Local Disaster Resilience across the Gulf Coast: Intersecting Capacities for and Perceptions of Resilience

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Abstract contains excerpts from the forthcoming book
Local Disaster Resilience: Administrative and Political Perspectives, Routledge.

Introduction

Perceptions are merely abstractions of reality; however, they profoundly shape the world around us as what we perceive often influences our decision-making. In disaster management, the intersection of resilience perceptions with tangible realities of resilience reveals the conditions that either strengthen or impede its development on a local level. This analysis explores how objective approximations of county-level adaptive capacity overlap with perceptions of the adaptive process held by county emergency managers to identify the county characteristics linked to high, moderate, and low disaster resilience.

What is disaster resilience?

Community resilience has two components – adaptive capacity and the adaptive process – that theoretically should be mutually reinforcing. Adaptive capacities are the strengths a community has for disaster response and recovery. There are multiple types of capacity including:

- *Social capacity for resilience* is the aggregation of a community's characteristics including age, education levels, wealth, and language capacity that translate to able, mobile, and resource-enabled individuals in the event of a disaster.

- *Community capital* refers to the connectedness of community members that enable cooperation and collaboration in disaster planning, response, and recovery.

- *Economic capacity for resilience* refers to the robustness and diversity of a community's economy.

- *Institutional capacity for resilience* concerns the plans and preparations a community has made for disasters.

- *Infrastructure capacity for resilience* refers to a community's basic public service capacity in terms of shelter, roads, and medical facilities that may be needed in the event of a disaster.

- *Ecological capacity for resilience* speaks to how community development has affected natural coastal boundaries such as wetlands.

A community with a high degree of adaptive capacity has a population with low social vulnerability, a robust and diverse economy, reduced vulnerability to hazards as a result of both project and process mitigation policies and programs, sound support systems to enable evacuation in case of an emergency and speedy restoration of services following an event, and protected natural barriers to hazards. Additionally, a community with considerable adaptive capacities has a citizenry with high levels of social capital and community competence, willing and able to participate in collective decision-making.

These adaptive capacities are translated into the adaptive process when a disaster strikes. Very severe disasters may temporarily disable the community's abilities, but once restored the adaptive capacities developed prior to the event will imbue the community with strengths to engage in the adaptive process. This process involves collaboration to pursue recovery in a manner that improvises solutions to local problems, coordinates collective action, engages the community, and works to formalize solutions to endure beyond the short-term. This recovery process should produce outcomes that feedback into adaptive capacities to buffer against future hazards.

Measuring Disaster Resilience

To assess resilience in its entirety we need approximations of both adaptive capacity and the adaptive process. Adaptive capacities largely entail tangible products and observable characteristics of a community. Disaster mitigation plans exist on paper. Flood insurance is traceable through records. Education levels, age groups, and special needs populations are recorded by government agencies. These factors as well as others comprise the components of a community's adaptive capacity for disaster resilience and are measurable through secondary sources such as the U.S. Census Bureau and the Federal Emergency Management Agency (FEMA).

While adaptive capacity is amendable to objective measurement because it involves tangible policies and outcomes, the adaptive process is somewhat more elusive because it can widely vary in the way it manifests across different communities. Assessments of the process of adaption, therefore, have been based on perception in this study. These perceptions are measured by survey responses from county emergency managers.

The sample studied in this analysis includes counties and parishes within 25 miles of the Gulf of Mexico in the states of Alabama, Florida, Louisiana, Mississippi, and Texas, totaling 75 jurisdictions. Emergency management directors were contacted in each county and parish and invited to take part in the project's survey. A total of 56 counties and parishes participated, as shown in Figure 1.

