outside of urban areas, racial and ethnic minorities are twice as likely to live in substandard housing as white residents (Housing Assistance Council 2012b).

Financial capital. Rural America is persistently poor; the higher incidence of rural poverty has existed since the 1960s (USDA Economic Research Service 2017b). In 2016, the

poverty rate of non-metro (rural) residences was 16.9% compared to 13.6% of metro (urban) residences (USDA Economic Research Service 2017b). The median household incomes have been, for the past 10 years, approximately 25% lower than urban households; while this does not account for cost of living, the income of rural families remains lower than that of their urban counterparts (USDA Economic Research Service 2017a). In 2015, rural households spend a greater percentage on utilities, fuel, and public services, compared to urban households – 8.6% of total spending compared to 6.8%, respectively (U.S. Bureau of Labor and Statistics 2016). Rural local governments, too, face challenges including fiscal constraints (Bull et al. 2001, 356-359; Waugh Jr 2013, 291) that can detract from emergency management organizational effectiveness (Demiroz, Kapucu, and Dodson 2013, 48-60).

Natural capital. Rural economies continue to be tied to agriculture and natural resources (Wojan, T, McGranahan, D. 2018), which are more sensitive to environmental and climate-based incidents than other industries (Bockel and Thoreux 2009). Natural capital, however, can serve as a buffer to lessen the severity of hazard impacts (Kousky 2010, 343-356). Further, the interface of natural resources with society should theoretically serve to create capacities for community action (Flint and Luloff 2005, 399-412).

Social capital. Rural communities are typified by a culture of self-reliance and close community ties (Harrald 2012). In addition, rural residents have higher rates of homeownership and are more likely to live in their state of birth (US Census Bureau 2016). These characteristics are indicative of social capital and a strong sense of place, factors that have been found to facilitate, enable, and motivate disaster recovery (Boon 2014, 683-701).

Given these trends in rural community capital assets, we expect that rural disaster resilience will develop, in terms of adaptive capacities, and be deployed, through the adaptive

process, in a manner that is distinct from urban communities. We analyze this in the context of Hurricane Harvey in four small towns in Texas. The following section outlines the data and methods we use in this analysis.

Data & Methods

Disaster Context

In 2018, a scattered tropical depression in the Gulf of Mexico intensified within 40 hours into a Category 4 hurricane, dubbed “Harvey” (National Weather Service n.d.). Hurricane Harvey made landfall at Rockport, Texas, located on the Middle Texas Coast, around 10 pm on Friday, August 25. It was the first major hurricane in this area since Celia in 1970 (Ehrlich 2017). Peak wind gusts were recorded at 132 mph, and the highest storm surge levels were more than 12 feet above ground level in some areas near landfall (National Weather Service n.d.). In addition to wind and storm surge, Harvey produced torrential rainfall and flash flooding. Behaving differently than typical hurricanes that move inland and away from the coast, Harvey stalled over Southeast Texas for days (Henson 2017). It dumped more than 40 inches of rain in 48 hours in the Houston area (National Weather Service n.d.), and rainfall totals peaked at 51.88 inches (Morast 2017). The excessive precipitation resulted in major river flooding throughout Texas. Approximately 25 to 30 inches of rain in Fayette County caused major flooding along the Colorado River producing the third highest crest ever at La Grange (Blake and Zelinsky 2018). After meandering across the state for days, Harvey made second landfall east of the Texas-Louisiana border in Cameron, Louisiana (National Weather Service n.d.).

Hurricane Harvey was responsible for at least 68 direct deaths in Texas, three of which occurred in Galveston County (Blake and Zelinsky 2018). The storm caused an estimated \$125

billion in damages (Mooney and Dennis 2018). Over 300,000 structures have been damaged, and up to 500,000 cars reported flooded across southeast Texas; at least 160,000 structures were flooded in Harris and Galveston counties (Blake and Zelinsky 2018). Approximately 15,000 homes were destroyed in Aransas, Nueces, and Refugio counties. Over 400 homes and businesses flooded in La Grange and across Fayette County; 200 of those homes sustained major flood damage.

Study Cases

To assess rural resilience in the aftermath of Hurricane Harvey, we conducted household interviews in four small towns across Texas that were hard-hit by the storm: Port Aransas (Nueces County), Refugio (Refugio County), La Grange (Fayette County), and Dickinson (Galveston County). The first three of these towns we consider rural, and the fourth, Dickinson, serves as an urban comparison case. Key characteristics of each community are presented in Table 1 that justify the assessment of the case as rural or urban. In terms of population, Dickinson is much larger than the other three cases; it is also closer to the nearest large city (Houston). While Port Aransas is closest to the nearest big city (Corpus Christi), it is an island, which geographically isolates it and makes mobility more challenging. Agriculture employment is higher in Port Aransas, Refugio, and La Grange than in Dickinson. Because Port Aransas is a destination for many “winter” Texans or senior nomads as well as a destination for many artists, nativity is lower in this case. In all, Port Aransas is a coastal rural case while Refugio and La Grange are inland rural cases to be compared to the urban case of Dickinson.

[Table 1]

Two of the towns – Port Aransas and Refugio – were affected by hurricane hazards, namely wind and storm surge, while the other two – La Grange and Dickinson – were impacted by flooding as a result of excessive rainfall from the storm. Port Aransas is located on the Middle Texas Coast and Refugio is located inland from the coast; both are approximately 20 miles from where Hurricane Harvey made landfall in Rockport. Dickinson is approximately 30 miles southeast from Houston, near the Upper Texas Coast in Galveston County. La Grange is located on the Colorado River, approximately 100 miles west of Houston and 60 miles east of Austin. While physical structure damage was widespread in Port Aransas, Refugio, and Dickinson, it was more localized to neighborhoods on the river in La Grange.

