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THE AUSTRALIAN NATURAL DISASTER RESILIENCE INDEX: ASSESSING AUSTRALIA'S DISASTER RESILIENCE AT A NATIONAL SCALE

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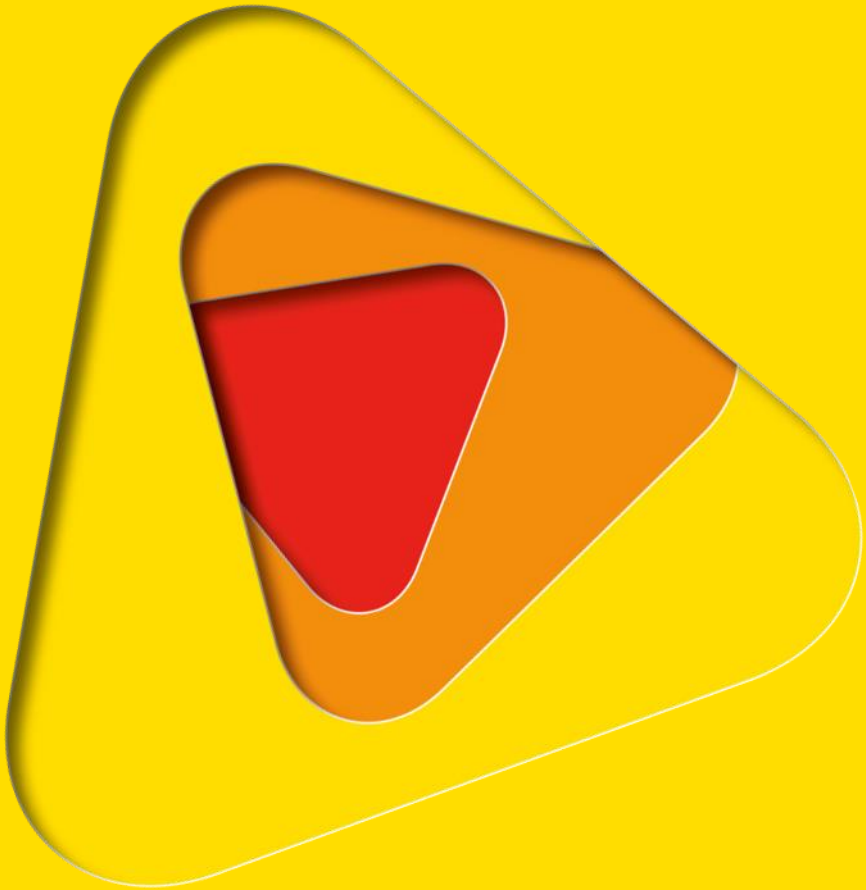

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ABSTRACT

The Australian Natural Disaster Resilience Index (ANDRI) is Australia's first national-scale standardised snapshot of disaster resilience. Because of its national extent, the ANDRI takes a top-down approach using indicators derived from secondary data. The ANDRI has a hierarchical design based on coping and adaptive capacities representing the potential for disaster resilience in Australian communities. Coping capacity is the means by which people or organizations use available resources, skills and opportunities to face adverse consequences that could lead to a disaster. Adaptive capacity is the arrangements and processes that enable adjustment through learning, adaptation and transformation. Coping capacity is divided into themes of social character, economic capital, infrastructure and planning, emergency services, community capital and information and engagement. Adaptive capacity is divided into themes of governance, policy and leadership and social and community engagement. Indicators are collected to determine the status of each theme. This paper will present a preliminary assessment of the state of disaster resilience in Australia, and the spatial distribution of disaster resilience across Australia. We then outline the framing of the assessment outcomes as areas of strength and opportunities for enhancing the capacities for disaster resilience in Australian communities. The utilisation of the ANDRI into emergency management agency programs and tools will also be discussed.

ACKNOWLEDGEMENTS

We thank the many emergency service agencies and agency staff who have collaborated with the research team to co-design the Australian Natural Disaster Resilience Index.

INTRODUCTION

The focus in managing natural disasters in Australia and internationally has, in recent years, moved from risk and vulnerability towards resilience, which includes an emphasis on shared responsibility. This shift towards disaster resilience recognises the uncertainties inherent in natural hazards. These uncertainties range from the unpredictability of natural hazard location and impact, to the changing patterns of hazards resulting from climate change, to the demographic, economic and institutional patterns in society. Understanding how to improve disaster resilience will help communities, governments and organisations to develop the capacities needed for living with natural hazards.