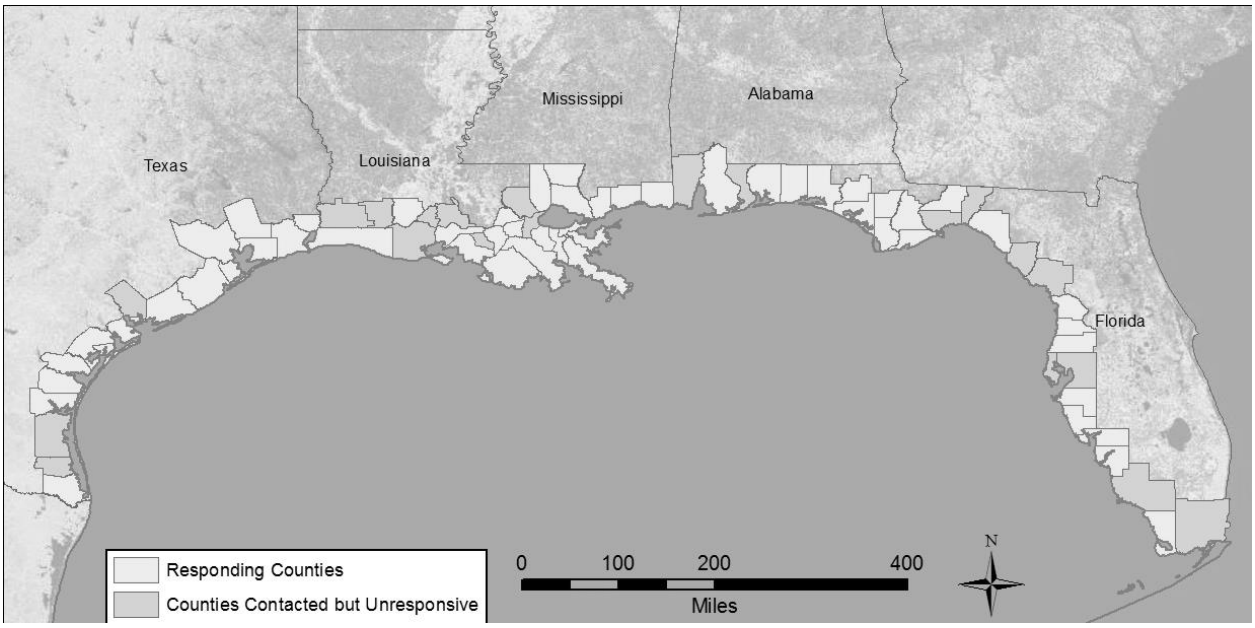

Figure1: Study Sample

Adaptive Capacity for Resilience

Adaptive capacities were measured across six components – social, community capital, economic, institutional, infrastructure, and ecological – using multiple indicators from secondary sources, summarized in Table 1. These indicators were aggregated to create a score for each county, ranging from one (very low capacity) to five (very high capacity). Counties in Texas and Mississippi scored moderate to low while the scores in Louisiana and Alabama were moderate to very high. Counties in Florida exhibited varied levels adaptive capacities.

Perceptions of the Adaptive Process of Resilience

The adaptive process is measured as ratings of coordination and collaboration during past disaster response and recovery. These ratings are taken from county emergency manager survey responses and are averaged to represent the overall quality of the adaptive process. The survey asked participants to rate coordination with the following groups: 1) citizens and citizen groups; 2) private partners; 3.) non-profit partners including faith-based and volunteer groups; 4) local elected officials including municipal and county government; 5) neighboring county emergency managers; 6) state emergency management officials; and 7) federal emergency management officials. Possible responses included "poor" (coded 1), "adequate" (coded 2), "good" (coded 3), and "excellent (coded 4). The average coordination ratings across the groups were: 3.18 for citizens, 3.35 for private partners, 3.49 for non-profit partners, 3.51 for local government, 3.78 for neighboring county emergency managers, 3.47 for state emergency management, and 2.80 for federal emergency management.