Data

In-depth interviews were conducted with heads of households in each location. Short questionnaires to collect demographic and health data on the interviewees were also administered. The interviews asked about damages incurred from Hurricane Harvey, challenges for recovery, information on recovery from local government, risk perceptions of the storm, evacuation behavior, and social capital connections. The interviews lasted approximately 20-40 minutes and were conducted 2-3 months after Harvey occurred. Interview participants were recruited at community events, including town parades and holiday celebrations. The field team visited diverse locations in the community – schools, commercial areas, neighborhoods – and attended local events to ensure the opportunity to invite a wide range of households to participate.ⁱⁱ In total, 108 interviews were conducted with both females and males of varied race and ethnic background.ⁱⁱⁱ

Methods of Analysis

We use a mixed-method approach to analyze the interview data collected that focuses on qualitative thematic and quantitative descriptive analyses. Excerpts were created to isolate discrete responses. In total 338 excerpts were analyzed from responses to the three questions: 1) “What are the biggest challenges to recovery for you?”; 2) “What are the biggest challenges to recovery for your community?”; and 3) “What does your community do best with recovery from disasters like this?”. The excerpts were deductively coded for predominant themes focused on adaptive capacities, including the five capital areas (human, social, financial, physical, and natural) of the sustainable livelihoods pentagon (International Recovery Platform 2010), and adaptive processes, representing key recovery activities and dynamics (Quarantelli 1999). Adaptive capacity codes were also assigned household or community level, and the adaptive process codes were designated as positive or negative affect. The adaptive capacity codes included: emotional state, physical health, recovery process, housing, physical structures, financial, social network, and natural capital. The adaptive process codes included: external aid, media coverage, government performance, community action in response, community interactions, and institutional communication.^{iv}

The process for coding was iterative. The lead coder created excerpts from a randomly drawn 10 interviews, then coded them using an initial coding scheme created from the adaptive capacity and adaptive process framework. The second coder then created excerpts from an additional, randomly drawn, 10 interviews and coded them using the same coding scheme; additions to the coding scheme were made at this time by the second coder. At this stage of the process, the first and second coders met to revise the codes. Following this revision, the lead

coder recoded the first 20 interviews as well as an additional 10 interviews. Using these results, the lead coder set up inter-coder reliability training tests using the software Dedoose (Lombard, Snyder-Duch, and Bracken 2002, 587-604; Dedoose 2016). From this training, an acceptable level of 0.70 of Cohen's kappa statistic was met (Cohen 1960, 37-46), indicating "good" agreement among three coders (Cicchetti 1994, 284; Fleiss 1971, 378; Landis and Koch 1977, 159-174). Then the remaining interview sample was split for coding by each of the three coders. Once coded, the data was analyzed using cross-tabulations across cases (Port Aransas, Refugio, La Grange, and Dickinson) and across capacity and process areas. We looked specifically for the prevalence of themes as well as the content of themes as the former indicates a commonly shared issue and the latter speaks to the meaning and importance of the issue, according to community members. Both improve our understanding of how rural resilience is distinct from urban resilience.

Findings: Rural Patterns of Resilience

Are there specific capital attributes of rural societies that define the way resilience emerges in their community? To answer this, we first explore the data in terms of adaptive capacities then in relation to the adaptive process. Cross-tabulations illustrating key trends in the data are provided as evidence for the claims made, and interview excerpts are given to illustrate meanings rural residents assigned to these trends. Following the presentation of the central findings, we discuss the implications of these results for understanding rural resilience dynamics and improving disaster response and recovery in rural communities.

Adaptive Capacities

Figure 2 represents the frequency of each adaptive capacity area coded in response to the question asking, “What are the biggest challenges to recovery for you?”. All capacity areas were mentioned, but the most predominant capital needs and deficiencies were human, physical, and financial. Social capital mentions peaked with Port Aransas while natural capital mentions were largely absent.

[Figure 2]

Physical and financial capitals were reported as the biggest challenges: 63.0% of mentions in Port Aransas, 68.9% of mentions in Refugio, 57.4% in La Grange, and 65.3% in Dickinson. The majority of these responses focused on damages to homes and businesses in the community as well as financial issues for recovery, including a lack of insurance to support rebuilding.

There is a noticeable dearth of natural capital mentions. However, when natural capital occurs, it was often in relation to other capital areas. Of the seven natural capital occurrences, three were mentioned in conjunction with financial capital, reflecting agriculture industry in the rural cases. Natural capital mentions also reflected the environmental conditions. One interviewee (R2) specifically focused on the routine of disaster recovery in the community’s vulnerable environment, noting, “It happens every time there's a storm. They gut out the flood, they redo the roofs, the pile of stuff gets big, and it's coastal living.”

There was considerable variance in adaptive capacities across the cases. Figure 3 reports the frequency, in terms of percent of total, of the capital areas identified as the “biggest” challenge for households and communities. The bars are stacked with dark gray representing household challenges and light gray representing community challenges. Social capital mentions

are highest in Port Aransas and Refugio, and natural capital highest in Refugio. These highlight that social and natural capital are most important in the rural cases.

[Figure 3]

The two hurricane-hit towns – Port Aransas and Refugio – had the most mentions of financial capital needs. In the category of financial capital, insurance was mentioned in 47 of 62 excerpts. Many households in these communities were uninsured. Some of this reflects the unprecedented nature of the storm and changing hazard profiles in these communities. With this in mind, one interviewee (R3), said, “So there's people that lived here 50, 60 years, never had an issue, then all the sudden their entire house is flooded. And like I said, being that they weren't in a floodplain, they didn't have flood insurance. They kind of lost everything.”

One interviewee (R4) expressed a prevailing sense of frustration with waiting on insurance disbursement: “The biggest thing is the insurance. People are just so frustrated with the wait. It feels like you have to fight for everything to get your home back the way it was.” Another interviewee (R5) put it this way: “ People are willing to pitch in and roll up their sleeves and make things happen. But so many people are just, ‘I can't do anything. My insurance company is sitting on this thing.’”

Beyond frustration, respondents also expressed a sense of unfairness in relation to insurance and how it works in disaster recovery. One respondent (R6) described it this way:

Dealing with insurance companies. Windstorm, flood, homeowners denies everything. It's just a shame. You pay for all this stuff for years and then when it comes down to pay off, they don't pay off...There are people that after their deductibles are over ... They're not getting full recovery. After paying insurance, I've been paying flood insurance, windstorm insurance, and homeowner's insurance. They all blame it on...the entities all blame it on the other entity.

