

Ex-Ante Capacity Building in Social Infrastructure to Improve Community Resilience and Post-Disaster Well-Being

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Abstract

Restoration of civil infrastructure is **not** equivalent to the full recovery of a community from natural hazards. Having robust social infrastructure plays a key role in achieving community resilience and well-being. Social infrastructure is defined as formal entities such as governmental organizations, community centers, NGOs, religious centers, etc. as well as informal social ties such as those among individuals and households that assist in post-disaster recovery and alleviate the distress caused by natural disasters in the communities affected by hurricanes. Social infrastructure not only addresses post-disaster tangible needs such as shelter, food, and water but also helps alleviate disaster-induced social and psychological distress in communities. This research focuses on identifying the capacity needs of the social infrastructure to achieve community resilience, measured using community well-being as the recovery metric. Community well-being can be defined as the state in which the needs and desires of a community are fulfilled.

Community well-being models proposed in social science can benefit from considering the role of infrastructure systems and the built environment. On the other hand, engineering resilience models can benefit from considering socio-economic factors through well-being models. There is a need for a quantitative model to identify the infrastructure capacities needed for achieving post-disaster community well-being while integrating the cascading impacts from disruptions in six other supporting infrastructure, i.e., civil, civic, cyber, financial, environmental, and educational.

The research starts with modeling post-disaster community well-being using the indicators selected from existing community well-being models. After the selection of indicators, several data sources such as phone call, survey, and FEMA support programs data were used to quantify post-disaster community well-being. Next, Bayesian Network modeling was used to identify the role of social infrastructure services in the form tangible, emotional, and informational support on enhancing post-disaster community well-being. The Bayesian model was then used to propose capacity building strategies for increasing the robustness of social infrastructure and its supporting infrastructure to foster post-disaster community well-being in the face of future hurricanes.

The key outcomes and contributions of this research are:

1) Quantifying post-disaster community well-being benchmarked with pre-disaster well-being (Objectives 1,3). Using community well-being as the recovery metric allows for considering social and economic impacts of natural hazards in disaster resilience planning. Chapter 3 uses 211 disaster helpline and survey data related to Hurricane Harvey to quantify post-disaster community well-being. The proposed approach can be expanded into a Community Well-being Monitoring dashboard in post-disaster situations using other real-time datasets such as 311, 511 phone call, mobile location, power, and cellular outage data.

2) Chapter 4 introduces a Bayesian Network (BN) modeling framework for identifying the community capacity needed to mobilize the required post-disaster support to achieve target well-being levels under low and high hurricane damage scenarios (Objective 2,3). The Bayesian Model can serve as an Ex-Ante Capacity building tool for decision-makers to prioritize capacity building efforts. The application of the BN model resulted in a set of “thresholds” for different dimensions of community capacities, as well as capacity heatmaps, visualizing the adequacy of community capacities for the state of Texas.

3) Chapter 4 also identified inequalities in post-disaster support, and thereby, community well-being. The analysis revealed that the zip codes with older population, higher African American residents, and more single parent households received lower support. Providing post-disaster support customized to the needs of these vulnerable sub-populations, discovered through their direct, rather than indirect engagement, can be a remedy for this inequality.