Table 1: Adaptive Capacity for Resilience Indicators by Component

	Variable	Definition (± Effect on Resilience)	Data Source
Social Resilience	education	Percent of the population with a college degree (+)	American Communities Survey 2010
	transportation access	Percent of households with a vehicle (+)	American Communities Survey 2011
	communication capacity	Percent housing units with a telephone (+)	American Communities Survey 2011
	language competency	Percent of the population over 5 years of age that speak English "very well" (+)	American Communities Survey 2010
	non-vulnerable population	Percent non-elderly population (+)	USA Counties 2009
		Percent population without a physical disability (+)	US Census 2000
	health care coverage	Percent population with health insurance (under 65 years of age) (+)	USA Counties 2007
Community Capital	place attachment	Net international migration per 1,000 population (-)	American Communities Survey 2009
		Percent of the population born in the state that resides in the state (+)	American Communities Survey 2010
	political engagement	Percent voter turnout in 2008 presidential election (+)	Secretary of State/Dept. of State 2008
	social capital	Religious adherents per 1,000 (+)	ASARB 2010
		Civic organizations per 10,000 (+)	County Business Patterns 2009
		Social advocacy organizations per 10,000 (+)	County Business Patterns 2009
Economic Resilience	housing capital	Percent owner occupied housing (+)	US Census 2010
	employment	Percent of the population that is employed (+)	American Communities Survey 2010
		Percent of labor force that is female (+)	American Community Survey 2010
	income equality	Quintiles of Gini Index (higher values = more equal) (+)	American Communities Survey 2012
	economic diversity	Percent of the population not employed in farming, fishing, forestry, or extractive industries (+)	US Census 2012
	business robustness	Ratio of large to small business employees (+)	US Census 2009
	health care access	Total physicians per 10,000 (+)	USA Counties 2009
Institutional Resilience	mitigation plans	Percent population covered by a multi-hazard mitigation plan (+)	FEMA 2012
	mitigation organizations and activities	Percent population participating in Community Rating System (+)	FEMA 2012
		Percent population covered by Citizen Corps council (+)	Citizen Corps 2012
		Percent population in Storm Ready communities (+)	NOAA 2012
	emergency services	Percent local government expenditures for health/hospitals, fire and police (+)	USA Counties 2002
	administrative decentralization	Number of municipalities, school districts, and special districts (-)	US Census 2007
	disaster experience	Number of Presidential disaster declarations, 2002-2011 (+)	FEMA 2012
Infrastructure Resilience	housing vulnerability	Percent of housing not mobile homes (+)	American Communities Survey 2010
		Percent housing units built 1970-94 (-)	American Communities Survey 2010
	evacuation capacity	Primary and secondary road miles per square mile (+)	US Census 2010
	medical capacity	Number of hospital beds per 10,000 (+)	County and City Data Book 2007
	shelter capacity	Percent vacant rental units (+)	US Census 2010
		Number of hotels/motels per square mile (+)	County Business Patterns 2009
	service restoration	Number of public schools per square mile (+)	FEMA Hazus 2.0 2011
Ecological Resilience	wetland preservation	Net change in percent wetland area between 1996 to 2006 (+)	NOAA 2010
	impervious surfaces	Percent impervious surface in square miles of land area (-)	National Land Cover Database 2006
	floodplain development	Index of severe repetitive loss properties (higher values = more loss) (-)	FEMA 2007

Intersecting Capacities for and Perceptions of Resilience

For each county, the measures of adaptive capacities and the adaptive process are paired and plotted. Adaptive capacity is broken into two categories: 1) high which includes rankings of high and very high (numerical equivalent of 4 and 5); and 2) moderate to low which incorporate rankings of moderate, low, and very low (numerical equivalent of 1, 2, and 3). The adaptive process is also grouped into high and low categories. High includes ratings that are on average the equivalent of "good" or "excellent" (numerically expressed as 3 or 4), and low includes average ratings that range from "poor" (numerical equivalent of 1) to above "average" (2.99). This means that some cases with coordination rankings higher than "average" but not quite the equivalent of "good" are considered low coordination. These standards ensure comparability and set up groupings where the highest categories represent the most developed attributes of resilience.

Four groups emerge from pairings of adaptive capacity and the adaptive process as shown in Figure 2. Group 1 includes those cases that are ranked high on capacity and have high average ratings of the adaptive process. There are 18 counties that fall into this group. Group 2 also includes cases that have high ratings of coordination but moderate to very low capacity.[1] There are 29 counties that exhibit this combination of qualities. Group 3 is characterized by high capacity but low ratings of coordination.[2] There are only two cases in this category. Finally, Group 4 includes those cases that have low ratings of coordination and moderate to low adaptive capacities.[3] There are six counties in this category. This group faces the most challenges in developing resilient outcomes as they are deficient in both pre- and post- disaster resilience.