Focusing specifically on human and physical capital variance across the cases, Table 2 presents the frequency of codes in these capital areas. Human capital needs were predominantly evident as recovery process gaps – lack of understanding of the recovery process but also mention that it is a learning process. These were more prevalent in La Grange than the other cases. This might be a reflection that the flood has revealed that housing locations are not sustainable; people are being forced to relocate, and this is a complicated issue.^v

[Table 2]

In terms of physical capital, physical structure damage was most frequently the focus of responses in Refugio and Dickinson. While damages were mentioned in both rural and urban settings, housing is a problem in rural areas. Housing was predominant in 44.0% of Port Aransas physical capital excerpts, 29.6% of Refugio excerpts, 61.9% of La Grange excerpts, and only 12.5% of Dickinson excerpts. This reflects a lack of subsidized housing in Refugio, a lack of affordable housing in Port Aransas, and relocation away from river in La Grange.

In sum, the adaptive capacity issues most prevalent with the rural cases of Port Aransas, Refugio, and La Grange was financial, physical, and human capital. The urban case of Dickinson, however, also revealed these issues. The distinction between rural and urban capacity issues came down to recovery process, considered human capital, and housing, considered physical capital.

Adaptive Process

It is useful to examine adaptive processes in terms of sources or providers. Sources or providers of the activities and resources that support recovery processes include: 1) the community; 2) the government; and 3) external groups, including volunteer and non-profit

entities. Table 3 reports recovery process themes broken into these three groups. It is evident that the rural cases of Port Aransas, Refugio, and La Grange relied most on community while the urban case of Dickinson relied most on government. La Grange also relied heavily on external groups, which may reflect the mobilization of nonprofits from Austin, the closest big city.

[Table 3]

Examination of the specific adaptive processes mentioned by interviewees tracks with the provider trend. As shown in Figure 4, mentions of community action in response were more prevalent in the rural cases of Port Aransas, Refugio, and La Grange than in the urban case of Dickinson. In the urban case of Dickinson, institutional communication and government performance were mentioned more, and negative evaluations (shown in light gray) of these were predominant.

[Figure 4]

However, government performance was an issue brought up in all of the communities studied. One interviewee (R7) said, “FEMA was a hustle. Red Cross was ineffective. Our county and city officials in all of our cities in our county were completely unprepared for this. They had no idea what to do.” Eleven of the 18 mentions of poor government performance specifically mentioned Red Cross or the Federal Emergency Management Agency (FEMA). Many cited that the response by these entities was too slow. For example, a church was established as an impromptu shelter in Refugio while Hurricane Harvey was making landfall because the Red Cross shelter was not yet in place. Interviewees also mentioned that Red Cross was unreasonable in its methods, asking for online filing when people did not have internet service due to the storm damages to infrastructure.

In relation to both Red Cross and FEMA, several interviewees cited disappointment in the lack of success of securing federal aid. One interviewee (R8) expressed this feeling, saying, “The flood didn't pick and choose whose house to destroy, and so I'm frustrated that FEMA's picking and choosing based on income, and everything else that they can decide to make a criteria on.”

In the vacuum of what was perceived as poor government response, particularly local government, communities came together to help one another. Reflecting on this, one interviewee (R7), said, “I feel like the city failed. I feel like the county failed and I feel like the only positive recovery came from individuals. Just friends helping friends, family helping family.” Another interview participant (R9) noted that city leadership was not prepared and “the folks who were really pitching in to repair and prop up, were the residents. Not officials. Not state, county, city, or federal. It's the people who call Port Aransas home.”

Digging deeper into the community action that emerged as critical in rural communities, the category may be broken into specific actions: debris and clean up (18%); emotional support/community spirit (13%); finance (9%); food and other donations (32%); information sharing (10%); and housing/shelter (4%).^{vi} Food provisions were particularly important, and the interviews demonstrate that the value goes beyond the provision of caloric sustenance. One interviewee (R9) reflected on the care a chef brought to the food he served and how the meeting place became a central community hub:

If he had handed out bologna sandwiches, that would've been fine, but he didn't. He was making the most wonderful food 'cause he's a chef and he loves food and that's what he does. It was just astounding. He and his daughter and the whole staff, they just spent all day doing this. They had some picnic tables ... you couldn't go in 'cause the place was all busted up, but they had some picnic tables out front. People would come and it looked like this big family-style thing. You would actually see a neighbor or somebody you knew that you hadn't seen and you had a chance to say, "Oh, hey. Whoa. It's good to see you.

Are you okay?" So it was a big community networking thing, too, while people were there. I was just amazed at the whole scene. I'm not big on talking to strangers, but I met a lot of nice people there at that picnic table. I think he really contributed a lot.

In the post-disaster environment, food can meaningfully bring the community together to heal and to connect, linking social and human capital needs. Because these needs go beyond the immediate aftermath of a disaster, an interfaith alliance in La Grange served meals to flood-affected families at a local hall on a routine basis months following Hurricane Harvey.

Beyond food provisions, the rural communities studied were able to meet the needs of their community members in innovative ways. This included the creation of a local organization in Port Aransas to provide housing. An interview participant (R10) described it with pride:

And this group of people started this *Homes for Displaced Marlins*. Port Aransas Marlins are the mascot of the school. The school has been struggling for years to keep kids in school, but now even more so. So they're buying, they've gotten hundreds of thousands of dollars to buy RVs for people to move back to town to go to school. And that's been like ... that was just a couple of people in town to start that to get people back, which has been really, I mean it's awesome.

Other community actions were less formalized, but as meaningful in meeting needs. Examples included neighbors helping one another with removal of fallen trees or gutting houses of damaged materials. Also noted was that the agriculture industry, specifically, was an important part of community response in Refugio. Many farmers and ranchers offered their equipment and services for clean-up in the town's center.

The interview responses revealed that a driver of community action in the rural communities studied is an attitude of self-reliance on the community, a spirit of "get it done" and "do it yourself." This seems to be facilitated by the social capital in small, rural communities. Many interviewees referred to their community as "a family." Another respondent (R11) simply reflected that it is just the way it is in a small town.

I know my neighbor is there if I need them. My family is there if I need them. That's a lot of the recovery is just being able to know that you have somebody you can depend on, also they can be dependent on you if they need it. I have my neighbor across the street that I work with. I think a lot of people miss out on that in the larger cities. They don't even know who their neighbors are. They don't take the time to maybe meet them unless it is something devastating like this.

