Testing indicators of resilience for rural communities

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Contents

1. Abstract

The resilience of rural communities – their ability to adapt to change over time – is a concern in itself and for its effects on the agricultural sector. The present pilot study investigated the possibility of using official statistics for the purpose of measuring resilience, and in particular tested the possibility of identifying resilience thresholds for the indicators. The study used community workshops to investigate the drivers of self-reported resilience among residents of four rural communities in New Zealand, and then compared the self-reported ratings against indicators from official data sources. The self-reported ratings of overall community resilience tended to be more influenced by economic and institutional drivers than social, cultural, or environmental drivers. In addition, the overall self-reported resilience ratings tended to match estimations of resilience based on official statistics. It was therefore possible to identify resilience thresholds for these indicators, that is, values of indicators that reflect more and less resilient communities.

2. Introduction

Agricultural policy in New Zealand, as elsewhere, has multiple objectives. One important goal for the sector is strong economic performance, as signalled particularly by the government's stated goal to double the value of primary sector exports by 2030 (Ministry for Primary Industries, 2015). At the same time, the government has announced its Clean Water Package, with the goal of having 90 per cent of rivers and lakes swimmable by 2040 (Ministry for the Environment, 2017). The policy document describes both urban and agricultural drivers of water quality and specifically proposed policies to ameliorate agricultural impacts, such as the exclusion of cattle and pigs from waterways. The Clean Water Package thus provided one example of agricultural policy with an environmental objective. The proposed policy fit with the understanding of the interaction between economic and environment goals – that one major driver of change across conservation values and recreation values is agricultural intensification (Gluckman, 2017). Beyond the economic and environmental concerns, New Zealand is also involved in more general policy initiatives. The United Nations Sustainable Development Goals, for example, include broader goals that will affect agriculture, such as food security and waste reduction.

It can be challenging to integrate economic and environmental goals in agricultural policy, even focusing just on farm management and land use. Moreover, 'sustainability is commonly seen to encompass at least three dimensions, economic, environmental and social sustainability' (Wustenberghs, Coteur, Debruyne, & Marchand, 2015, p. 3). Rural communities are nevertheless facing challenges across all those dimensions (Steiner, 2016).The farmers that manage farms are members of communities; their families are part of schools, churches, and voluntary societies; the farm businesses are part of local economic flows; and the physical farms are part of the landscape and its ecosystems. This social embeddedness in particular has led to public concern recently in New Zealand that the agricultural sector cannot continue to support small towns throughout the country (Spoonley, 2016).

The public concern signals that agricultural policy is a public values problem (Bozeman & Sarewitz, 2011) that has elements of both science and 'trans-science' (Sarewitz, 2016). Carefully and exactly measuring the environmental impacts of agricultural intensification is not likely to provide an answer to the public value problem as the issues are more to do with higher level political trade-offs and values than the precision of our estimation of impacts. Instead, there is a place for participatory processes that bring to the surface some of these public values and begin a conversation about their implications for science research (Bozeman & Sarewitz, 2011). While that type of social science research is likely to be contested, '[a]ny evidence that can be brought to bear on those choices, even when fraught with known methodological limitations, is likely an improvement over intuition, habit, rough-hewn ideology, political self-interest, powerful myths about how the world works, and other such biases that so typically guide investments' (Bozeman & Sarewitz, 2011, p. 13).

The present research was a pilot study to investigate the multiple values or goals associated with agriculture and rural communities. The core concern of the work was to develop an understanding of what 'more resilient' and 'less resilient' might mean with regard to rural communities, and thereby to provide, tentatively, an empirical measure or scale to incorporate resilience into agricultural policy. It is common to talk about community resilience growing or declining (Steiner, 2016), which suggests that resilience can be quantified. Based on this idea, further questions were developed:

- Can resilience be a useful concept for rural communities?
- Can resilience drivers be identified?
- If resilience is validated conceptually, can it be used as an organising framework for multidisciplinary research?
- Is it possible to provide empirical measures of resilience to inform agricultural policy?
- Can official statistics serve as a useful proxy for self-reported resilience?
- Which aspects of resilience most strongly influence community perceptions of resilience?

The pilot study demonstrates a method for addressing these questions. The study obtained two distinct data sets, which are termed *indicators* and *ratings* throughout the paper. The ratings data set was captured in community workshops held in two regions in the North Island where participants rated the resilience of their community on a one to ten scale. The indicator data set consisted of a set of statistics collected from official sources such as Statistics New Zealand. The indicators are not determinative of resilience, but ideally will correlate with it – the indicators are not fundamental causes of towns being resilient or not-resilient but are only measurable signposts that allow policymakers to understand resilience. The research analysed the indicator data and ratings data to investigate the concept of resilience and potential ways to measure it. The findings suggest that there is some utility to the concept and the research method, and also suggest possible ways to extend the work.

3. Literature Review

'Resilience' is seeing more use as a term and a concept, and is commonly understood as the ability to recover from a disturbance (Salt, 2016). The current use in research and policy derives from four main research areas: psycho-social, ecological, disaster relief, and engineering (Salt, 2016; Steiner, 2016). Resilience captures two somewhat different ideas. One is the idea that a system can 'bounce back' from a disturbance and recover to its prior state, while the second idea is about adapting to change while retaining essential features of its previous identity (Salt, 2016; Steiner, 2016; Mackay & Petersen, 2015).

At a community level, resilience involves the 'ability of groups of communities to cope with external stresses and disturbances as a result of social, political, and environmental change' (Wilson, 2012; Adger, 2000). One hypothesis regarding community resilience is that there are tipping points or thresholds: if a system is pushed too far, it cannot 'bounce back'. The idea has foundations in the environmental literature, which suggests that there are limits to ecological systems, such as the safe level of greenhouse gases in the atmosphere or the consumption of freshwater (Rockstrom, et al., 2009). Beyond those limits, ecological systems can have tipping points that lead to qualitatively different states (Lenton, et al., 2008). The hypothesis is that there 'are limits to how much a self-organising system can be changed and still recover. Beyond those limits it functions differently because some critical feedback process has changed. … The system's identity changes when a threshold is crossed' (Salt, 2016). The idea of threshold effects becomes even more complicated when resilience, like sustainability, is seen as multi-dimensional. If resilience has economic, environmental, social, and other dimensions, then it is possible that thresholds are similarly multi-dimensional. This concern is the focus of Georgescu-Roegen's critique of economic modelling (Daly, 1997): that there is a minimum requirement for natural resources and no amount of built capital can fulfil that requirement.