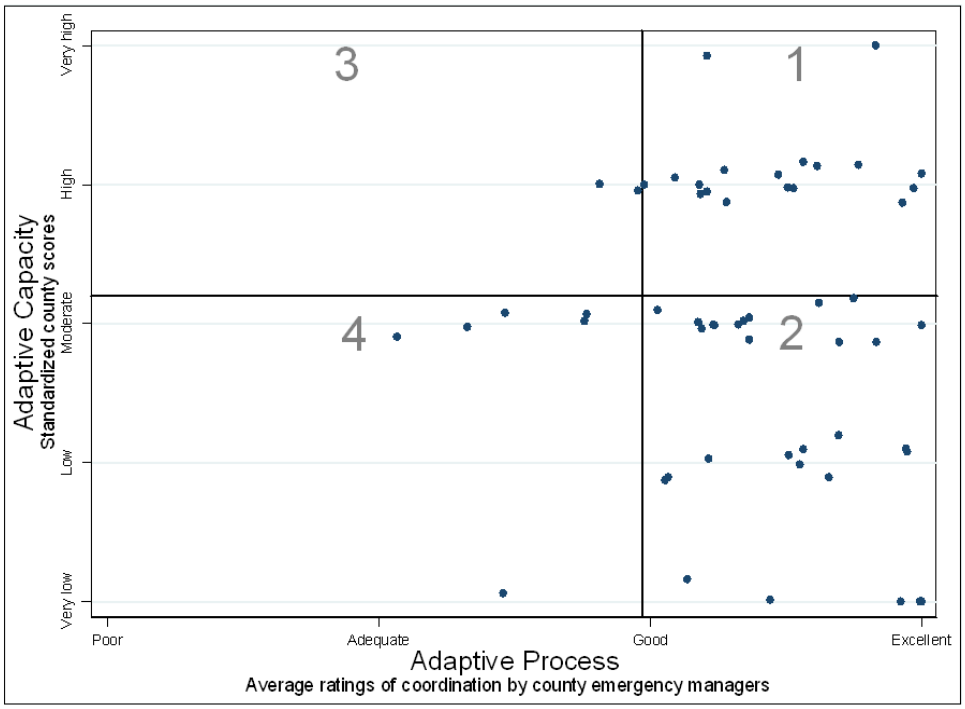

Figure 2: County Adaptive Capacities Coupled with Ratings of the Adaptive Process

Note: Each point represents a county in terms of its adaptive capacity and adaptive process. The points were "jittered" to offset overlapping cases for visual presentation. Similarly, the vertical and horizontal reference lines are moved slightly to accommodate the offset points.

Resilience Profiles

Which characteristics describe counties and parishes that exhibit the most resilience? Four factors were analyzed to identify patterns that exist among the groups: state context, rural-urban character, disaster severity, and fiscal and human resources. State context conditions the environment in which resilience develops on the local level as states set up institutions and rules that affect disaster management. While there are many dynamics at play within states, one political institution that may affect local government is home rule. States that allow counties to self-govern including Florida, Mississippi, and Louisiana may exhibit different patterns of resilience than those that do not, namely Texas. The urban-rural character of localities should also influence disaster management on the local level as urban counties have a greater demand for emergency services but rural counties also face the challenge of delivering services to a dispersed population.[4] Disaster severity may matter for local disaster resilience as it could set counties back that have suffered substantial damage; on the other hand, disasters offer the opportunity for improving local conditions and developing resilient capacities. Finally, a greater pool of resources in terms of staff, expertise, and funding should enable counties to invest more in disaster management and cultivate their resilience. A variety of data are used to measure these attributes.

Measuring Factors that Affect Resilience

Six categories to represent the urban-rural character of counties were adapted from the Rural-Urban Continuum or Beale Codes from the United State Department of Agriculture.[5] The first includes metropolitan counties[6] with a population of one million or more. The second category includes metropolitan counties with a population of 250,000 to one million; the third group is comprised of metropolitan counties with a population less than 250,000. The fourth group includes non-metropolitan but urban counties with populations of 20,000 or more while the fifth category includes urban counties with a population of 2,500 to 19,999. The final category includes completely rural counties with population less than 2,500.

