Weighting Indicators of Resilience:

Expert Opinions on the New Zealand Resilience Index

Aim

The Trajectories Toolbox of the Resilience to Nature's Challenges Kia manawaroa – Ngā Ākina o Te Ao Tūroa National Science Challenge (RNC-NSC) has been working on the development of the New Zealand Resilience Index (NZRI), which measures place-based community resilience. The index uses a multi-capital model, including indicators of resilience in the built and natural environment, social, cultural, governance[1], and economic domains[2]. However, some indicators of resilience may contribute more to the measurement of resilience outcomes than others. To understand this, we conducted an expert weighting exercise, eliciting the views of resilience and disaster risk reduction academics and practitioners working in New Zealand.

Findings Overview

- A total of 89 academics and practitioners working in disaster risk reduction and resilience in New Zealand participated in the survey.

- Indicators relating to the resilience of the built environment were rated most highly compared to all other resilience capitals.

- Social resilience was the second most highly weighted capital, with indicators of community connectedness and belonging and personal resilience rated as the third and fourth most important indicators.

- Health system response capacity and household economic capacity were rated as equally important.

- Preservation and valuing of heritage and culture was rated as contributing the least to place-based resilience relative to the other resilience concepts, followed by emergency response capacity, the availability of natural buffers and economic sector diversity.

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[1] Including disaster risk reduction indicators.
[2] For a full discussion on the development of the NZRI and the rationale for the included indicators, see Stevenson et al. (2018).

Results

Around 53% of invited participants completed the 1000 Minds survey (n = 89). A further 14 participants started the survey but did not complete it, resulting in a 75% completion rate. The wording and part-worth utilities of the 12 resilience concepts included in the 1000 Minds survey is shown in Table 1. Part-worth utilities reflect the relative importance of each indicator to community resilience as perceived by survey participants. Table 1 shows that, on average, participants felt that *building safety and functionality following a disruption* had the greatest influence on resilience with a derived importance of 11.7%, meaning that it is seen as two and a half times more important as *heritage and culture are valued and preserved*, which had a 4.7% part-worth utility. These part-worth utilities are used to weight the indicators when they are aggregated into a single measure of resilience. For more information on interpreting part-worth utilities see Orme (2002).

Indicators relating to the built environment were ranked as the most important, with *building safety and functionality following a disruption* weighted most highly (11.7%). This was closely followed by *network infrastructure resilience* (11.5%). Indicators related to social and human capital were also rated relatively high, with *levels of community networks and sense of belonging* and *personal resilience capacities of individuals* contributing 11.3% and 10.5% respectively. Indicators in the cultural and natural environment spaces were deemed as contributing less to resilience outcomes than built and social indicators. Experts weighted the item *heritage and culture are valued and preserved* as contributing the least (4.7%), followed by *community access to shelters and welfare* (5.3%), and *availability of natural buffers* (6.2%).

Table 1. Indicators and indicator weights following the expert weighting exercise.

Capital	Indicator	Part-worth utility
Built	Buildings safety and functionality following a disruption*	11.7%
Built	Network infrastructure resilience (roads, electricity, water and waste water)	11.5%
Social	Levels of community networks and sense of belonging	11.3%
Social	Personal resilience capacities of individuals (e.g., education, physical and mental wellbeing)	10.5%
Gov.	Health system response capacity	8.9%
Econ.	Household capacity to cope with economic disruption	8.9%
Gov.	Quality of legislation and plans addressing hazards	8.0%
DRR	Household emergency preparedness	6.7%
Econ.	Economic diversity (businesses from several different sectors)	6.4%
Natural	Availability of natural buffers (e.g., green space, undeveloped flood plains)	6.2%
DRR	Community access to shelters and welfare centres*	5.3%
Culture	Heritage and culture are valued and preserved	4.7%
* indicator not currently included in the NZRI due to a lack of nationally consistent data		

Perhaps one of the more interesting weightings was the comparatively low level of importance given to *community access to shelters and welfare centres*. However, this could be explained by the higher rating of buildings safety and functionality following a disruption

as arguably shelters are less likely to be needed if buildings are safe and functional following an event. It is a reactive rather than a preventative contributor to resilience capacities. The weights of all indicators included in the expert weighting exercise are outlined fully in Table 1.

Method

A total of 170 disaster risk reduction and resilience academics and practitioners working in New Zealand were invited to participate in the expert weighting exercise. Invitees were also encouraged to forward the invitation to those within their network who they thought would be good candidates to participate in the survey. Participants had approximately six weeks to complete the survey, and a reminder email was sent one week following the initial invitation.

The expert weighting exercise was in the form of a survey, which was distributed via 1000 Minds, a Multi-Criteria Decision-Making software developed in New Zealand. This software allows for rapid decision making on the relative importance of multiple criteria quickly and efficiently. Participants were asked to complete a survey through 1000 Minds. The survey required them to indicate which of two alternatives they prefer (or whether they are equal). Figure 1 shows an example of how questions were presented in the survey. 1000 Minds then used these ratings to compute the respective weights for each indicator in the NZRI. For more information on 1000 Minds, including how the weights are computed, see Hansen & Olsen (2008).

Figure 1. Visual of the format of the 1000 Minds survey.

Limitations

One limitation of the process used in the expert weighting exercise was that we were only able to weight the indicators that we currently had data for, or for which we thought we could obtain data (e.g., the sheltering capacity and buildings data). New Zealand's journey toward making data more open and accessible (Internal Affairs Te Tari Taiwhenua, 2011) will, hopefully, allow for the population and inclusion of indicators that are not currently considered in the NZRI. However, these indicators will remain unweighted, which may influence the composition of the NZRI as a result. It must be remembered that the weights of the current 12 indicators are relative to each other. As a result, the inclusion of other indicators of resilience could potentially change the weights dramatically. Once there are more publicly available national datasets that could be utilised in the NZRI, the weighting exercise should be repeated.

One major limitation of the process was the length of the 1000 Minds survey. Participants made an average of 75 decisions taking an average of 13 seconds per decision, meaning that the average time of completion was 16 minutes. Although this may not seem like a long time, the survey required a high level of attention. This may have contributed to survey fatigue and drop-out. However, only 14 participants started the survey and did not complete it (a 75% completion rate), indicating that participants found this a worthwhile task. Unfortunately, the length of the survey could not be reduced due to the need to weight all indicators in the NZRI against each other.

Additional reading

For overviews on the Trajectories Toolbox work with the Resilience to Nature's Challenges National Science Challenge, see the Resilience Challenge Newsletter (December 2018): https://mailchi.mp/6131a8bf1489/8ld0jhlfcr-527741?e=ebfc992470.

For more on the construction of the New Zealand Resilience Index please read our latest paper: Stevenson, J. R., Kay, E., Bowie, C., Ivory, V., & Vargo, J. (2018). The Data Challenges of Monitoring Resilience. In K. Stock & D. Bunker (Eds.), *Proceedings of the Information Systems for Crisis Response and Management Asia Pacific 2018 Conference Innovating for Resilience* 5 – 7 November, Wellington, New Zealand (pp. 153–165). Wellington: Massey University. Available from http://idl.iscram.org/files/joannestevenson/2018/1680_JoanneStevenson_etal2018.pdf.

Acknowledgements

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Reference as: