

## **Exploring the role of community capacity and planning effort in disaster risk reduction and environmental sustainability: spatio-temporal vulnerability and resiliency perspectives**

Hyun Kim<sup>1</sup>, David W. Marcouiller<sup>2</sup>

*<sup>1</sup>University of Wisconsin-Madison*

*hkim9129@gmail.com*

*<sup>2</sup>University of Wisconsin – Madison*

*dave.marcouiller@wisc.edu*

Using the basic premise that natural disaster effects are fundamental social processes that require pro-active planning, a conceptual model of disaster losses that involves local exposure, shock, and loss within the context of inherent social system spatial and temporal vulnerability and resilience was formulated. Based upon a review of the extant literature, three theoretical hypotheses were proposed. First, disaster effects will have a negative association with social and economic development metrics; second, the higher the levels of a community's social and economic capacity, the lower the disaster losses; and third, better planning effort, social capital, and social justice in place before a natural disaster will lower disaster losses.

This study focuses on examining disaster loss from flooding with respect to local planning effort, and social and economic condition at the county level within the Mississippi River basin in the United States. Data were collected from secondary sources (archival review and existing databases). Mixed analytical methods were used including log-linear models, quantile regression, two-stage least square models, longitudinal data analysis, spatial modeling, and content analysis.

Unlike previous research, which has mainly focused on a theoretical approach to disaster resilience, this study adopted an empirical approach based on panel data at the county level from secondary sources. This framework embraced three phases that included (1) examining socio-economic factors contributing to vulnerability and

resilience within counties affected by natural disasters (flooding) and environmental change using cross-sectional and time-series studies; (2) evaluating the quality of natural disaster mitigation plans within study areas using qualitative text analysis (content analysis) and (3) applying resilience principles to evaluate flood-prone community response to flooding. For the first phase, among about 1,600 counties within the Mississippi River Basin areas, we selected 1,266 counties in 22 states by flooding experience and presidential disaster declaration during the last 20 years. For the second phase, we selected 160 counties among the 1,266 counties in accordance with the criteria of having a local hazard mitigation plan and a high flood risk level. In addition, for the third phase, we selected 85 counties among 1,266 counties with the criteria of spatial clustering of risk. In addition, we selected two local rural communities, Hancock County in Illinois and Crawford County in Wisconsin according to their similar spatial clustering of risk levels, similar high flood risk levels, and socio-economic conditions.

Community capacity characteristics included various environmental and geographical characteristics, human and social capital characteristics, economic and housing characteristics, and planning effort characteristics. Natural disaster mitigation plan quality was assessed to identify the role of planning effort in disaster risk reduction by using content analysis. More recently, studies on plan quality and evaluation have been conceptualized and systemized by contemporary researchers who have evaluated comprehensive plans related to natural disasters. Three elements of plan quality were identified. These included (1) fact basis, (2) goals and objectives, and (3) policies, tools, and strategies. Based on the above three components of plan quality and a coding protocol which incorporated hazard mitigation measurement into these components, we evaluated a sample of 160 local plans related to natural hazard mitigation to determine how well they supported natural disaster risk reduction. Our interest focused on the application of resilience concepts and the evaluation of a rural community's responses to natural disasters. Relying on multiple resources, this qualitative approach allowed for triangulation to provide context for our quantitative results. This mixed method analytical process was useful in providing important insights on how to make communities more resilient to the adverse impacts of natural

disasters and in underscoring the critical importance of a local hazard mitigation plan in contributing to resilience.

Results of spatial modeling suggested that engaged social capital, more equitable distributional characteristics, and local proactive planning in place before a disaster resulted in lower disaster losses. In addition, better plan quality and higher levels of community resilience characteristics resulted in reducing disaster losses. Disaster-prone rural communities need to implement new social and environmental planning strategies to potentially mitigate negative effects of natural disasters that incorporate long-term planning and implementation, land use, and structural and non-structural mitigation designs.