One interviewee (R12) linked social capital directly to the agriculture community in his town, stating:

I think a lot of the attitude, a lot that close-knit attitude comes from the fact that we're farmers and ranchers. Something needs to be done, get it done. You know, it don't matter, rich, poor, white, black, none of that matters. Male, female. You know you see something that needs to be done it gets done. I think that brings everybody together. I think it has a lot do with a rural agriculture, "let's go do it" type of an attitude.

In sum, adaptive processes were dominated by community providers in the rural cases of Port Aransas, Refugio, and La Grange while the government was the primary source of recovery in the urban case of Dickinson. Community action mentions were highest in the three rural cases while government performance and institutional communication mentions were highest in the urban case. Community action in the rural cases was attributed to a sense of identity and self-reliance, connected to social capital and agriculture community ties. These findings have implications for how we understand resilience in rural communities in terms of capacity and how that understanding may be translated into practice. Two central findings are explored further in the following section: rural housing and social capital.

Discussion: Implications for Rural Resilience

Our findings indicate that rural communities have distinct capacity needs and assets in the disaster context. Likely due to their geographic isolation and fiscal constraints – on a household, local government, and community level – the particular problem of post-disaster

housing within the physical capital domain emerged as dominant issue in the rural cases. This issue, like so many involved in disaster recovery, has cascading impacts, affecting not only the state of physical capital but also social capital as many families are displaced, some long-term, from their homes and the community itself.

As a consequence of the scarcity of recovery resources in rural communities from private and civic sectors, there is considerable reliance on formal, public sector institutional support to address the issue of housing (Housing Assistance Council 2012a). Yet, federal and state government has let many down in Texas following Hurricane Harvey. Six months after the storm, only 8,000 families – roughly 2% of those who applied for federal assistance – have benefited from temporary housing or housing repairs supported FEMA (Elliot and Drew 2018). Housing advocate groups are voicing concern that the state agency charged with housing recovery, the Texas General Land Office, is relying on a flawed system for distribution of assistance, which will risk leaving \$1 billion of unmet needs for low and middle income families (Wallace 2018). Unfortunately, this aligns with past research on housing recovery that finds it is fraught with inequities, falling along income and racial lines (Tootle 2007; Peacock et al. 2014, 356-371). Studies have shown that providing race and ethnic minorities and low income families with voice in the planning process is important (Tootle 2007) and that leveraging the disorientation and loss of place identity that many experience following a disaster could create more equity in rebuilding decisions (Cox and Perry 2011, 395-411). More research is needed to examine these factors in conjunction with rural community housing recovery to Hurricane Harvey, including the assessment of programs that target rural residents such as assistance from the United States Department of Agriculture (USDA) Rural Development.

In addition to the issue of housing, our findings indicate that rural communities are distinct in the manner in which social capital is developed and deployed in a disaster event. While the therapeutic community (Fritz 1961) was evident in both urban and rural settings, social and community capital was particularly important in disaster response and short-term recovery in the rural cases analyzed. A sense of place motivated the Port Aransas community to address housing needs; altruism, grounded in community spirit, was evident in the sustained provision of meals by the interfaith alliance in La Grange; and a spirit of self-reliance was a driver of the agriculture community's assistance for debris removal and reconstruction in Refugio. While similar community actions were evident in the urban case of Dickinson, they were not as prevalent and there was greater reliance on government expressed among this community. Further, rural interviewees connected community spirit, sense of place, and attitudes of self-reliance with the agriculture community (i.e. farmers and ranchers, 4-H organization, local cotton gin), specifically, highlighting that relationships and norms of reciprocity developed in the financial domain through natural capital resources spill over to social capital stocks.

Although research has found that social capital is a driver of adaptive capacities in rural communities (Cutter, Ash, and Emrich 2016, 1236-1252), this study has revealed that interactions tied to agriculture industry create social capital, more broadly. Programs that support this social capital in the form of self-reliance and community-derived efforts should be explored more fully in research and practice. The Community Emergency Response Team (CERT) program has promise in rural areas as they serve as frameworks for leveraging diverse sets of existing capabilities while also developing deficient capacities (Brennan and Flint 2007, 111-126). Despite their potential, CERTs are more commonly found in urban settings; more should be done to facilitate their establishment in rural communities. Another opportunity to facilitate

self-reliance and organization is through the establishment of rural skills bank. Successful skills banks have been observed in past disasters (Clay, Greer, and Kendra 2018) where people exchange skills (and associated equipment), such as carpentry, electrician, and babysitting, for labor they need. Formalized exchanges such as this could not only extend the reciprocity engendered by the agriculture community (and other technical and service-based industries), it could also serve as a network of skills and labor in resource-constrained, geographically-isolated rural communities.

Conclusion

This study has explored rural resilience using interview data from four Texas towns affected by Hurricane Harvey. It approached the study of disaster resilience in terms of adaptive capacities – framed as human, social, physical, financial, and natural capital assets – and adaptive processes of collaboration and improvisation. The results demonstrate that considerable human, physical, and financial capital needs emerge in both rural and urban settings. The rural communities analyzed exhibited more housing and recovery process issues than the urban case studied. In response and recovery, the rural communities relied more on community action, driven by social and natural capital ties, than the urban case, which relied more on government assistance. These findings point to a need for targeted interventions to meet needs specific to rural communities in the post-disaster environment.

Endnotes

ⁱ See Appendix A for a table of quoted respondent characteristics, including place, gender, and age. All other descriptors are removed to preserve the anonymity of the interview participants.

ⁱⁱ This method of recruitment was most appropriate in a post-disaster context to locate affected families during a period of housing and community disruption when routines are not intact and traditional recruitment may have produced unreliable results. However, we recognize this limits the generalizability of the findings. This findings of this study, however, are an important exploration of rural resilience issues in the context of Hurricane Harvey.

ⁱⁱⁱ The interview pool, compared to the population, oversampled females but was reasonably representative of racial and ethnic minorities. See Appendix B for a table reporting the demographic characteristics of the sample, compared to the population.

^{iv} See Appendix C for a description and example of each code.

^v It does not seem to be an issue of poor education; pairwise correlations of demographic characteristics show that in La Grange recovery process codes were associated with white ($r=0.3449$; $p<0.05$), more educated ($r=0.3431$; $p<0.05$) individuals with home-owner's insurance ($r=0.2549$; $p<0.05$). Therefore, this may be evidence of a learning process by individuals with high human and financial capital.

^{vi} Other mentions comprise the remaining 14%.