Although 'community', like 'resilience', is a contested term, a spatial understanding of rural communities can be useful for collecting data on resilience (Wilson, 2010; Robinson & Carson, 2015) and for research on the future of rural areas (Spoonley, 2016). Viewed that way, 'community' is a term for the social system interactions that occur within a defined location (Wilson, 2010; Cutter, et al., 2008). While this approach does not resolve the issue around the term 'community', it provides something of a definition as well as a pragmatic approach (Wilson, 2012). The research approach aligns with discussions of how to do research when to tackling complex and interdisciplinary research (Bammer, 2013; Sarewitz, 2016).

Resilience is conceptually linked to sustainability, in that sustainability means that people, social systems, and institutions are all meant to be resilient to disturbances (Kates, Parris, & Leiserowitz, 2005). Another example of the close links between the two concepts comes from a network of agricultural researchers: 'The TempAg research collaboration on sustainable temperate agriculture aims to deliver resilient agricultural production systems at multiple levels' (Wustenberghs, Coteur, Debruyne, & Marchand, 2015, p. 1). These and other examples suggest that sustainability and resilience are bound up with each other, although they also appear to capture differences that are meaningful to the researchers.

Sustainability as a concept has been criticised as meaning different things to different people (Kates, Parris, & Leiserowitz, 2005). 'Sustainable development has broad appeal and little specificity' (Parris & Kates, 2003, p. 559). More recent work has added concreteness and specificity. For example, the United Nations Sustainable Development Goals can be considered concrete descriptions of sustainable environments and societies, such as 'universal clean energy' and 'food security' (Griggs, et al., 2013). These broad goals are being given further precision with targets and measurable indicators (UN Inter Agency and Expert Group on Sustainable Development Goal Indicators, 2016). Conceptually, 'sustainability science is a field defined by the problems it addresses rather than by the disciplines it employs' (Clark, 2007).More generally, researchers have been working on distilling practical advice on sustainable development from the experience of different researchers and projects (Clark, van Kerkhoff, Lebel, & Gallopin, 2016), such that 'sustainability' becomes defined by its programme of work.

The same criticisms of lack of specificity and meaning can be levelled at resilience: it is appealing to think of a system returning to its previous functioning, but every definition uses more terms that themselves need defining. What does it mean for a community to 'function', and what is a community's 'identity' whose change signals that a threshold has been crossed? One approach to the lack of specificity is to agree on goals, targets, and indicators (Parris & Kates, 2003). This approach to quantification applies to both sustainability and resilience (Whitehead, et al., 2016). Indicators add more precision to the concepts, by defining what needs to be sustained or developed and over what time period (Kates, Parris, & Leiserowitz, 2005). The use of indicators to understand non-specific or contentious concepts and to add specificity to research is not new. In the 1970s and 1980s, analysing social indicators was an approach to using quantitative data to 'go beyond purely economic concerns and enlarge their scope in the direction of social well-being or the quality of life' (Young & MacCannell, 1979, p. 23). This sort of 'macrosocial accounting' gave researchers a tool for understanding the interactions of economic and social drivers in communities (MacCannell, 1988).

Although indicators may be useful, they are also problematic. First, they are contentious at a conceptual level. Mahon, et al. (2017) assessed whether the term 'sustainable intensification' was being used as cover for agricultural systems that had productivist orientations. They identified a number of schemes and investigated the indicators suggested by the schemes. The outcomes indicators identified included both production-oriented ones, such as yield per hectare, and non-productivist indicators, such as animal welfare and gender equity. They found that indicators supported both production and sustainability, suggesting that while the term 'sustainable intensification' was conceptually ambiguous, it was also broad enough to support a number of different goals. A second problem with indicators, even if designed around clear concepts of resilience or sustainability, is that many are also ambiguous or unclear (Mahon, Crute, Simmons, & Islam, 2017). Some indicators may suffer from ambiguity in their definitions; a classic problem is defining who a 'farmer' is. Other indicators have different meanings in different places: an increase in irrigation in one place may signal increased resilience, while it could signal increased fragility in another (Mahon, Crute, Simmons, & Islam, 2017). However, modifying indicators to suit the local conditions has its own issues. It may be fairer to take local conditions into account rather than insist on universal application, but 'local tuning' has implications for comparability and aggregation at

other scales (Whitehead, et al., 2016). Finally, there are many sustainability frameworks and schemes. For example, Wustenberghs, et al. (2015, p. 2) 'compiled an inventory that currently contains 170 sustainability frameworks, metrics and tools'. The inventory contained a number of different scoring systems for the indicators, with different approaches to comparability and verification. Furthermore, across these multiple frameworks and indicators, consistency can be elusive. Olde, et al. (2016) reported 'a lack of consensus amongst experts about what constitutes reliable knowledge and useable datasets for assessing sustainability' (p. 13). The experts did not even agree about how to evaluate the sustainability indicators used to evaluate farming systems. For example, on whether it was important that something be 'easily communicated', expert opinion ran the whole gamut of the 11-point 'importance' scale (Olde, et al., 2016).

Despite these issues, the idea of community resilience has motivated empirical research. Fielke & Srinivasan (2017) provided an example of applying the concept of community resilience meaningfully in assessing a specific case study in a particular location. Their use of the concept of community resilience – whatever its weaknesses and contentious nature – suggested that 'we can know far more than the skeptic says we can know and far less than the dogmatist or the mystic says that he can know' (Chisholm, 1982, p. 62). In addition, some of the issues with resilience and indicators arise from a lack of agreement among researchers and stakeholders. However, it is not clear that focusing on fostering agreement, whether among experts or among community members, is necessarily helpful for achieving sustainability in the long run or even deciding today what sustainability looks like tomorrow. As Arrow (1950) demonstrated mathematically, there is no consensus ordering possible for a social group with heterogeneous preferences.