There are many ways to operationalise resilience into policy and programs. Part of operationalising disaster resilience in Australia involves assessing the current state of disaster resilience. Researchers from the Bushfire and Natural Hazards CRC have teamed with emergency service agencies around Australia to develop an index of disaster resilience that is designed to help meet the challenges of Australia's increasingly uncertain hazard future. For the first time, this index will assess and report the state of disaster resilience on a large scale – Australia-wide. The index will use a nationally standardised measure that will make it easy for end-users to identify areas of strength and areas needing improvement, to plan future actions, policies and programs and provide a baseline from which to measure progress in disaster resilience. The index of disaster resilience has potential inputs into macro-level policy, strategic planning, community planning and community engagement at national, state and local levels.

This paper outlines the structure of the Australian Natural Disaster Resilience Index.

BACKGROUND

Academic research on disaster resilience is diverse and active, and resilience is increasingly the foundation of public policies and programs in natural hazard and disaster management (Parsons et al., 2016). There are many definitions of disaster resilience but they are consistent in three aspects. These are the capacities to:

- absorb or accommodate the effects of an external disturbance or stressor event
- recover and return to a functioning state or to persist following an event
- learn, adapt or transform.

For the Australian Natural Disaster Resilience Index, disaster resilience is defined as the capacities of communities to prepare for, absorb and recover from natural hazard events; and to learn, adapt and transform towards resilience (Parsons et al., 2016). Importantly, this definition does not highlight the actual realisation of resilience but the capacities for resilience.

DESIGN OF THE INDEX

Coping and adaptive capacities

The Australian Natural Disaster Resilience Index assesses resilience based on two sets of capacities – coping capacity and adaptive capacity (Figure 1).

Coping capacity enables people or organizations to use available resources and abilities to face adverse consequences that could lead to a disaster (sensu UNISDR, 2009). In a practical sense, coping capacity relates to the factors influencing the ability of a community to prepare for, absorb and recover from a natural hazard event.

Adaptive capacity is the ability of a system to modify or change its characteristics or behaviour to cope with actual or anticipated stresses (Folke et al., 2002). Adaptive capacity entails the existence of institutions and networks that learn and store knowledge and experience, create flexibility in problem solving and balance power among interest groups (Folke et al., 2002). In a practical sense, adaptive capacity relates to the factors that enable adjustment of responses and behaviours through learning, adaptation and transformation.

Together, these coping and adaptive capacities form the core of our assessment of resilience to natural hazards. Coping capacity and adaptive capacity help to answer the question 'How able is a community to prepare for, respond to and recover from a natural hazard event and return to a satisfactorily functioning state in a timely manner, and to strategically learn and adapt to improve its resilience to future natural hazard events?'

Indicator themes

Themes divide coping capacity and adaptive capacity into its sub-components (Figure 1). Themes are the factors – related to coping capacity or adaptive capacity – that contribute to community resilience to natural hazards (Table 1). Themes have a basis in the literature: some with empirical evidence of the relationship between the theme and resilience, and others that conceptualize this relationship but with little empirical testing (Parsons et al., 2016).

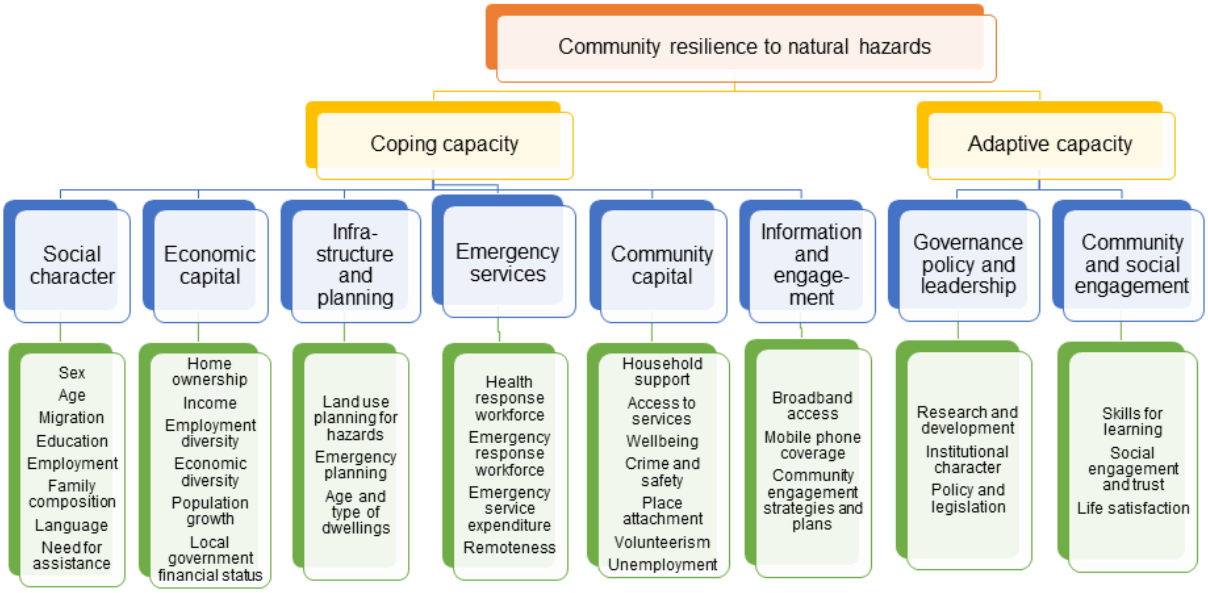

Figure 1. Hierarchichal structure of the Australian Natural Disaster Resilience Index.

