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Social Resiliency at the Meso-Scale in the Upper Mississippi River Watershed: Challenges and Opportunities

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Motivation and Conceptual Approach

The Upper Mississippi River Watershed (UMRW), encompassing parts of the upper Midwest and Great Plains, has experienced dramatic socioeconomic and environmental changes since the 1980s. In non-metropolitan areas, many towns have experienced decline in terms of shrinking populations, exodus of younger people, job losses, and poorer community services.[\[1\]\[2\]\[3\]](#) In contrast, many of the region's metropolitan areas are expanding in terms of population, economy, and geography. Growth has primarily occurred in suburban and exurban portions of conurbations, while urban cores have remained stable or declined, resulting in urban sprawl.[\[4\]](#) However, one common threat facing all communities in the UMRW is climate change, which appears to be increasing the frequency and severity of flooding events.[\[5\]\[6\]\[7\]](#) For example, the 2019 Midwest floods are thought to have been caused by a combination of climate factors: heavy rainfall in the preceding summer that saturated soils; extreme cold and scant snowfall in early winter that froze saturated soils deeply; heavy snowfall in late winter that covered and insulated frozen soils from spring thaw; and in March a "bomb cyclone" that rapidly warmed temperatures and caused heavy spring rains.[\[8\]\[9\]](#) Quick melting of a deep snowpack on still frozen soils, along with spring rain, caused major flooding and damage in communities along the Missouri and Mississippi rivers. Costs are still being counted, but current figures place the property damage at just under \$3 billion, not counting the emotional distress of residents impacted by floods.[\[9\]](#)

Events such as the one just described have sharpened calls to increase resiliency to climate change in UMRW communities. The concepts of resiliency and vulnerability have their origins in ecology.[\[10\]\[11\]](#) Traditionally, it is defined as the ability of an *ecosystem* to respond, adapt, and recover from environmental shocks. These concepts have been increasingly used in the social sciences to understand community and sustainable development in sociology;[\[12\]\[13\]\[14\]](#) and urban and regional development in economics.[\[15\]\[16\]](#) In particular, resiliency frameworks are de rigueur in community studies of natural disasters and economic shocks.[\[17\]\[18\]](#) In the social sciences, community resiliency is generally defined as the ability of a *place* to cope with, adapt to, and recover from hazards, be they environmental, economic, or social.[\[19\]\[20\]](#) Social and economic resiliency are components of community resiliency, albeit with different foci.[\[21\]\[22\]](#)

In this exposition, I use the above definition of community resiliency to explore the challenges and opportunities in measuring social resiliency to plan for and respond to

climate change events in the UMRW. Previous research has linked resiliency with greater collective action and robust governance structures.[\[23\]](#) Through collective action, socially resilient places are able to mobilize economic, social, political, and cultural resources to respond to hazards. This permits the community to sustain and renew itself so it can pursue new development trajectories.[\[18\]](#) In fact, Bergstrand et al. argue that social resiliency not only allows the community to recover from hazards, but potentially the community may experience unanticipated benefits as a result.[\[19\]](#) In a similar vein, Sherrieb et al. make the case that social vulnerability, or lack of resiliency, may result in delayed or no recovery in the community; and may in fact result in additional negative effects from the initial hazard.[\[24\]](#) In sociology, there is some consensus that resiliency makes it impossible for communities to return to their prior state, as the hazard and response creates a new social system rather than replicating the previous one.[\[19\]](#)

However, all forms of resiliency, including social, suffer from three major shortcomings that limit its utility in research (Kulig et al. 2013; Robinson and Carson 2016).[\[23\]\[25\]](#) First, resiliency is a dynamic process over time that can only be determined by looking at the community response to hazards prior to and after the shock. Most extant resiliency research is *ex post facto*, with prior conditions inferred from secondary data or by having current residents recall them. Both are problematic in that secondary data may be unavailable or limited across time and spatial scale; and recall of prior conditions lacks internal validity (Singleton and Straits 2009).[\[26\]](#) Second, there is little distinction between the antecedents and consequences of resiliency, with many studies being tautological by having identical causes and effects. Third, there are a host of other critiques: poor definition of community, a normative bias that stigmatizes non-resilient communities, an implicit acceptance that responsibility for hazards should be devolved from nations to localities, and that the concept legitimates and promotes acceptance of human-caused local shocks imposed by global forces.[\[27\]\[11\]](#)
[\[28\]\[29\]](#)