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Tables & Figures

Table 1. Case Characteristics

	Population	Distance to city (miles)	Commute time (minutes)	Born in state	Agriculture Employment
<i>Port Aransas</i>	3,444	13.2	15.9	42.0%	3.6%
<i>Refugio</i>	2,902	39.4	20.5	84.1%	16.6%
<i>La Grange</i>	4,628	59.0	16.0	73.7%	8.9%
<i>Dickinson</i>	18,494	29.9	29.4	66.6%	2.1%

Note: Population, nativity, agriculture employment, distance to nearest big city data obtained from U.S. Census Bureau American Community Survey (ACS) 2010 5-year estimates; commute time data taken from 2012-2016 ACS 5-year estimates.

Table 2. Human & Physical Capital Components across the Cases

		HUMAN CAPITAL			PHYSICAL CAPITAL		
		Emotional state	Physical Health	Recovery Process	Physical Structure	Housing	
Port Aransas (n=16/25)	<i>household</i>	18.75% (3)	0.00% (0)	31.25% (5)	36.00% (9)	20.00% (5)	
	<i>community</i>	25.00% (4)	0.00% (0)	25.00% (4)	20.00% (5)	24.00% (6)	
Refugio (n=17/44)	<i>household</i>	23.53% (4)	0.00% (0)	29.41% (5)	45.45% (20)	11.36% (5)	
	<i>community</i>	11.76% (2)	5.88% (1)	29.41% (5)	25.00% (11)	18.18% (8)	
La Grange (n=18/21)	<i>household</i>	33.33% (6)	0.00% (0)	27.78% (5)	23.81% (5)	28.57% (6)	
	<i>community</i>	5.56% (1)	0.00% (0)	33.33% (6)	14.29% (3)	33.33% (7)	
Dickinson (n=15/16)	<i>household</i>	26.67% (4)	6.67% (1)	40.00% (6)	50.00% (8)	6.25% (1)	
	<i>community</i>	13.33% (2)	0.00% (0)	13.33% (2)	37.50% (6)	6.25% (1)	

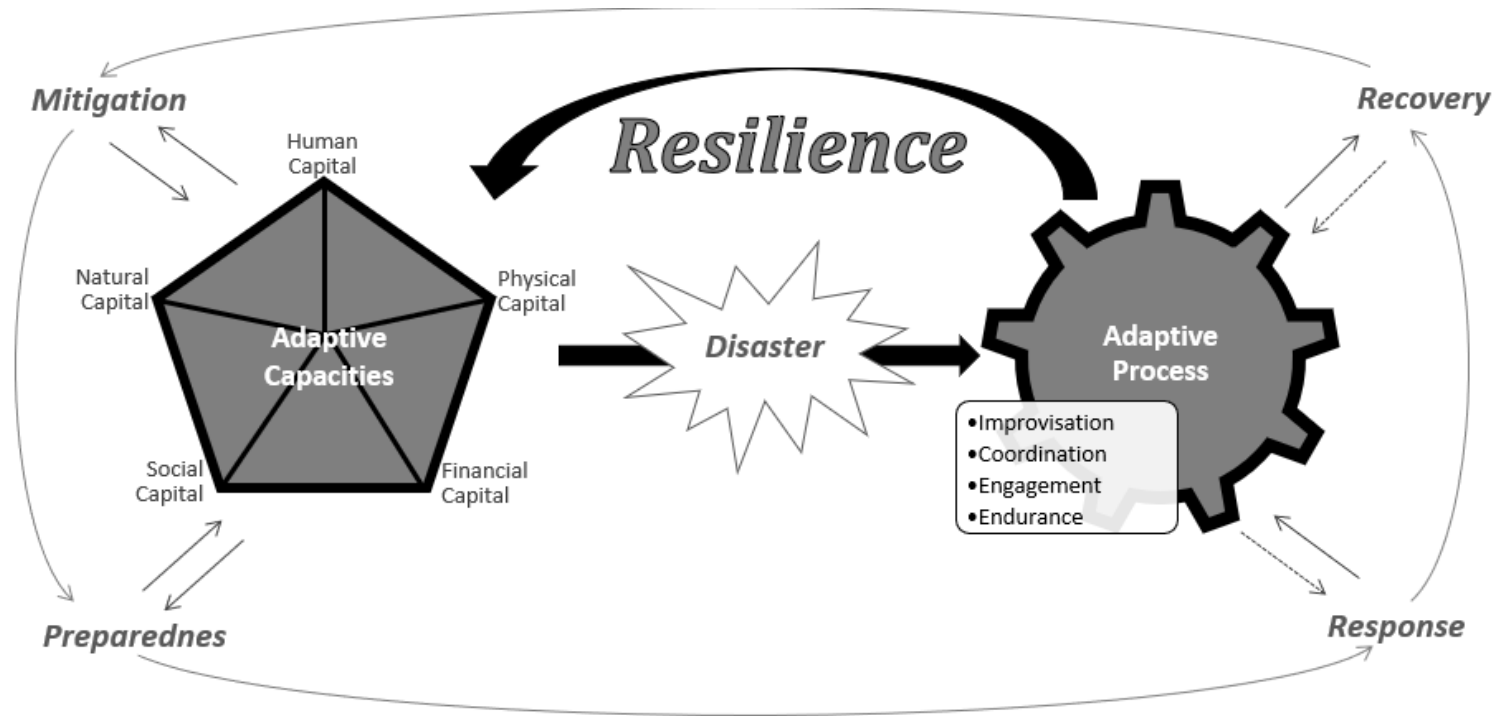
Note: Percent of mentions of human and physical capital components reported for each case. The number of mentions for human and physical capital, respectively, is reported in the parentheses.