Disaster severity is considered across three types of events – hurricanes, tornadoes, and the BP *Deepwater* Horizon oil spill. Hurricane severity is measured as average hurricane maximum property damage caused by hurricane events from 2002-2011 in millions of dollars. These data were obtained from SHELDUS.[7] Tornado severity is measured as average maximum Fujita-scale (F-scale) value recorded for tornado events during the time period 2002-2011. This information was obtained from NOAA's National Weather Service Storm Prediction Center.[8] The BP oil spill variable was constructed from economic loss zones and ranges from zero – no economic impact – to five – the most economic impact. Higher values on all the disaster indicators indicate more severe disaster events.

Resources are measured in multiple ways. The first is external grants secured from the Federal Emergency Management Agency. This includes the average number of Public Assistance grants for all categories of work awarded during the time period 1998-2012.[9] Also considered are the average number of Hazard Mitigation Grant Program projects awarded to each county from 1989 to 2011.[10] The second set of indicators reflects human resources, namely the average number of emergency management staff by county. These data were taken from surveys of county emergency managers. The third set of indicators in the resource category represents the qualifications of the county emergency manager. This includes average years of experience and percentage of those managers with college degrees.

Information on emergency manager qualifications was gathered from responses to the emergency manager survey.

These data were aggregated for each group to determine which patterns exist among varying degrees of resilience. For some data averages were taken; for others the percentages of the categories of the data were examined. This information is presented in Table 2. The profiles that emerge are discussed in the following section beginning with the most resilient category represented by Group 1 then moving to the least resilient class represented by Group 4. Finally Groups 2 and 3 data are considered as indicative of a profile for moderate resilience.

Most Resilient Profile

The most resilient counties are represented by Group 1's characteristics. Over fifty percent of the cases in this group are from Louisiana, and nearly one-third is from the state of Florida. Both of these states permit home rule for county and parish governments, and both have considerably reorganized and invested in their state emergency management institutions and infrastructure following severe storms – Hurricane Andrew (1992) and Hurricane Katrina (2005).

The majority of counties in the most resilient category are metropolitan areas, and none are rural with populations under 2,500. The counties in this group have experienced somewhat severe disaster damages. They have the highest tornado damage of all the groups with an average F-scale of 1.3 and the second-highest hurricane property damage of $365.6 million. They also have the second to highest average BP economic loss claim zone – 2.1. This indicates that the majority of the areas in these counties are in Zone C which is the third tier of economic loss behind Zone A and B.

Regarding fiscal and human resources, Group 1 has secured the most Public Assistance grants of the four groups and the second-most Hazard Mitigation grants from the Federal Emergency Management Agency (FEMA). This group also has the highest average emergency management office staff with an average of 4.6 employees and the highest percentage (27.8%) of emergency management office staff numbering six employees or more. Emergency managers in this group have the least amount of average experience (14.9 years) but comprise the highest percentage of college graduates (66.7%).

Least Resilient Profile

The least resilient counties are represented by Group 4. They have moderate to low adaptive capacities and low ratings of the adaptive process. Most of these counties are from Texas (50%), but nearly a one-third is from Louisiana as well. Fifty percent of the cases in this group are urban areas with small populations ranging from 2,500 to 19,999.

This group has had little disaster experience; in terms of property damage they have been impacted by hurricanes the least of all the groups, averaging $315.2 million, and tornado damage has been small as well with an average of 0.5 on the F-scale. They have also been least affected economically by the BP oil spill. Their average claim zone score is 1.25 indicating that most of the counties in this group are in Zone D – the lowest category of economic loss.