Operationalizing Social Resiliency at the Meso-Scale

To illustrate the challenges and opportunities of the social resiliency concept, I operationalize a simple social resiliency measure using available secondary data for all counties in the Upper Mississippi River Watershed (UMRW). In the literature, social resiliency is conceptualized as being composed of social advantage and social capital (Gallent 2013; Halstead and Deller 2015).[\[30\]\[31\]](#) *Social advantage* measures the social structural conditions of a community in terms of favorable demographics (such

as fewer minorities, fewer dependents, and higher education), stronger economies (including higher incomes, lower poverty and inequality, strong labor markets, and a robust tax base), and lower social risk factors (examples are single-headed families, disability, substance abuse, and crime). *Social capital* measures the community's ability to promote norms of reciprocity, social trust, social networks, and civic engagement.[32] Social capital is often delineated into three forms.[33] Bonding social capital is relationships between people who are similar in some manner, typically based on strong affective ties that make them emotionally close (social trust). Bridging social capital is ties between dissimilar people that connects different groups in the community to acquire a wider range of resources and information to achieve some collective purpose (reciprocity norms). Linking social capital is defined as vertical networks between individuals and institutions that have formal power over them. Internal linkages are between residents and local institutions; and external linkages are ties between local actors (residents and local institutions) that reach out to institutions outside of the community, bringing in outside resources and new ideas.

Data and Methods

Units of analysis are 792 counties in nine states (IL, IA, KS, MN, MO, NE, ND, SD, and WI) containing the Mississippi River and its major and secondary tributaries. The Upper Mississippi Watershed proper includes 314 counties where one of these rivers flows through or is adjacent to the county. Major tributaries of the Mississippi include the Illinois, Missouri, and Ohio rivers. Secondary tributaries of the Mississippi include the Chippewa, Des Moines, Iowa, Kaskaskia, Minnesota, Rock, St. Croix, and Wisconsin rivers. Secondary tributaries by way of the Missouri include the Cheyenne, James, Kansas, Niobrara, Osage, and Platte rivers. The Kankakee River is also a secondary tributary by way of the Illinois River.

The *social disadvantage index* is composed of three indicators: percent of persons in poverty; percent of the population that is a non-white race or Hispanic; and percent population that is 17 years and younger or 65 years and older (dependency ratio). Data are taken from U.S. Census Bureau's American Community Survey (ACS) using 2012-16 estimates. The *social capital index* also includes three indicators: number of civic, social, and political organizations per 10,000 people; number of non-profit organizations per 10,000; and percent eligible voters who cast a ballot in a federal election. Items are from the 2014 Social Capital Index produced by the Northeast Regional Center for Rural Development at Pennsylvania State University. For both indices, indicators are standardized to z-scores to remove scale differences (mean and

standard deviations based on $n=792$ counties) and then summed across items. Standard scores are censored at ± 3 to minimize the effect of extreme values. The index ranges from -6 (very low) to 6 (very high), with zero indicating average scores. The spatial distribution of social disadvantage and social capital in the UMRW is presented in Figures 1 and 2.

Figure 1. Map of social disadvantage index z-scores in 2012-16 for n=314 counties adjacent to the upper Mississippi River and its major tributaries.

Figure 2. Map of social capital index z-scores in 2014 for n=314 counties adjacent to the upper Mississippi River and its major tributaries.

The social resiliency index is constructed by multiplying the social disadvantage and social capital indices. However, since this approach yields positive and negative

numbers with different interpretations, we must disaggregate the social resiliency index into two sub-scales. The social advantage resiliency sub-scale multiplies negative disadvantage scores by social capital, then reverses the sign for interpretability. Scores near 6 indicate *social resiliency* (low social disadvantage and high social capital) and scores near -6 indicate *social apathy* (low disadvantage, but low social capital). The social disadvantage resiliency sub-scale multiplies positive disadvantage scores by social capital. Again reversing the sign, scores near 6 indicate *social vulnerability* (high social disadvantage and low social capital) and scores near -6 indicate *social perseverance* (high disadvantage, but high social capital). The scatterplot of social disadvantage and social capital scores is presented in Figure 3; and the spatial distribution of social resiliency scores is shown in Figure 4.