Table 3. Response & Recovery Providers

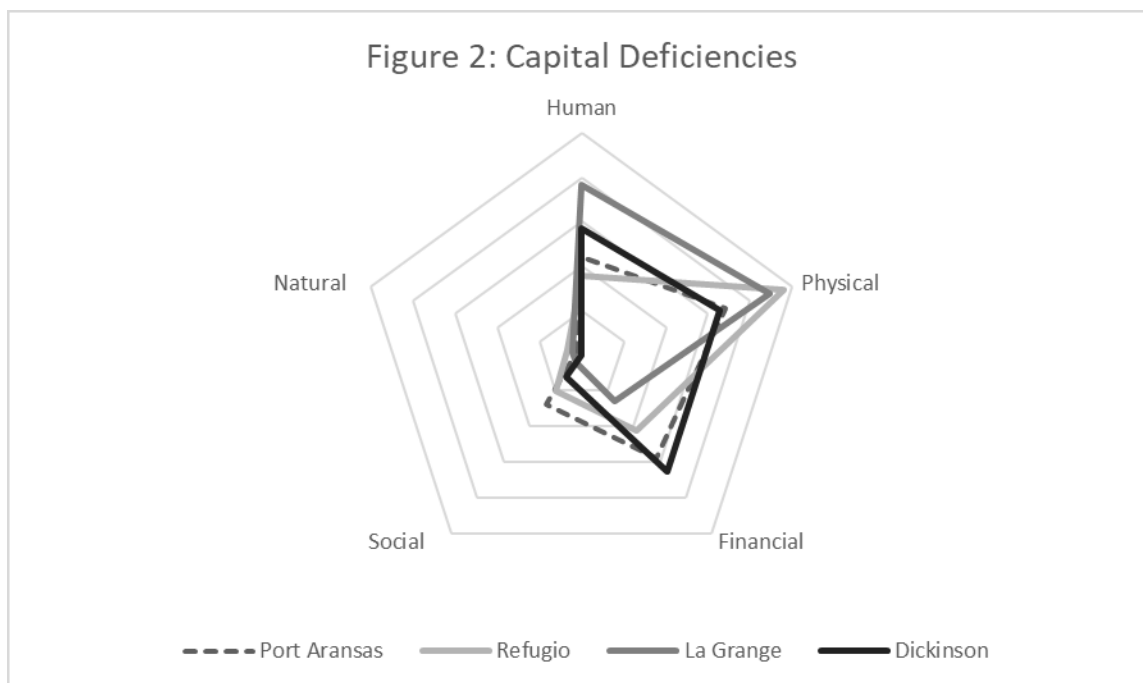
	PROVIDER TYPE					
	Community		Government		External Groups	
<i>Port Aransas (n=45)</i>	62.22%	(28)	20.00%	(9)	17.78%	(8)
<i>Refugio (n=51)</i>	68.63%	(35)	13.73%	(7)	17.65%	(9)
<i>Dickinson (n=39)</i>	46.15%	(18)	35.90%	(14)	17.95%	(7)
<i>La Grange (n=29)</i>	58.62%	(17)	13.79%	(4)	27.59%	(8)

Note: Percentage of mention within each case reported. Number of mentions shown in parentheses. Community counts include mentions of community action in response as well as community interactions; government tallies include mentions of government performance and institutional communication; and the figures for external groups are comprised of mentions of external aid.