The present research did not try to resolve the conceptual issues of resilience or achieve *a priori* consensus on appropriate indicators. Using the language of Binder, Feola, & Steinberger (2010), it focused less on the 'normative' dimension that concerns the link between indicators and the concept of sustainability. Instead, the focus was on the 'systemic' dimension, which considers both parsimony and sufficiency: do the indicators adequately reflect resilience without too much complexity. It also incorporated the 'procedural' dimension by considering replication and consistency as well as the participation of stakeholders. To do this, the research started with a framework reported in Fielke, Kaye-Blake, & Vibart (2017). The framework can be presented in a diagram, as shown in Figure 1. Building on prior research, such as the Community Capitals Framework (Emery & Flora, 2006), the resilience framework covers cultural, environmental, institutional, economic and social dimensions of resilience, as well as external factors or drivers affecting a community. Although all these dimensions have been included in prior research, it is not uncommon for indicators schemes to focus mainly on economic, environmental, and social indicators (Wustenberghs, Coteur, Debruyne, & Marchand, 2015) because they are central to the concept of community resilience. Each of the five dimensions (excepting the external dimension) is presented as a wedge of a circle, and each wedge can be larger or smaller. Together, the wedges make a single, circular area, which represent the resilience of a particular community.

The framework diagram explicitly incorporates three ideas about resilience. The first idea is that resilience can be quantified, at least to the extent that it can be represented as an area on a diagram. Furthermore, each resilience dimension can be quantified separately, so that, for

example, social resilience can be meaningfully separated from economic resilience. The second idea is that total resilience is a function of the separate dimensions of resilience. For the purpose of the diagram, total resilience is the coloured area, and it is made up of the wedges for each of the five resilience dimensions. This presentation suggests that, to some extent, it is possible to substitute one dimension for another. A bit more environmental resilience with a bit less cultural resilience can still produce the same overall area on the diagram; the suggestion is that it also produces the same overall resilience in the community. Finally, the third idea incorporated into the diagram is that of thresholds. An inner dashed-line circle denotes a minimum necessary level for each resilience dimension. The concept, as discussed above, is that communities must have a minimum level of each dimension in order to be resilient overall.

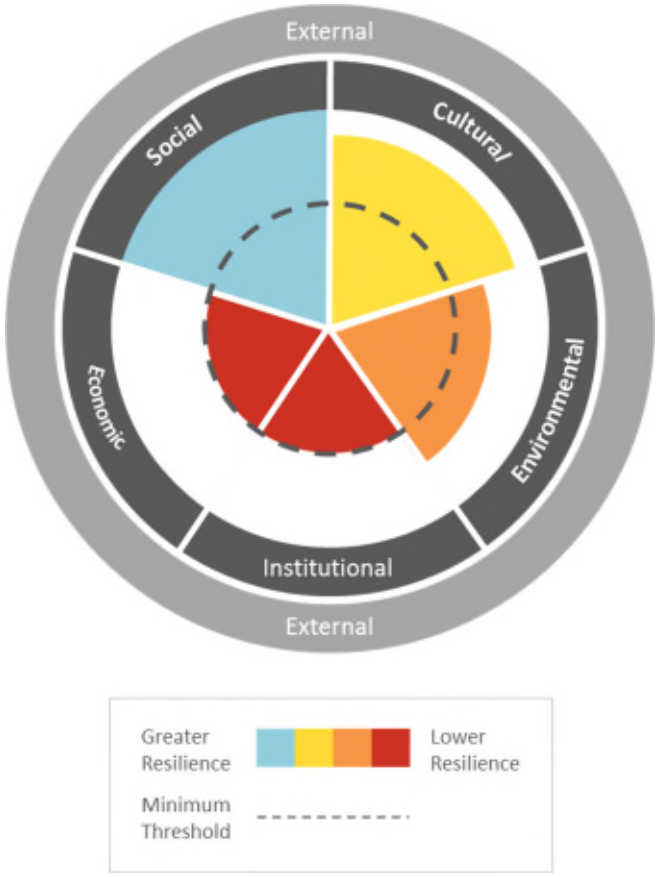


Figure 1 Resilience Framework

The resilience framework provided structure to the present research and a way to organise the data from official sources and community workshops. As explained in the following section on method, the individual resilience dimensions were tested for links between self-reported ratings and official data, and links between the dimensions and overall community resilience were also investigated. The analysis demonstrated how to use indicators to add specificity to the concept of resilience, and even to inform a discussion about minimum thresholds for these indicators (Parris & Kates, 2003).