Table 2: Patterns across Resilience Groups

			Group 1	Group 2	Group 3	Group 4
		Adaptive Capacities	*High*	*Mod. to Low*	*High*	*Mod. to Low*
		Adaptive Process	*High*	*High*	*Low*	*Low*
State Context	*Percent of counties by state*	Alabama	5.6%	0.0%	0.0%	0.0%
		Florida	27.8%	34.5%	50.0%	33.3%
		Louisiana	55.6%	17.2%	50.0%	16.7%
		Mississippi	0.0%	10.3%	0.0%	0.0%
		Texas	11.1%	37.9%	0.0%	50.0%
Urban/Rural Character	*Percent of counties by urban/rural classification*	Metro: ≥ 1 million pop	27.8%	24.1%	0.0%	0.0%
		Metro: 250,000 - 1 million pop	16.7%	24.1%	0.0%	33.3%
		Metro: <250,000 pop	5.6%	20.7%	100%	16.7%
		Urban: 20,000 pop	27.8%	13.8%	0.0%	0.0%
		Urban: 2,500-19,999 pop	22.2%	10.3%	0.0%	50.0%
		Rural: < 2,500 pop	0.0%	6.9%	0.0%	0.0%
Disaster Severity	*Hurricane*	Average maximum property damage in millions of dollars	$365.6	$461.7	$791.7	$315.2
	Tornado	Average F-scale (scale ranges 0-5)	1.3	1.1	0	0.5
	Oil Spill	Average economic loss claim zones (scale ranges 0-5)	2.1	1.4	2.5	1.25
Fiscal and Human Resources	*Grants*	Average number of PA Grants awarded 1998-2012	884.8	715.1	238.3	693.3
		Average number of HMGP funding awarded 1989-2011	24.4	27.0	16.0	18.0
	EM Office	Average number of staff in emergency management office	4.6	4.4	2	3.8
		Percent of emergency management offices with 3 to 5 employees	44.4%	51.2%	0%	66.7%
		Percent of emergency management offices with 6 employees or more	27.8%	20.7%	0%	16.7%
	EM Qualifications	Average years of experience	14.9	21.7	16.5	18.5
		Percentage with college degrees	66.7%	39.3%	50.0%	50.0%
		Number of cases	18	29	2	6

Sources: Urban-rural data were adapted from the USDA's Beale codes. Disaster data were taken from SHELDUS, NOAA, and BP. Resource data were taken from FEMA and surveys of county emergency managers.

Counties in this group have secured fewer FEMA Public Assistance and Hazard Mitigation grants than Groups 1 and 2. Similarly, the number of employees in county emergency management offices ranks third behind Groups 1 and 2 with an average of 3.8. Sixty-seven percent of the counties in this group have emergency management office staff ranging from three to five, and nearly 17% have staff of six or more. The average of county emergency manager experience is 18.5 years which is the second highest of the four groups. Additionally, fifty percent of county emergency managers in this category have a college education.

Moderate Resilience Profile

While Group 1 represents the most resilient cases and Group 4 the least resilient cases given their adaptive capacity and process pairings, Groups 2 and 3 are indicative of moderate development of resilience. Group 2 cases have high ratings of the adaptive process but moderate to low capacity while Group 3 is the opposite – low ratings of the adaptive process but high capacity. This middle ground is important because a majority (56%) of the cases fall into these categories.

The cases in Groups 2 and 3 are counties and parishes from all of the Gulf Coast states, except Alabama.[xi] Moreover, sixty-nine percent of Texas counties, 61% of Florida counties, and all of the Mississippi counties studied are considered to have moderate resilience. By contrast only 35% of the Louisiana parishes included in the sample are in this middle ground. There is also a mix of urban-rural counties in these two groups. Approximately 50% of the cases in Groups 2 and 3 are metropolitan counties with populations ranging from 250,000 to over one million. Another quarter is metropolitan areas with populations less than 250,000. There are urban counties with smaller populations as well, and the two counties in the study that are rural with populations less than 2,500 belong to Group 2.

These groups are mixed with regards to their disaster experience as well. They have the highest hurricane property damage with $461.7 million for Group 2 and $791.7 million for Group 3. However, Group 3 has not experienced recent tornadoes, and Group 2's experience has been moderate in comparison to the other groups with an average F-scale of 1.1. BP oil spill damages have been greatest for Group 3 (average of 2.5 claim zone) while Group 2 has been largely unaffected (average of 1.4 claim zone).