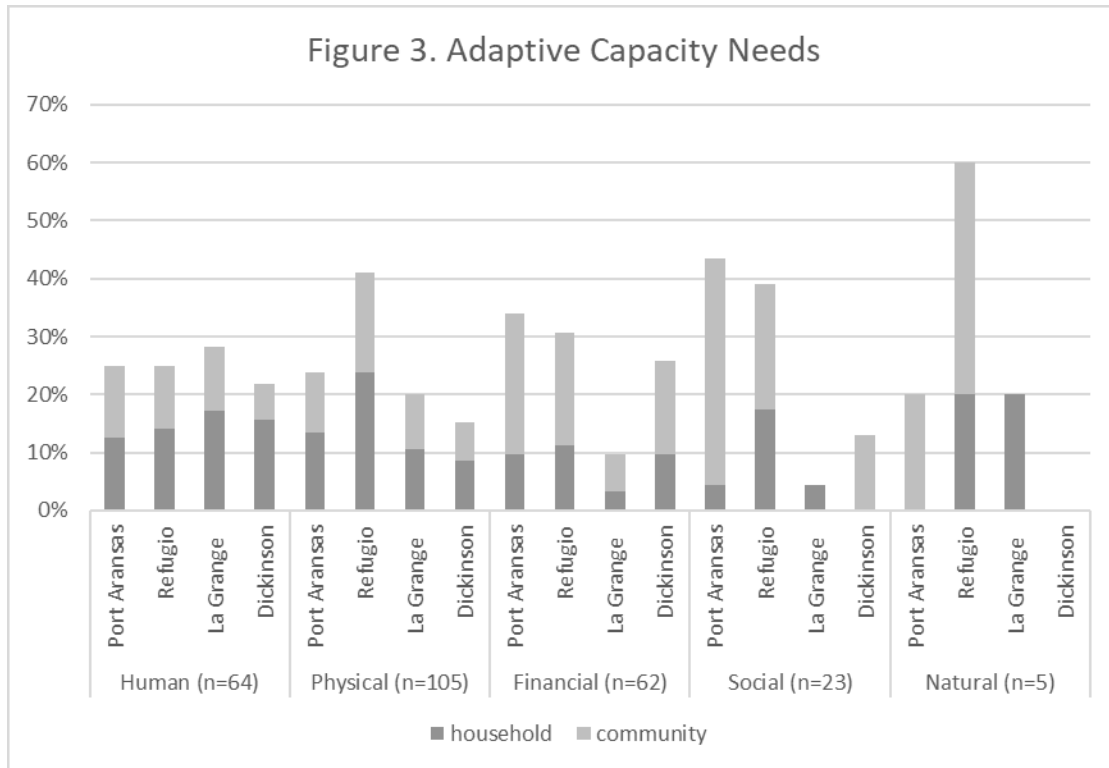
Figure 1. Theoretical Model



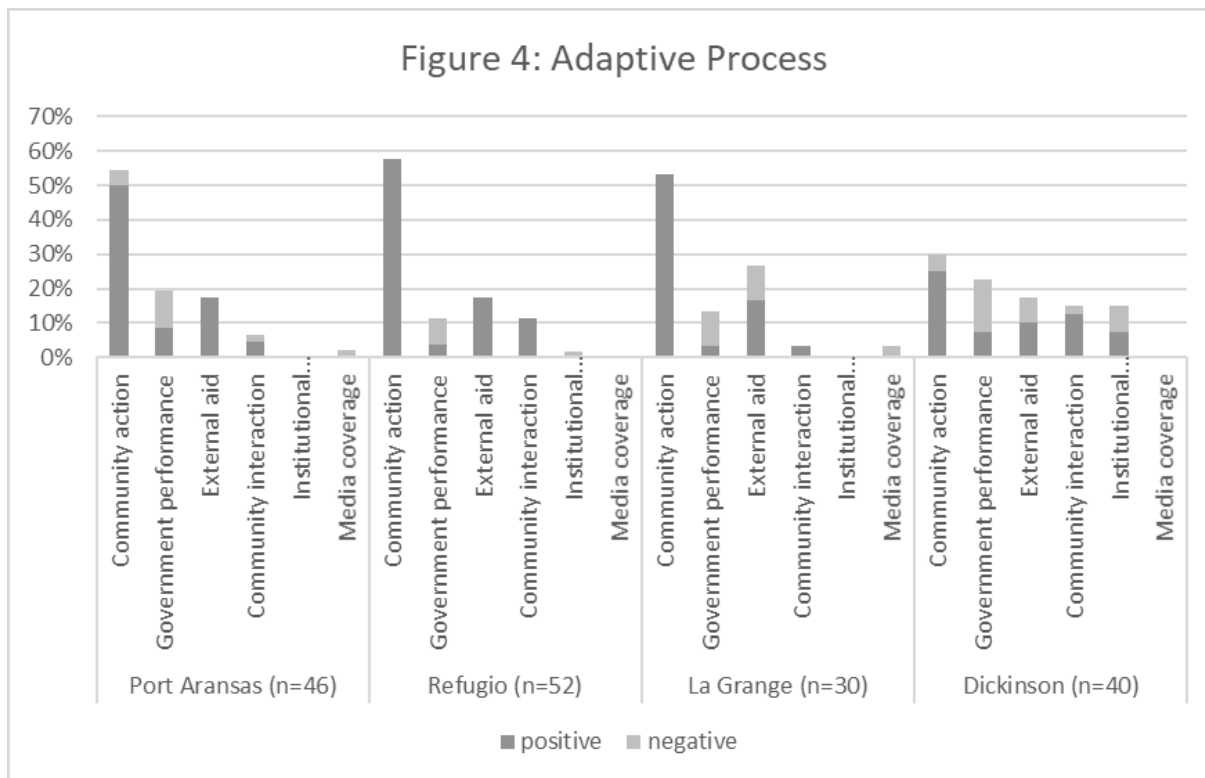
Note: Theoretical model adapted from Ross (2014).



Note: The percent of total mentions of each capital for each case are shown. Mentions were in response to an interview question that asked respondents to identify the “biggest” challenge facing their household and community in disaster recovery.



Note: The stacked bars report the percentage of mentions of household (dark gray) and community (light gray) capacity needs per case within each capacity area.



Note: Percentage of mentions of each type of adaptive process is reported; percentages calculated for each case. The stacked bars show positive (dark gray) and negative (light gray) affect for each type of process.

Reviewer Comments

Note: Page numbers referenced by the reviewer may vary due to different pagination of the submission and this document.

Reviewer statement:

Thank you for providing me the opportunity to review the manuscript: Capital Assets and Rural Resilience: An Analysis of Texas Communities Impacted by Hurricane Harvey. In this manuscript, the author(s) seek to develop and evaluate a new conceptual model of rural resilience. Such models are needed, the author(s) argue, because rural communities differ from their urban counterparts, both in terms of their vulnerabilities to hazards, but also their ability to prepare for, respond to, and recover from disaster events. The value of the manuscript is twofold. First, the author(s) seek to expand theoretical discussions of resilience by developing conceptual a conceptual model that captures the distinctness of individual communities. Second, the findings discussed in this manuscript contributes to discussions about how to operationalize and measure community resilience, particularly in rural communities, which is an important question for policy makers and researchers engaged in explorations of resilience thinking.

Major suggested revisions:

1. In the sections where the author(s) discuss the capital elements of rural communities, the author(s) might consider making minor changes to their presentation and discussion of each of the elements. For example, each element might be addressed in the following way:

Human Capital:
 - a. Human Capital is defined as X (cite)
 - b. In urban areas, human capital supports resilience by X, Y, and Z (cite)
 - c. In rural areas, however, we see the following trends, which suggest that human capital my (or may not) support resilience in the same way.
 - d. Reference relevant examples from the literature.
2. At the end of the literature review, the author(s) claim that rural resilience ... will differ in a manner that is distinct from urban communities. While this may be the case, the author(s) do not actually specify why this is the case. The author(s) should elaborate, by either providing a separate section that explores the how capital capacities support resilience in urban communities, or as indicated above in the human capital example, integrating this discussion into the exploration of each of the elements. The latter approach may be more efficient and easier to follow.
3. The disaster context section of the manuscript seems out of place. Two thoughts. First, the author(s) could consider condensing this material and moving it to the introduction of

the paper. Second, the author(s) could consider focusing more specifically on Harvey's impact to rural communities. This information was available in Excel tables, at a county and community level, at: <https://www.dps.texas.gov/dem/sitrep/default.aspx>.

4. The opening sentence of the "Study Cases" section indicates that the author(s) are "assessing rural resilience." This gives rise to a question about the focus of the manuscript. Are the author(s) actually assessing rural resilience in this study, or are they assessing a proposed model of resilience, which suggests that rural communities will be different from their urban counterparts in terms of the elements of resilience that are stressed?
5. In the last sentence of the Methods of Analysis section, the author(s) indicate they are coding interviews for both adaptive capacities and adaptive processes. This is the first and only mention of adaptive processes in the manuscript, other than the reference to processes in Ross's definition of resilience on page 3. The author(s) should either: 1) expand their literature review to include a discussion about adaptive processes in urban contexts and how they differ from adaptive process in rural contexts; or 2) focus the manuscript specifically on the adaptive capacities. Option 2 might be better, as it sharpens the focus of the manuscript and allows the author(s) to make better use of their qualitative data. The author(s) could then write a separate paper on the adaptive processes (with luck, using the qualitative data from the interviews at hand).
6. The author(s) have clearly collected some amazing qualitative data. The presentation of the qualitative findings, however, could be strengthened to capture the richness of the data collected from the 108 interviews. Are the author(s) reporting on the "trends" (a word used in the literature review to describe rural communities) that exist in rural communities or are the author(s) reporting on the themes that emerged from the coding of the interviews. These themes should connect, directly or indirectly, to each of the capital elements of resilience discussed in the literature review. Each of these themes would likely have their own distinct subheading in the findings section, assuming that is where the data takes the author(s).
7. The adaptive capacities findings section is three pages long, and the adaptive processes findings section is four pages long. To me, it appears that the manuscript is attempting to do too much. As indicated above, the author(s) might be better served to only focus on the adaptive capacities component of the model, leaving the adaptive processes component of the model for a later paper. This would enable the author(s) to use this manuscript to explore each of the adaptive capacity elements in greater detail, and in doing so, focus more details on the similarities and differences between the urban and rural communities included in the present study.