4. Method

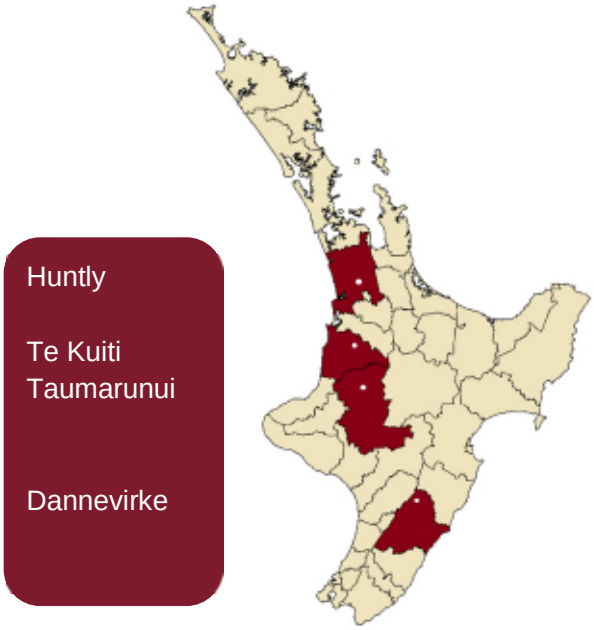
Choosing the locations for the project

The first step in the method was to choose locations for study. To identify possible towns, a list was developed of all the population centres in New Zealand with a population of between 2,000 and 10,000 people. The population figures were taken from Statistics New Zealand's population estimates for minor urban areas[1] as of June 2016. The exercise identified 67 possible rural communities. The list was refined by narrowing the range of towns to between 4,500 and 10,000 people, resulting in a list of 32 towns. In order to ensure that representative data would be available on the towns selected, the ward boundaries were matched against town boundaries for the towns on the short list since wards are Statistics New Zealand's smallest area unit for publishing census statistics. The concern was to establish for each town whether most of the population was contained in one or two central wards or was more dispersed, since dispersed communities would be difficult to match workshop data to official statistics spread over many units, or where perceptions of a community's resilience may vary over a wide area within a community. The result was a short list of 15 towns where the population within the town matched closely to the population within a well-defined ward. Finally, a wider group of researchers, including university researchers in community resilience, was consulted on the short list.[2] Four towns were chosen from the short list based on the research group's expert judgement, a paired-sample case study design involving four towns in two regions, and perceptions of two of the towns being resilient (Huntly and Dannevirke) and two being less resilient (Te Kuiti and Taumarunui). The towns are in two regions in the North Island of New Zealand, Waikato and Horizons. The location of the four towns are shown in Figure 2 below.

[1] http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7541#

[2] Researchers consulted were: AgResearch – Margaret Brown, Ronaldo Vibart, Robyn Dynes, Alec Mackay. Lincoln University – Michael Mackay. Others – Meredith Niles, Willie Smith.

Figure 2 Locations of the four towns



Indicator data from official sources

The next step in the research was obtaining official data. Data were collected to compare the four towns in two regions: Waikato towns of Huntly and Te Kuiti and Horizons towns of Taumaranui and Dannevirke. To help with calculating benchmarks, New Zealand national statistics were also gathered. The information was obtained from Census statistics at the Territorial Authority, District and Regional Council levels (Stats NZ, 2017a; Stats NZ, 2017b), from Regional Council websites and reports (Horizons Regional Council, 2013; Horizons Regional Council, 2014; Waikato Regional Council, 2015), as well as Ministry for the Environment statistics (Ministry for the Environment, 2015). All data informing social, economic and cultural indicators were collected from the territorial ward boundaries that spatially covered the entire town boundaries. These Wards, Districts and Regional Councils are shown in Table 1 for each town. Descriptive statistics on each town are included in Appendix A.

Table 1: Wards, districts and regional councils covering towns included in study

Town	Wards	District	Regional Council (RC)
Huntly	Huntly East Huntly West	Waikato	Waikato
Te Kuiti	Te Kuiti	Waitomo	Waikato
Taumaranui	Tarrangower Taumaranui Central Sunshine-Hospital Hill Manunui	Ruapehu	Horizons
Dannevirke	Dannevirke East Dannevirke West	Tararua	Horizons

As conceptualisations of community resilience transcend disciplinary silos it is important to clarify what is meant by the dimensions of community resilience. Table 2 highlights the dimensions of community resilience that have been utilised in previous work in the space, with a particular focus on research that has focused on ongoing characteristics of resilience as opposed to rapid onset, post-hazard characteristics (McCrea et al., 2014; Ross and Berkes, 2014; Steiner and Atterton, 2014; Wilson et al., 2016). The dimensions in Table 2 indicate those subsequently utilised in the framework developed here. For each dimension, appropriate and obtainable data was required in the form of indicators. Indicators used and other studies that have used them are noted in Table 3.

Table 2: Dimensions of community resilience and the studies utilising these conceptualisations

Dimension	Studies utilising
Economic	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Sherrieb et al. (2010); Wilson (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
Environmental	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Wilson (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
Social	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Magis (2010); Sherrieb et al. (2010); Wilson (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
Institutional	Cutter et al. (2008); Buikstra et al. (2010); Maclean et al. (2014); Bailey and Buck (2016)
Cultural	Kirmayer et al. (2009); Buikstra et al. (2010); Magis (2010); Wilson (2012)
External	Cutter et al. (2008); Magis (2010); Wilson (2012); Skerratt (2013)

Table 3: Indicators of community resilience utilised in the RRC framework and level of data obtained including previous studies utilising these specific indicators

Dimension	Indicator/question to ask	Data level obtained*	Studies utilising
Economic	Income	Ward	Cutter et al. (2008); Kirmayer et al. (2009); Wilson (2010); Wilson (2012); Maclean et al. (2014); Steiner and Markantoni (2014); Akamani and Hall (2015)
	Employment levels	Ward	Cutter et al. (2008); Buikstra et al. (2010); Sherrieb et al. (2010); McManus et al. (2012); Wilson (2012); Steiner and Markantoni (2014); Akamani and Hall (2015)
	Diversity of income streams	Ward	Magis (2010); Sherrieb et al. (2010); Wilson (2010); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
	Diversity of occupations	Ward	Cutter et al. (2008); Sherrieb et al. (2010); Wilson (2012)
Environmental	Fresh water quality	RC	Cutter et al. (2008); Kirmayer et al. (2009); Wilson (2010); Wilson (2012); Bailey and Buck (2016)
	Soil erosion	RC	Cutter et al. (2008); Kirmayer et al. (2009); Wilson (2010); Wilson (2012);

			Akamani and Hall (2015); Bailey and Buck (2016)
	Biodiversity	RC	Cutter et al. (2008); Wilson (2010); Wilson (2012); Akamani and Hall (2015); Bailey and Buck (2016)
	Air quality	RC	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Wilson (2010); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015)
Social	Population change	Ward	Wilson (2012); Akamani and Hall (2015); Bailey and Buck (2016)
	Education levels	Ward	Buikstra et al. (2010); Wilson (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
	Dependency ratio[3]	Ward	Cutter et al. (2008); Kirmayer et al. (2009); Magis (2010); Wilson (2012); Maclean et al. (2014); Bailey and Buck (2016)
	Volunteering	Ward	Kirmayer et al. (2009); Magis (2010); Wilson (2010); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
	Access to phone	Ward	Cutter et al. (2008); Buikstra et al. (2010); Magis (2010); Sherrieb et al. (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
	Access to internet	Ward	Cutter et al. (2008); Buikstra et al. (2010); Magis (2010); Sherrieb et al. (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
Cultural	Māori affiliated	Ward	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Magis (2010); Wilson (2010); McManus et al. (2012); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
	Te reo speaking	Ward	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Magis (2010); Wilson (2010); McManus et al. (2012); Wilson (2012a); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)

[3] The dependency ratio is the proportion of people of working age (15-65) in the population.