Indicators

Indicators provide the data for a theme – together the indicators measure the status of the theme. Selecting indicators is both an art and a science. Many indicators have a basis in the literature and have demonstrated relationships with aspects of natural hazards or disasters. For example, there is a documented relationship between income, housing type and gender and the ability to prepare for and respond to natural hazard events (Morrow, 1999). The indicators used to measure the status of the theme can be selected using a set of criteria that increase confidence in the associations between an indicator and disaster resilience (Winderl, 2014).

We have collected 89 indicators across the eight themes. Each indicator has data available in each State and Territory and represents the relationships to disaster resilience outlined in Table 1. For brevity in Figure 1, indicators have been grouped into dimensions. However, there may be several indicators associated with one dimension. For example, employment is comprised of three indicators: % of the labour force unemployed; % not in the labour force; and % managers and professionals.

Table 1. Explanation of themes within the Australian Natural Disaster Resilience Index. The right hand column overviews the relationship between the theme and natural hazard resilience, although a review process will further explore these relationships as part of the project

Theme	Description	Influence on natural hazard resilience
Social character	• The social characteristics of the community. • Represents the social and demographic factors that influence the ability to prepare for and recover from a natural hazard event.	• Gender, age, disability, health, household size and structure, language, literacy, education and employment influence abilities to build disaster resilience (Morrow, 1999; Thomas et al., 2013).
Economic capital	• The economic characteristics of the community. • Represents the economic factors that influence the ability to prepare for and recover from a natural hazard event.	• Access to economic capital may be a barrier to resilience building activities (Bird et al., 2013). • Losses from natural hazards may increase with greater wealth, but increased potential for loss can also be a motivation for mitigation. • Economic capital often supports healthy social capital (Thomas et al., 2013).
Infrastructure and planning	• The presence of legislation, plans, structures or codes to protect infrastructure. • Represents preparation for natural hazard events using strategies of mitigation or planning or risk management.	• Considered siting and planning of infrastructure is an important element of hazard mitigation. Multiple levels of government are involved in the planning process (King, 2008; Crompton et al., 2010). • Planners can be agents of change in building disaster resilience (Smith, 2009).
Emergency services	• The presence, capability and resourcing of emergency services, warning systems and disaster response plans. • Represents the potential to respond to a natural hazard event.	• Emergency response capabilities and systems support resilience through the entire PPRR cycle.
Community capital	• The cohesion and connectedness of the community. • Represents the features of a community that facilitate coordination and cooperation for mutual benefit.	• Social networks assist community recovery following disaster (Akama et al., 2014). • High levels of social capital can enhance solutions to collective action problems that arise following natural disasters (Aldrich, 2012).
Information and engagement	• Availability and accessibility of natural hazard information, engagement of the community with natural hazards and public-private or other partnerships to encourage risk awareness. • Represents the relationship between communities and information and the uptake of information about risks and the knowledge required for preparation and self-reliance.	• Emergency management community engagement is made up of different approaches including information, participation, consultation, collaboration and empowerment (EMA, 2013). • Community engagement is a vehicle of public participation in decision making about natural hazards (Handmer and Dovers, 2013).

Table 1. (cont.)

Theme	Description	Influence on natural hazard resilience
Governance, policy and leadership	• The capacity within government agencies to adaptively learn, review and adjust policies and procedures, or to transform organizational practices. • Represents the flexibility within organizations to learn from experience and adjust accordingly.	• Effective response to natural hazard events can be facilitated by long term design efforts in public leadership (Boin, 2010). • Transformative adaptation requires altering fundamental value systems, regulatory or bureaucratic regimes associated with natural hazard management (O'Neill and Handmer, 2012). • Collaborative learning facilitates innovation and opportunity for feedback and iterative management (Berkes, 2007; Goldstein, 2012).
Community capital and social character	• The cohesion and connectedness of the community and the social and demographic character of a community. • Represents the resources and support available within communities for engagement, learning and adaptation and the factors influencing the uptake of adaptation information and strategies.	• High levels of social capital can enhance solutions to collective action problems that arise following natural disasters (Aldrich, 2012). • Cooperation and trust are essential to building disaster resilience and arise partly through social mechanisms including social capital (Folke et al., 2002; Kaufman, 2012).

