Project drawing on recovery lessons from Hurricane Sandy to improve U.S. resilience and disaster preparedness

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Purdue University will lead research to determine why some communities recover from natural disasters more quickly than others, an effort aimed at addressing the nation's critical need for more resilient infrastructure and to enhance preparedness.

The research team will apply advanced simulations and game-theory algorithms, access millions of social media posts and survey data collected along the New Jersey shore, which was devastated by Hurricane Sandy in 2012.

The project, funded with a $2.5 million, four-year grant from the National Science Foundation, will focus on six communities.

"Why do some communities recover faster than others, and why do some neighborhoods never recover?" said Satish Ukkusuri, the project's principal investigator and a professor in Purdue's Lyles School of Civil Engineering. "What are the underlying factors and mechanisms that lead to this recovery? We need to understand this from an integrative, interdisciplinary and data-driven perspective and provide tools for emergency preparedness agencies so that both rural and city governments can be more prepared when disasters happen."

He is working with co-principal investigators Shreyas Sundaram, an assistant professor in Purdue's School of Electrical and Computer

Engineering, and Seungyoon Lee, an associate professor in Purdue's Brian Lamb School of Communication. Also a member of the team is Laura Siebeneck, an associate professor in the University of North Texas Department of Emergency Management and Disaster Science.

"It's a very interdisciplinary team that involves social science, civil engineering, computer engineering and disaster management," Ukkusuri said. "We chose Sandy because it is the most recent large-scale disaster that has happened in the nation that involved a complex, diverse community. Sandy is not too old, so the data are fresh, and yet it is old enough that we can talk about recovery."

The team will investigate recovery over a time scale ranging from the storm's immediate aftermath to the present day.

"So, it's from 2012 until 2016, and we might even look into the longer term because recovery time could take almost 10 or 20 years," he said.

From the social science perspective, the team will collect various kinds of data through surveys of residents in communities on the New Jersey shore.

"We will ask questions related to the recovery efforts, and we also want to understand how their social networks, their family structures, their community structures impede or contribute toward the recovery of these communities," he said.

The project will serve as part of the NSF's multiyear initiative on modeling resilience in interdependent systems and is funded by a program known as CRISP: Critical Resilient Interdependent Infrastructure Systems and Processes. Researchers will probe how to more efficiently allocate resources, better prepare, and reduce the time and cost of recovery when a community is struck by a disaster.

"We have the social side, which is how people interact with other people, and then we have the physical side, which is all these infrastructure networks, the power grid, the communication systems and so forth," Sundaram said. "And you have interdependencies between the two sides. You have to understand both in order to really get a clear picture."

Modeling approaches will be harnessed for improved knowledge of both social factors such as how residents' involvement in the community affects their willingness to return to the neighborhood, and physical factors such as road and infrastructure repairs that enhance recovery.

Officials across the nation will be able to use the simulations in what-if scenarios.

"So you can change the initial conditions and then see what kinds of recovery outcomes you are going to get," Sundaram said. "And you can change community structures, people's objectives, what we call utility functions, and see how that would result in different kinds of recovery outcomes in the end."

Ultimately, Ukkusuri said, his team's goal is to allow governmental and emergency agencies to take actions that will accelerate system recovery and enhance the resilience of communities.

"The scientific tools will be broadly applicable to various types of disasters and communities," he said.

The project also will provide opportunities for students to work with a multi-disciplinary research team, preparing them for complex, systems-related challenges.

Provided by Purdue University