	Born overseas	Ward	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Magis (2010); Wilson (2010); McManus et al. (2012); Wilson (2012a); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)
	Religious affiliation	Ward	Cutter et al. (2008); Kirmayer et al. (2009); Buikstra et al. (2010); Sherrieb et al. (2010); Wilson (2012)
Institutional	Self-rated health	RC	Magis (2010); Wilson (2010); Wilson (2012); Akamani and Hall (2015); Bailey and Buck (2016)
	Court convictions	Local court	Sherrieb et al. (2010); Wilson (2010); Wilson (2012); Maclean et al. (2014); Bailey and Buck (2016)
	Local voting percentage	District	Sherrieb et al. (2010); Wilson (2010); Wilson (2012); Maclean et al. (2014)
	State owned houses	Ward	Cutter et al. (2008); Magis (2010); Wilson (2012); Maclean et al. (2014); Akamani and Hall (2015); Bailey and Buck (2016)

**RC = Regional Council*

After gathering the data available at the lowest spatial levels possible for each township (see Table 3), an index for each variable was developed to consolidate the different measures. The resulting index key is presented in Table 4. It allowed for the averaging and comparison of indices across townships and to the National indices. To produce the categorisation for each of the variables, the range was set for the whole of New Zealand as it was necessary to compare to national benchmarks. The subdivision of the range into five categories was considered in light of the variation in the data between the four towns and the national measure. The categories were divided evenly to achieve some form of variation in the data to show meaningful differences. If expanded to other areas, particularly urban communities, the averages of the rural towns will likely be much more similar and require either new subdivision ranges, which would likely result in these towns falling into the same index categories, or the expansion of the scale to elucidate the larger variation in measures (perhaps from a 1-5 scale to a 1-10 scale)."

Table 4: Index key converting variables to a number between 1 and 5, where 1 = most vulnerable and 5 = most resilient

Categorical value:	**1**	**2**	**3**	**4**	**5**
Social indicators[4]					
Annual Pop. Change (2006-2013) %	loss of 2% or more	loss of under 2%	stable or growing less than 1%	1.01-2% growth	2.01% growth or more
Dependency ratio	70% or more	60-69.99%	55-59.99%	50-54.99%	less than 50%
Education level (finished secondary) %	less than 40%	40-49.99%	50-59.99%	60-69.99%	70% or more
Education level (finished tertiary)%	less than 5%	5-9.99%	10-19.99%	20-29.99%	30% or more
Access to phone %	less than 60%	60-69.99%	70-79.99%	80-89.99%	90% or more
Access to internet %	less than 50%	50-59.99%	60-69.99%	70-79.99%	80% or more
Volunteering (%)	0%	0.01-5%	5.01-10%	10.01-20%	20% or more
Economic indicators					
Unemployment rate %	15% or more	10-14.99%	7-9.99%	3-6.99%	less than 3%
Median income	less than $20000	$20001-22,500	$22501-27500	$27501-34999	more than $35000

[4] Ranges were established by examining the variation across rural communities and dividing the range into five categories. If a greater range of communities is included, the values associated with each variable will need to be adjusted accordingly.

Industry diversity ANZSIC06 no industries employing over 10% of workers	7	5 or 6	3 or 4	1 or 2	0
Occupation diversity ANZSCO count of occupations with over 20% of workers	4	3	2	1	0
Cultural indicators					
Spiritual affliation %	less than 40%	40-44.99%	45-49.99%	50-59.99%	60% or more
Māori % population	less than 15%	15-25%	25.01-35%	35.01-45%	45.01% or more
Te reo %	less than 5%	5-10%	10.01-15%	15.01-25%	25.01% or more
Born overseas %	less than 10%	10-15%	15.01-20%	20.01-25%	25.01% or more
Institutional indicators					
Court convictions (local court per capita Census pop %)	5% or more	3-4.99%	2-2.99%	1-1.99%	less than 1%
Local election voter turnout (district) 2016 %	less than 30%	30-34.99%	35-39.99%	40-49.99%	50% or more
State owned households 2013 %	20% or more	15-19.99%	10-14.99%	5-9.99%	less than 5%
Self rated health (regional council) 2012 poor %	20% or more	15-19.99%	10-14.99%	5-9.99%	less than 5%
Environmental indicators					
Soil erosion ton/year/person 2012/3	75 ton or more	50-74.99 ton	25-49.99 ton	10-24.99 ton	less than 10 ton
Indigenous vegetation cover % 2012/3	less than 10%	10-19.99%	20-24.99%	25-29.99%	30% or more

Air quality exceedances MfE state of our air (% of sites exceeding 2 day PM10 concentration) 2012	more than 50%	25.01-50%	10.01-25%	0.01-10%	0
Bacteria (E.Coli) indicator comparing sites in NZ	worst 25%	worst 50%	median	best 50%	best 25%

There were two key issues with the raw data available and calculating accurate township resilience dimensions and overall resilience indices: data inconsistency and spatial incompatibility. The data inconsistency issue arose particularly with obtaining appropriate data on environmental and institutional dimensions. All other dimension indicators were also somewhat restricted in terms of the variables that were available within Census data. That said, the social, economic and cultural indicators used, although at times quite crude, were at least representative of local townships with the same geographical boundaries and at the same point in time (during 2013 Census collection). On the other hand, the environmental and cultural indicators were less reliable, with varying time periods and boundaries. The data inconsistency highlighted an important problem in obtaining and producing accurate measurements of community resilience. The spatial incompatibility arose from the different spatial scales used for different data. As the 'data level obtained' column in Table 3 highlights, there are variations across the variables in terms of the spatial level at which data are available. For instance, all of the environmental indicators were only available at the regional council level and the data varied over time periods. Similarly, court convictions were registered at the local court in each town but included different judicial boundaries to the ward boundaries for which Census data were available. Local voting percentages were also at best available at the district level. The implication was that the data are not completely reliable or comparable across the resilience dimensions.