INDEX COMPUTATION AND ANALYSIS

Index calculation is the process of bringing together the indicators to form an index. Methodological issues in the construction of composite indices have been extensively discussed and/or analysed in a number of different disciplines, including sustainability, environmental condition, climate change and international development. The history of composite index development shows that the representation of a complex system with a single number has an irresistible allure. The addition or averaging of rescaled indicators has had an intuitive appeal that has made it the most widespread of aggregation methods. However, as composite index construction has received increasing scrutiny, and an increasing number of fields have found applications for composite indices, their shortcomings are becoming better understood. Chief among these are the issues of indicator rescaling and compensability. These problems have driven the search for non- or partially compensatory aggregation methodologies where weights can validly be interpreted as measures of importance.

The Australian Natural Disaster Resilience Index will consider and apply best practice composite index methods in the component areas of computation: functional form, construct validity and content validity; populations, samples and outliers; transformations of indicators; indicator reversals; correlation between indicators; and, weighting and aggregation. The computation of the index is presently underway.

REFERENCES

1. Akama, Y., Chaplin, S. and Fairbrother, P. 2014. Role of social networks in community preparedness for bushfire. International Journal of Disaster Resilience in the Built Environment, 5: 277-291.
2. Aldrich, D. 2012. Building resilience: Social capital in post-disaster recovery. The University of Chicago Press: Chicago.
3. Berkes, F. 2007. Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. Natural Hazards, 41: 283-295.
4. Bird, D., King, D., Haynes, K., Box, P., Okada, T. and Nairn, K. 2013. Impact of the 2010-2011 floods and the factors that inhibit and enable household adaptation strategies. National Climate Change Adaptation Research Facility, Gold Coast, Queensland.
5. Boin, A. 2010. Designing resilience: Leadership challenges in complex administrative systems. In: Comfort, L.K., Boin, A. and Demchak, C.C. (Editors) Designing Resilience: Preparing for extreme events. University of Pittsburgh Press, Pittsburgh, PA. Pages 129-142.
6. Crompton, R.P., McAneny, J., Chen, K., Pielke, R.A. and Haynes, K. 2010. Influence of location, population and climate on building damage and fatalities due to Australian bushfire: 1925-2009. Weather, Climate and Society, 2: 300-310.
7. [EMA] Emergency Management Australia. 2013. National Strategy for Disaster Resilience Community Engagement Framework. Handbook Number 6, Attorney General's Department, Canberra.
8. Folke C., J. Colding, and F. Berkes. 2002. Building resilience for adaptive capacity in social-ecological systems. In: Berkes F., J. Colding, and C. Folke (Editors). Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press, Cambridge, UK.
9. Goldstein, B.E. (Editor). 2012. Collaborative resilience: moving through crisis to opportunity. The MIT Press: Cambridge, Massachusetts.
10. Handmer, J. and Dovers, S. 2013. Handbook of disaster policies and institutions. Routledge: Abingdon, UK.
11. Kaufman, S. 2012. Complex systems, anticipation and collaborative planning for resilience. In: Goldstein, B.E. (Editor). Collaborative resilience: moving through crisis to opportunity. The MIT Press: Cambridge, Massachusetts. Pages 61-98.
12. King, D. 2008. Reducing hazard vulnerability through local government engagement and action. Natural Hazards, 47: 497-508.
13. Morrow, B.H. 1999. Identifying and mapping community vulnerability. Disasters, 23: 1-18.
14. O'Neill, S.J. and Handmer, J. 2012. Responding to bushfire risk: the need for transformative adaptation. Environmental Research Letters, 7, online. doi: 10.1088/1748-9326/7/1/014018.
15. Parsons, M., Glavac, S., Hastings, P., Marshall, G., McGregor, J., McNeill, J., Morley, P., Reeve, I., and Stayner, R. 2016. Top-down assessment of disaster resilience: a conceptual framework using coping and adaptive capacities. International Journal of Disaster Risk Reduction 19: 1-11.
16. Smith, G. 2009. Planning for sustainable and disaster resilient communities. In: Pine, C. (Editor). Natural Hazards Analysis. Taylor and Francis: Boca Raton, FL. pp. 221-247.
17. Thomas, D.S.K., Phillips, B.D., Lovekamp, W.E., and Fothergill, A. (Editors). 2013. Social Vulnerability to Disasters. CRC Press: Boca Raton, FL.
18. [UNISDR] United Nations International Strategy for Disaster Reduction. 2009. UNISDR terminology on disaster risk reduction. UNISDR, Switzerland.
19. Winderl, T. 2014. Disaster resilience measurements. Stocktaking of ongoing efforts in developing systems for measuring resilience. United Nations Development Programme.