8. The presentation of the findings could be strengthened. The manuscript briefly identifies a theme, and then uses a large number of direct quotations to support that theme. My recommendation would be to not use such a large number of direct quotes. Rather, the author(s) should consider spending more time identifying and describing the primary themes extracted from their coding of the interviews. Then the author(s) can use one or two direct quotations (for each capital capacity element) as illustrative examples. This is obviously an art, but one that requires a balance between the text generated by the author(s) and the quotes provided by the interview subjects. The reader wants learn about what the author(s) learned from their large number of interviews.

Other suggested revisions:

9. In the first sentence of the second paragraph, the author(s) suggest that they are going to analyze rural resilience from a “capitals approach.” It would be helpful if the author(s) define what they mean by the capital approach at this point, using a citation or two from the resilience literature (which they refer to later in the paper). This would help the reader to better understand how the authors are approaching this problem.
10. There are several fragment/incomplete sentences in the manuscript, for example, the second sentence of the first paragraph in the Disaster Resilience in Rural Communities section. The author(s) should go through the manuscript carefully and check for such issues. This would help the reader to navigate the argument advanced by the author(s).
11. The reader would benefit from some statistics about the difference between rural and urban contexts. One thought would be to report ambulance or fire department response times (which would differ due to distance to incident and medical facilities).
12. The author(s) indicate that they will integrate the sustainable livelihood capitals into Ross’ (2014) model of disaster resilience. This is an excellent idea, and I very much support the approach. The author(s) would advance their argument by: 1) defining what is meant by the sustainable livelihood approach (with relevant citations); and 2) explaining why this approach is germane and appropriate for this study (in other words, why did the author(s) choose this approach over an alternative approach?)
13. It was difficult to navigate the transition that occurred at the top of page 4, namely because it pushes the reader right into the new model without explaining the “sustainable livelihood framework.” My suspicion is that the author(s) could help the reader to navigate this transition by addressing the comments in the previous point.

14. It feels as if a citation is necessary for the last full sentence included on page 4: “by improvisation and coordination that connected available resources to needs.”
15. In the first full paragraph of page 5, the authors indicate: “These attributes are primarily concentrated in the area of social capital.” It seems to be that such a statement comes too soon, as this would be a conclusion that one would reach after a review of the literature.
16. Also, while it may be that social capital plays a large role in rural resilience, and I suspect that it is, the author(s) could reference literature that supports this statement. Some articles that might be of use to the broader discussion of rural resilience include:
- a. Imperiale, Angelo Jonas, and Frank Vanclay. 2016. “Experiencing Local Community Resilience in Action: Learning from Post-Disaster Communities.” *Journal of Rural Studies* 47 (October): 204–19. <https://doi.org/10.1016/j.jrurstud.2016.08.002>.
 - b. Rosanna Salvia, and Giovanni Quaranta. 2017. “Place-Based Rural Development and Resilience: A Lesson from a Small Community.” *Sustainability* 9 (6): 889. <https://doi.org/10.3390/su9060889>.
 - c. Kapucu, Naim, Christopher V. Hawkins, and Fernando I. Rivera. 2013. “Disaster Preparedness and Resilience for Rural Communities.” *Risk, Hazards & Crisis in Public Policy* 4 (4): 215–33. <https://doi.org/10.1002/rhc3.12043>.
 - d. Sadri, Arif Mohaimin, Satish V. Ukkusuri, Seungyoon Lee, Rosalee Clawson, Daniel Aldrich, Megan Sapp Nelson, Justin Seipel, and Daniel Kelly. 2018. “The Role of Social Capital, Personal Networks, and Emergency Responders in Post-Disaster Recovery and Resilience: A Study of Rural Communities in Indiana.” *Natural Hazards* 90 (3): 1377–1406. <https://doi.org/10.1007/s11069-017-3103-0>.
 - e. Rosanna Salvia, and Giovanni Quaranta. 2017. “Place-Based Rural Development and Resilience: A Lesson from a Small Community.” *Sustainability* 9 (6): 889. <https://doi.org/10.3390/su9060889>.
17. The reader stumbled a bit when reading the Financial Capital paragraph due to the reverse chronological order of the dates, moving from 2016 to 2015.
18. Another thought at this stage. The author(s) might think about how they use language to frame their argument. It is the word “distinct” that could lead to confusion. Are the author(s) suggesting that the elements of resilience in urban and rural communities are distinct (apples vs. oranges)? Or are the author(s) suggesting that the elements of resilience in urban and rural communities are not distinct, but rather, that urban and rural communities just stress some resilience capital capacities over others (big apple vs. small apple). I get the impression that it is the latter of the two. This is actually the point that the author(s) made on page 5, where they stated “these attributes are primarily concentrated in the area of social capital.” The author(s) might consider checking for language that could confuse the two perspectives.

19. Characteristics presented in Table 1. Why are these indicators appropriate for the selection for these communities? Is there literature the author(s) can reference to support their use?
20. What is the head of household criteria? How is the head for household defined? Is there literature the author(s) can reference to support their use of this criteria?
21. It is not clear how many coders were used to code the data. Two or Three? Please clarify.
22. At the end of the Methods of Analysis section, the author(s) indicate: “Both improve our understanding of how rural resilience is distinct from urban residence.” This is another example where the words used by the author(s) can be confusing for the reader. Is rural resilience distinct from urban resilience, or does the study improve our understanding of the elements that support resilience rural, as opposed to urban, contexts?”
23. The authors could develop the conclusion more, focusing on the need for future research, both in terms of exploring adaptive processes (rural vs. urban) but also, a broader study that studies more rural communities across the United States. Also, it might be too early, but the author(s) might consider specifying what the “targeted interventions” might be.