Ratings data from community workshops

The other source of data for the research was workshops held in the four towns. To obtain data on the perceived resilience of towns, workshops were held in each of the four selected towns. Participants from a wide variety of backgrounds were invited. Invitees were those likely to have a view on the resilience of the local community, including local government representatives, church leaders, medical practitioners, social workers, local businesspeople, iwi, farmers and teachers. Participants were invited to contribute in their professional capacities and therefore ethics approval was not required. In all, 24 people attended across four workshops. Of those, 22 people remained to the end of the three-hour workshops and provided quantitative data.

An example agenda for the workshops is provided in the appendix. In each workshop, the facilitators introduced the project and engaged participants in a collaborative activity eliciting qualitative responses from them about the town's resilience across four key questions:

- What about your town are you proud of?
- What about your town makes you happy to live there?
- What long-term trends are worrying you about your town?
- What issues are causing problems in your town right now?

Out of the discussion participants provided a description of the issues and strengths in their town. Figure 3 provides an example of qualitative data gathered at one workshop.

Figure 3 Example of qualitative data from workshop

The four questions proved to be useful for starting conversations and encouraging participants to talk about the positive and negative aspects of their towns. From these issues and strengths, workshop facilitators led discussions to elicit more detail from participants about the issues and how they have grown or been addressed over time. Facilitators also categorised the issues using the five resilience dimensions (economic, social, cultural, institutional and environmental). Where one or more dimensions had not been discussed or covered in sufficient depth, they directed discussion to elicit more information on participants' perceptions of the town with respect to those dimensions.

The workshops then included an activity focused on official indicator data about the towns. Information was provided on two to four indicators for each resilience dimension. Data were provided on a selection of the indicators for each town, from the indicators in Table 4. Given the workshop format and focus on participation, the indicators were provided in a 'pub quiz' format rather than a presentation. For each indicator, participants were asked to estimate the value for their town, with points awarded for providing the answer closest to the actual value. This approach had the added benefit that participants ended up discussing whether they were more pessimistic or more optimistic about their town than the official data would suggest.

Following the quiz, participants were asked to rate the resilience of their towns and their regions on a scale of 1 (least) to 10 (most). They were asked to rate each of the five resilience dimensions for the town and region, and as well to provide a rating of overall resilience. Figure 4 shows the output from one of the workshops. Red dots were used for the resilience ratings of the town and blue dots for the resilience ratings of the region.

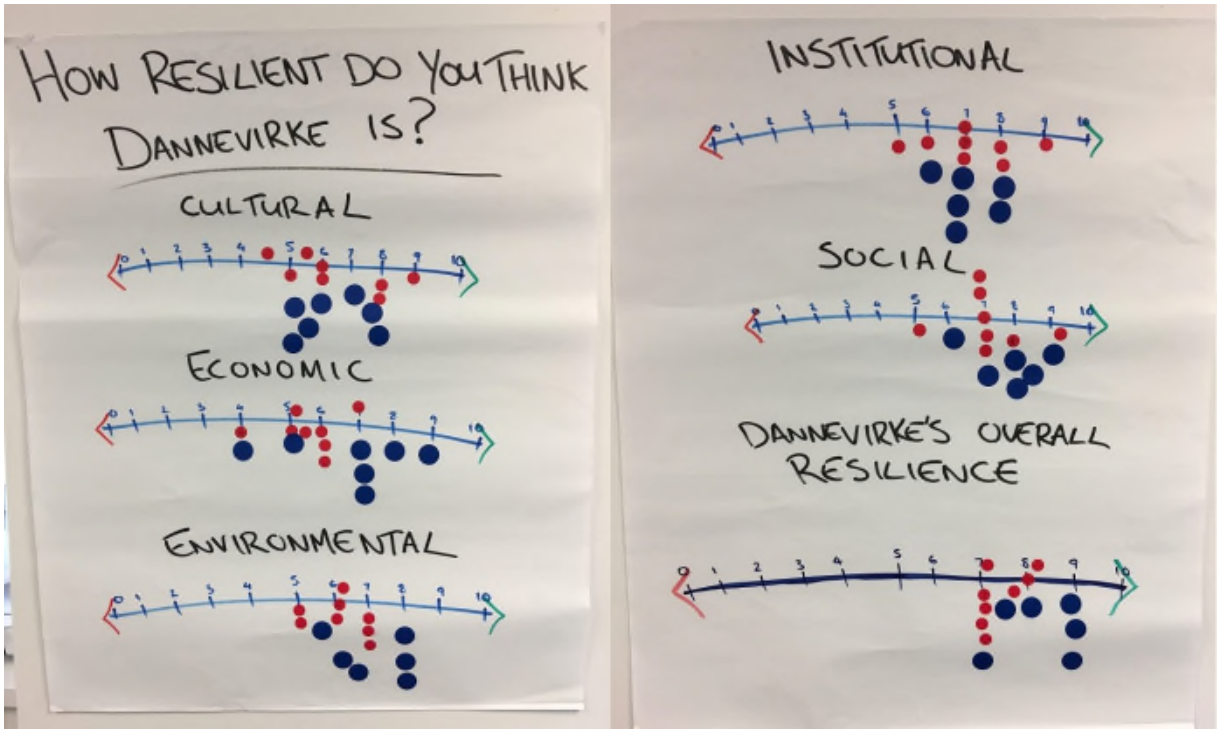


Figure 4 Example of resilience data collected

The ratings were followed by further discussion, highlighting points where participants had diverging views or where their view of the region was very different from the view of the town. The workshop was then closed with a small token of appreciation for participants' time (a $20 fuel voucher), and a brief explanation of the next steps of the project.