Figure 3. Scatterplot of social capital index and social disadvantage index z-scores in 2012-2016 for n=314 counties adjacent to the upper Mississippi River and its major tributaries.

Results

Counties are classified into a social resiliency typology if their scores exceeds ± 2 on the social advantage and social disadvantage sub-scales. Counties in the social resiliency typology are highlighted in Figure 5. In the UMRW, I find 22 *socially resilient communities* that have structural advantages as well as having high levels of social capital. These communities will be able to plan for and implement climate change mitigation projects easily, as they have sufficient economic resources and the ability work collectively on projects. Further, socially resilient places will be better able to recover from natural disasters when they occur. These counties tend to be sparsely populated and slower growing, mostly located in rural sections of the Missouri, Minnesota, and James watersheds (i.e. in Minnesota and the Dakotas). Resilient communities are socially active places with strong structural advantages. Researchers and planners will likely find these places receptive to resiliency projects, but the problem is these advantaged places are not in need of outside assistance.

On the other hand, the UMRW also has a number of *socially vulnerable communities*. These 24 counties have extreme levels of poverty, are majority-minority communities, have large numbers of dependent children, have few local social or civic organizations, and citizens are disengaged from the political process. Primarily located along the upper Missouri and the lower Mississippi rivers, the upper reaches are dominated by Native Americans on reservation land, while the lower reaches are heavily African American on former plantation and sharecrop land. There are large numbers of single-headed families, vacant homes, high school non-completers, and an unemployment rate that is high and rising. Given these more immediate challenges, it is unlikely vulnerable places will see climate change mitigation as a pressing priority. Even if residents desired to pursue such plans, they lack the structural resources and collective efficacy to implement them. Socially vulnerable communities are most at risk from climate change because they are ill equipped to respond to natural disasters from both a monetary and collective efficacy point of view. They are most in need of outside assistance, but there are major class and culture barriers that need to be overcome. A long history of mistreatment and neglect by the white upper middle class establishment makes residents in these communities highly suspicious of outsiders and their motives. Climate change interventions need to be tailored to meet the special challenges facing these communities. Further, academics and professionals need to be mindful of their class and culture privilege when dealing with some of the most disadvantaged citizens of the U.S.

Socially persevering communities are those that possess high levels of social capital, despite severe social disadvantages. Small in number (n=6), these communities are sparsely populated and remote, tending to cluster in the Great Plains. Population is falling yet the youth population is large, suggesting out-migration is the cause of decline, not natural decrease. The economy of persevering places is dominated by agriculture and manufacturing. Perhaps as a result, these communities are ethnically diverse, with large shares of Hispanics and those of other races. Persevering places are socially active communities with structural vulnerabilities such as poverty, ethnic diversity, and large numbers of dependent children. These places are more likely to be receptive to climate mitigation plans due to high social capital, but need outside financial resources to implement them. As the name implies, persevering places have some social resiliency to natural disasters, being able to pull together as a community to recover in a limited way using local resources. However, such communities lack structural resources (income, tax revenues, organizational infrastructure, etc.) to recover fully from disasters, indicating that federal and state aid is vitally important.

The last group in the typology consists of advantaged communities with very low levels of social capital. The n=17 *socially apathetic communities* are large metropolitan cities located primarily along the Mississippi River near confluences with tributaries. Apathetic communities can be best described as passive places with structural resilience, having low poverty and high incomes, a large labor force, a diversified economy in the services sector, and population growth fueled by in-migration. In other words, these places are resilient because of their population and economic advantages. These urban communities are likely to adopt and implement climate change mitigation plans, but probably without much citizen involvement. In the sociological literature, civically disengaged cities are often characterized as “clienteles” communities, where government and business elites set agendas and make decisions on behalf of their citizens. Researchers and planners need ensure the views of elite decision makers are representative of the entire community, especially those who are more disadvantaged.

