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Vulnerability - Can we measure how vulnerable people are to natural hazards?

(From the report: *Quantifying social vulnerability: A methodology for identifying those at risk to natural hazards.* Dwyer, A., Zoppou, C., Nielsen, O., Day, S. and S. Roberts. Geoscience Australia Record 2004/14, Commonwealth of Australia: Canberra.)

The occurrence of natural hazards is not a phenomenon of recent times, however, understanding the risk from natural hazards is a relatively recent trend and is currently increasing at a greater rate than ever before. As population and infrastructure increases, social conditions fluctuate and the relationship between humans and their environment becomes more complex.

All of these factors, and more, contribute to the wider picture of risk, including risk from natural hazards. While natural hazards will continue to occur, their capacity to become a disaster or merely a manageable event depends on many factors, including the magnitude of the hazard, the vulnerability of people and their communities, the built environment and political systems.

This report focuses on certain aspects of social vulnerability and its role in contributing to the risk from natural hazards. In particular, the study introduces a unique method of measuring the vulnerability of individuals within a household in order to contribute to the development of comprehensive natural hazard risk assessments.

The research undertaken for this report has been driven by two needs: firstly, to develop a custom-made methodology of quantifying social vulnerability that can be incorporated into the risk models being developed by the Risk Research Group at Geoscience Australia. The Risk Research Group undertakes natural hazard research for the Australian Government, with the aim of developing risk models that assist decision-makers in better managing natural hazard risk to Australian communities. Secondly, the research outlined in this report has been influenced by a need to integrate social issues with hazard model development in order to investigate the greater risk to communities. Underlying this research is the need for a practical, albeit experimental, methodology of measuring elements of social vulnerability. Therefore, the report is a step-by-step account of the methodology development that aims to measure one aspect of social vulnerability, the vulnerability of an individual within a household, as a means of identifying those at risk to natural hazards.

Executive Summary

In this study, a methodology is developed to assess the vulnerability of individuals within households to risk from natural hazards. The methodology introduces a technique for measuring certain attributes of individuals living within a household that contribute to their vulnerability to a natural hazard impact. The methodology has four main steps;

Step 1: Indicator Selection

As the study focuses specifically on measuring vulnerability, the indicators selected have been restricted to quantifiable indicators. Thirteen vulnerability indicators and two hazard indicators were selected for the study. The thirteen indicators are: Age, Income, Gender, Employment, Residence Type, Household Type, Tenure Type, Health Insurance, House Insurance, Car Ownership, Disability, English Language Skills and Debt/Savings. The two hazard indicators, residence damage and injuries, were included so that the following steps in the study were linked to a hazard context. The indicators are specific to people living in urbanised areas within an Australian city and were selected using selection criteria outlined in Chapter One.

Step 2: Risk Perception Questionnaire

In an attempt to identify how these indicators contribute to the vulnerability of a person within a household, a risk perception questionnaire was developed. The questionnaire was a means of collecting data on perceived vulnerability in lieu of the availability of actual vulnerability data. The questionnaire respondents were asked to rank the ability of hypothetical individuals to recover from a natural hazard impact based on their own perceptions of the situation. The hypothetical individuals were developed using the 15 indicators. The questionnaire was presented to 'experts' of disaster risk research and 'non-experts' for comparative purposes. The questionnaire results provided 1100 ranked hypothetical individuals, each with a unique set of indicator attributes.

Step 3: Decision Tree Analysis

Decision tree analysis is a classification methodology used to analyse and classify large sets of data. In this study, decision tree analysis was applied to the questionnaire data in order to sort and classify the data to find relationships between the indicator attributes. Based on data from the risk perception questionnaire, the decision tree analysis found 11 decision rules that determine high vulnerability to natural hazards. Each rule demonstrates that a combination of two or more indicator attributes are required in order to predict the vulnerability of a person within a household, challenging the notion that one personal attribute can determine vulnerability. The one exception is Rule 1, which found that if a person suffers a life-threatening injury, they are automatically considered highly vulnerable.

The attributes, referred to as vulnerability indicators, of most importance relate to various levels of: injury sustained, residence damage, house insurance, income and type of house ownership. This finding suggests that individual and household finances, when combined with other specific indicators, play a significant role in determining an individual's vulnerability to a natural hazard impact.

Step 4: Synthetic Estimation

The Australian Bureau of Statistics (ABS) do not release highly detailed data relating to an individual, due to privacy laws. For example, we are permitted to know how many people in one census district (a census district is approximately 200 households in size) are over 55, how many people live alone and how many people are low income earners. However, we are not permitted to know how many people are over 55 and live alone and earn a low income, which is referred to as cross-correlated data. As a result, synthetic estimation was undertaken for a study area of 224 census district areas in an area approximately 25 km north-east of Perth in Western Australia.
In lieu of access to cross-correlated data to the real population, synthetic estimation, a technique using available data and microsimulation models, was used. Synthetic estimates of the population in the study area were developed, providing information on which census districts contain households with people identified as 'highly vulnerable' by the decision rules. The synthetic estimates can be mapped in order to provide a useful tool for representing aspects of social vulnerability to natural hazard impacts.

Future Steps

The report demonstrates that aspects of social vulnerability can be quantified in order to contribute to an understanding of risk to natural hazards. While experimental, the methodology outlines detailed processes that can be undertaken in order to capture and measure some of the complexities relating to social vulnerability.

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