Different numbers of people attended the workshops in each town. While a large number of people were invited to each workshop, participation varied between towns as shown in

Town	**Number of participants**
Huntly	4
Te Kuiti	6
Taumarunui	4
Dannevirke	8

Method for data analysis

One aim of the research was to test whether it is possible to predict the resilience of a town from a set of indicators. Ultimately, resilience was to be treated as a binary variable where a town is either resilient or not-resilient. The goal was to investigate whether it is possible to find a threshold between being resilient and being not-resilient. The research obtained two distinct data sets – indicators and ratings. The indicator data set consisted of the statistics collected from official sources such as Statistics New Zealand, as described above (raw data are provided in Appendix A). The ratings data set consisted of the subjective ratings given by the workshop participants from each town. Each of these ratings was between zero and 10 for their town for each of the five dimensions and overall resilience. Analysis was performed using the statistical package R[5]. Generally, the significance and goodness-of-fit statistics were calculated and reported. Conventionally, a p-value of 0.05 is used to determine the variables that are significant to the outcome. It is improper, however, to draw any conclusions about statistical significance from this pilot study due to the small sample size. Instead, the p-values and goodness-of-fit statistics were used as a guide for assessing the variables relative to each other.

For the indicator data set, indicator scores for each dimension were developed. The scores were a composite of several indices. First, the raw statistics were turned into a value on a scale from one to five. Next, the index for each dimension was calculated by taking the mean of those scores (on the five-point scale) for the indicators in that dimension. The overall index for each town, in turn, was calculated by taking the mean of the indices for all five dimensions. In this way, the overall indicator score was simply an average that took into account all five resilience dimensions equally. The rating of overall resilience given in the workshop, however, was simply a rating out of ten given by each attendee. The overall resilience rating from the workshops, therefore, was not a mathematical average of the ratings for each dimension but a rating provided independently by participants.

The table below outlines the statistical tests that were carried out, the variables that were tested and the type of model used.

[5] https://cran.r-project.org/

Table 5. Summary of tests conducted

Test	Number of models in test	Dependent variable	Independent variables	Type of model
Test 1	1	Workshop ratings – overall resilience	Workshop ratings – each dimension	Linear model
Test 2	5	Workshop ratings – each dimension and overall resilience	Indicators – indices for each dimension and overall resilience	Linear models
Test 3	15	Workshop ratings – social, economic, cultural and institutional dimensions	Indicators – values of each indicator in social, economic, cultural and institutional dimensions	Linear models
Test 4	15	Workshop ratings – overall resilience	Indicators – values of each indicator	Linear models
Test 5	16	Binary resilience	Workshop ratings – overall resilience Indicators – values of each indicator	Logit models

Most of the analysis focused on investigating the relationships between the two data sets. It started out, however, with a simple analysis to test the relationships within the ratings data set. For the indicator data set, the overall index scores for each town's resilience was simply an average of the indices for each dimension. However, for the ratings data set, participants provided separate information on the overall ratings of resilience. Data analysis investigated how the workshop ratings for each dimension were related to their overall assessment of resilience.

Linear regression was used to model the relationship between the dependent variable and one or more explanatory variables. Multiple linear regression was used to test which of the dimensions were significant predictors of overall resilience and whether the set of dimensions did a good job of predicting the overall resilience ratings. In this test, the dependent variable was the overall ratings of resilience and the explanatory variables were the ratings on dimensions of resilience. Multiple

linear regression was used to understand the dimensions that people felt were most important to overall resilience.

The next step in the analysis was to test whether there was any relationship between the self-reported ratings and the indicators based on official statistics. For all analysis between the two data sets, the ratings were used as the dependent variable and the indicators were used as the independent or explanatory variables. These models tested whether the indicator data could be used to predict resilience based on residents' subjective ratings. The first test was of the relationship between the ratings and the indices for each dimension of resilience. Simple linear regression was used to test this relationship, with one regression for each dimension as well as overall resilience. The p-value for each of these regressions was noted to evaluate which dimensions were better for predicting the ratings.

To investigate this further, the relationships between the ratings for each dimension and the individual indicators within the respective dimensions were tested. Due to the small sample size, it was not possible to use multiple linear regression to test these relationships. As a result, simple linear regression was used, with one regression for each indicator. This test was used to observe which indicators were better for predicting how residents rated the dimensions of resilience for their town.

The next stage of analysis was centred on answering the key question of whether indicators can be used to predict overall resilience. First, the relationship between the indicators and the ratings of overall resilience was examined. Again, the small sample size meant that each indicator had to be tested individually against the overall ratings. This meant the models were more efficient, however the estimates given in the model are likely to be biased. Simple linear regression was performed, with one regression for each indicator. This test showed which indicators were better predictors of the overall resilience ratings.

While the linear regression was useful, it did not allow for a threshold to be calculated between resilient and not-resilient. The ratings from the workshop were simply judgements of the level of resilience rather than a categorisation of the town as resilient or not-resilient. In order to test whether a town was resilient or not-resilient, a binary resilience variable was required. A new resilience variable was created such that $y = \{0, 1\}$, where $y = 1$ for a resilient town and $y = 0$ for a non-resilient town. Based on the expert judgement of the wider research group, two of the towns in the study were designated resilient (Huntly and Dannevirke) and two were designated not-resilient (Te Kuiti and Taumarunui). This judgement was supported by the overall ratings from the workshops which rated Huntly and Dannevirke's resilience higher than that of Te Kuit or Taumarunui. The binary resilience variable was used to perform logistic regression on the relationship between the indicators and whether a town is resilient or not-resilient. Logistic regression was used to calculate likelihood of a town being resilient based on the value for each indicator. The models showed how well each indicator predicted the likelihood that a town is resilient. For selected indicators, the logistic model was used to estimate the odds and probability that a town was resilient for the range of values of the indicator. Using this model, a threshold of resilience was found for each indicator. The threshold used in this analysis was the point where the

probability that a town is resilient was greater than 0.5, however different thresholds could be used. This approach revealed the range of values for each indicator at which the likelihood that a town is resilient was greater than half. These values could be used to categorise the towns as either resilient or not-resilient, based on single indicators.