Group 2 has had success at securing Public Assistance and Hazard Mitigation grants from FEMA. It ranks second in average PA grants and first for HMGP grants of the four groups. It also has the second to highest average number of county emergency management office staff with 4.4 employees, and its emergency managers have the highest average experience – 21.7 years. However, it has the lowest percentage of county emergency managers with higher education; less than 40% have a college degree. Group 3, on the other hand, has the fewest number of grants and emergency management staff. Its county emergency managers also have the less average years of experience than Groups 2 and 4.

Resilience Patterns

The patterns that emerge from intersecting capacities for and perceptions of resilience indicate that highly resilient cases are in states with home rule institutions. Further examination of this political institution reveals that 55% of the most resilient cases (those in Group 1) are counties that have adopted home rule while only 35% of those cases in the moderate category (Groups 2 and 3) and none of the counties in the least resilient group (Group 4) have home rule charters. Additionally, the majority of the cases in the most resilient group are parishes from Louisiana while the majority in the least resilient group are counties from Texas. Clearly, there state dynamics affect how resilience develops locally.

The urban-rural character of counties also matters; however, the patterns that emerge for this factor are much more mixed. Each profile of resilience includes counties of varying sizes. The only pattern that is evident is that the most resilient cases do not include rural counties, which indicates that there are particular challenges for building resilience in rural settings.

Disaster experiences also emerged as having distinct patterns among the groups. The most resilient cases have suffered some disaster damages but not the most severe. The most severe disasters have hit the moderately resilient group while the least resilient group has little experience with disasters. This indicates that disasters can offer the opportunity to build resilience but that they also disadvantage communities by straining their capacities.

Resources are also clearly connected to resilience. The counties that exhibit the most resilience have secured the greatest number of Public Assistance grants as well as a considerable amount of Hazard Mitigation Grant Program funding from FEMA. Additionally, the most resilient cases have emergency management offices with the greatest number of staff and have the highest percentage of emergency managers with college degrees. The moderate to least resilient cases have medium sized to small emergency management staff and have emergency managers who have considerable years of experience but not the highest rate of college graduation.

These findings point out that the development of local disaster resilience is limited in rural settings and communities that have experienced severe disasters. However, resilience is improved where local emergency management offices are supported with fiscal and human resources. This underscores the resilience does not simply occur; rather investment is needed to nurture the capacities and collective action needed for resilient responses to disaster events.

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1 Cases in this category scored a three or lower on the adaptive capacity scale and ranked average coordination as three or higher.

2 Cases in this group scored a four or higher on the adaptive capacity scale and ranked average coordination as less than three.

3 Cases in this category scored a three or lower on the adaptive capacity scale and ranked average coordination as less than three.

4 William L. Waugh Jr., "Management Capacity and Rural Community Resilience," in Disaster Resiliency: Interdisciplinary Perspectives, ed. Naim Kapucu, Christopher V. Hawkins, and Fernando I. Rivera (New York: Routledge, 2013) 297.

5 U.S. Department of Agriculture, Economic Research Service, 2003 Rural-Urban Continuum Codes [Downloadable Data File] (Washington DC: USDA, 2004), http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx#.Udj8CKzlf2w (accessed April 5, 2012).

6 U.S. Department of Agriculture defines metropolitan as: "one urbanized area of 50,000 or more population plus adjacent territory and have a high degree of social and economic integration."

7 Hazards & Vulnerability Research Institute, The Spatial Hazard Events and Losses Database for the United States, Version 10.0 [Online Database] (Columbia, SC: University of South Carolina, 2013), http://www.sheldus.org (accessed September 5, 2012).

8 National Oceanic and Atmospheric Administration, Storm Prediction Center Severe Weather GIS (SVRGIS) [Online Database] (Norman: Storm Prediction Center, 2012), http://www.spc.noaa.gov/gis/svrgis/ (accessed October 5, 2012).

9 Federal Emergency Management Agency Library, FEMA Public Assistance Funded Projects Summary [Downloadable Data File] (Washington DC: FEMA, 2012), http://www.fema.gov/library/viewRecord.do?id=6299.

10 Federal Emergency Management Agency Library, FEMA Hazard Mitigation Program Summary [Downloadable Data File] (Washington DC: FEMA, 2012), http://www.fema.gov/library/viewRecord.do?id=6293.

11 There are, however, only two counties from Alabama in the study, and only one responded to the survey of county emergency managers.