Figure 5. Map of social resiliency typology counties in 2012-16 for n=314 counties adjacent to the upper Mississippi River and its major tributaries.

Implications for Future Sustainability Research

I see four main challenges to using the social resiliency concept in future sustainability research. Most of my proposals will require significant investment by federal funding agencies to develop the research infrastructure needed to move resiliency science forward. First, *more systematic research is needed to understand how social resiliency helps communities plan for and respond to natural disasters*. Extant research is *ad hoc* and *ex post facto*, which limits testing of hypotheses and theory. For example, the vast majority of research is conducted in communities after a disaster has occurred. There is little prior data on social interactions, except what can be poorly gleaned from secondary (typically county) data and after-the-fact recollections. A better approach would be to select a representative set of communities in disaster-prone areas, collect data every three to five years on social interactions and other perceptions using resident surveys, and then make predictions on whether certain places should be more resilient. If in the course of time sampled communities do experience a disaster, one can begin to test whether the predicted resiliency is manifest over time. Such an undertaking would require much effort and expense, but will ultimately address many methodological limitations concerning social resiliency.

Second, there is a *social capital data deficit across time and space*. As my analysis in the previous section demonstrates, there is a plethora of secondary data to measure social disadvantage/advantage at the local level over time. The U.S. Census American Community Survey provides quality annual updates for all places (cities, towns, villages) across the nation. By contrast, there is a dearth of data properly measuring social capital at the meso-level. At present, the Social Capital Index, produced by Pennsylvania State University, is the only national database at the meso-scale. However, this index is limited in terms of time (updated every five years), space (only county), and conceptualization (only organizations and voting behavior). Future research should be conducted to identify meso-scale indicators for other aspects of social capital beyond simply counting organizations from economic secondary data. Subjective assessments of community attachment, social support and trust, perceptions of organizations and leaders, and quality of life are all important indicators that are missing. Current subjective datasets are *ad hoc*, measuring different aspects of social capital over multiple scales and periods, making cross-community comparisons nigh impossible. Future research needs to find ways of combining relevant secondary data with primary data on subjective assessments to estimate a robust measure of social capital at the meso-scale over time. Lack of proper

and consistent measurement of social capital limits the usefulness of the social resiliency concept.

Third, there is an emerging question about whether *social resilience has been confused with class resilience*. In homogenous communities with low inequality, social and class resilience are likely similar. However, in diverse and unequal places the two concepts become more dissimilar. Further, the utility of social resiliency measures are diminished by averaging effects in unequal places, as “average” scores mask wide disparities between socioeconomic groups. There is a need to better understand why some segments of the population are more socially vulnerable in otherwise resilient communities, and vice versa. This is becoming more of a concern as income inequality has risen sharply in the U.S. over the past several decades, with most communities being more unequal today than in the past. More work is needed to understand the dynamics between person-based and place-based vulnerabilities. For example, are person-based social vulnerabilities (such as being minority, poor, old, and a new resident) ameliorated by living in an overall socially resilient community, or are such vulnerable populations more isolated and invisible in these advantaged places? Is personal vulnerability amplified for individuals living in socially vulnerable places, or is everyone equally vulnerable? Data and methods that link across micro/person and meso/community scales would be a major contribution to resiliency research.

Lastly, what are the implications for social resilience research as we *transition from communities of place to communities of interest*? Social resiliency, grounded in 20th century social capital theory, has assumed that social interactions occur in geographically bounded communities. However, the advent of social media in the 21st century has led to the proliferation of communities of interest. There is speculation that communities of place will become less important in our lives over the coming decades, to be replaced by a myriad of virtual communities of interest. The impact this may have on social capital creation and maintenance is unclear, as is the potential impact on social resiliency in a community. On one hand, virtual communities may allow place-based ones to acquire more information and resources from outside the community, which may strengthen local resiliency. On the other hand, virtual communities may isolate people from their place-based one, reducing community attachment, and causing individuals to disinvest in the place where they live. Communities of interest may only create individual resilience, possessed by and serving the individual and not the geographic community. In other words, social resilience will move away from being a public good (collectively created and shared) to a more private good. More research is needed to disentangle the complex relationship

between communities of place and interest in the 21st century, and how it may help or hinder social capital creation in the future.

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