Limitations of the resilience data

The ratings data from the workshops had limitations. The data were, at root, ordinal data specific to each person and resilience dimension. In the research, there was no attempt to understand what specific ratings meant to participants, such as what a '5' or a '6' meant about resilience. There was also no attempt to standardise ratings across participants, or, in fact, across dimensions. Future research could consider approaches to standardizing this data. Nevertheless, the analysis assumed that the ratings are interval data, and that the scales can be compared across participants (and towns) and dimensions. These assumptions could be challenged. Another limitation of the data was the small sample size, both in terms of number of towns and number of participants per town. Partly, the small sample size is a function of the nature of the method, which included engagement with town residents and qualitative data collection. The small size is also due to the pilot nature of the study.

5. Results

Issues raised by workshop participants

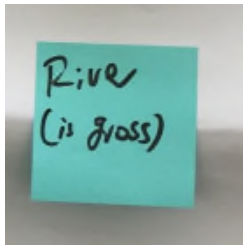


Figure 5 Water as an issue in Huntly

During the workshop discussions, participants raised a number of issues affecting their towns. Across the four towns there were some common themes. The majority of common concerns related to economic or institutional issues. One common concern was employment. Participants were concerned with the availability of jobs in their town, citing declining industries that had closed over a number of years such as mines, freezing works or milling. Related to this was a lack of opportunity for youth also commonly cited as a concern. This was leading to young adults leaving town when they had the opportunity and others joining gangs or not seeking work. A second, related concern was the narrow economic base of each town. Specific aspects of this concern included being heavily dependent on agriculture, losing industries that had been important or explicitly wanting more economic diversity. A third common concern was a lack of understanding from central government of how issues worked in the regions. Participants said that central government did not like to operate at the small scale necessary to effect change in smaller towns, which often meant issues went unaddressed. One example provided was of a dysfunctional family not being prioritised for support by a central government agency, when the local view was that a few individuals were having significant impacts on the town. Participants said that a change in that family could have had wider beneficial effects but central government was not willing to operate on that basis. Another example given was of a social sector trial with a church group working with at risk youth in holiday programmes. The trial was apparently very successful and participants said that because it was so

successful central government withdrew funding for the programme on the basis that it was worthwhile for the community to fund it themselves. A fourth issue raised was water (see Figure 5). Participants commonly had concerns about the governance of water in their region. However these concerns varied from place to place with some communities concerned about the limits placed on them by environmental regulations, with others concerned about the poor/hazardous quality of local waterways.

The majority of towns felt they have significant strengths in cultural and social aspects of resilience. One advantage cited repeatedly was local iwi. Local kohanga reo (immersion schools), marae or treaty settlements were discussed as making participants proud of or happy about their towns. Strong involvement of Māori in local communities was felt to be a major positive influence in the rural communities in the study. Treaty settlements were being invested in local communities and participants generally spoke very positively about iwi's role in the community. A second strength in the communities was local schools. Participants in all four towns talked about the strength of their schools as a positive aspect to living in their community. For example, participants said that the local high school in Huntly also includes Academies for students to gain skills in particular industries. According to the school, the Academy courses are recognised by relevant tertiary institutions and teach practical, employable skills in primary industries, hospitality and tourism, trades (wood and metal work in particular), services and outdoor education. Finally, the workshops discussed the value of community. Many of the participants spoke of a supportive community spirit among residents. The community was often described as tight-knit, welcoming and friendly. A strong sense of community where people support each other was often described by participants as a major strength of living in a rural community.

Each workshop also brought to the surface different issues or concerns. These more town specific concerns mirrored the importance of economic and institutional issues seen in the common concerns but occasionally also included social or environmental issues. Participants in the workshop in Huntly talked about two themes predominantly: the severe social deprivation occurring in the town now, and the huge potential the town had for social and economic success given its natural advantages. Social deprivation issues were described as severe in Huntly. Participants said that gentrification in Raglan and Auckland had led to poorer people moving into Huntly to avoid higher housing costs. While Huntly is close to both Auckland and Hamilton, public transport services are not sufficient to provide opportunities for the poorest to easily get work or training in the city. Facilitators were told that for many of the surrounding communities in Huntly, there are no public transport options to the city. Intergenerational poverty and family dysfunction are major issues, particularly for youth in Huntly. At the same time, some participants were optimistic and believed that Huntly has many opportunities it could be making more of. Its location and infrastructure close to major centres mean it has access to the population centres to develop its other advantages. Huntly was reported as having one of only 11 commercial diving schools in the world, because of its stable aquatic environment. Tourism is reportedly also a major industry for Huntly and has the potential to be bigger. In addition, engineering, manufacturing and hospitality offer opportunities in Huntly. Geothermal energy is a major skill that New Zealand has experience in. The Waikato District Council is apparently advising other countries on the environmental side of using geothermal energy, harnessing New Zealand's experience.

For the workshop in Taumarunui, the decline in population and in the robustness of institutions were important themes. Over the years, various industries have left Taumarunui, freezing works and (saw-)milling in particular. It was noted that where timber was once processed locally, now most processing is done overseas. Taumarunui has a strong set of sports and social clubs, but they are not as many or as strong as they once were. The long distance from services was discussed as an ongoing concern for the town. While the community hospital is very good, some preventative medicine and specialist procedures are not done in Taumarunui. Hamilton hospital is the nearest major hospital and it is three hours away by car on a rural road. According to workshop participants, one elderly resident needing a hip replacement was quoted $1,000 fee to travel by ambulance to Hamilton hospital since she was unable to get into a vehicle due to her disability. Tourism was discussed as an opportunity for the town. Adventure tourism (such as Forgotten World Adventures) was discussed as a major opportunity that was beginning to be exploited. The river and local rail trail provided opportunities for helicopter and jet boat operators to provide tourists with an experience of New Zealand's wilderness and natural beauty.

Participants in Te Kuiti described how they were largely weathering the issues of rural communities through the strength and collaboration of their institutions and thanks to the strong involvement of local marae in social services. Te Kuiti's institutions often collaborate across the wider region to improve outcomes and to ensure that services remain viable for their collective populations. This includes schools collaborating on shared classes for niche subjects, shared medical services thanks to the support of local GPs, and local government collaborating with other councils across the region. The cultural institutions including theatre, artists and choirs were described as a major strength of Te Kuiti. Te Kuiti was described as a strongly multicultural place, with large Pacifika, Indian and Filipino communities. Churches and marae provide a great deal of support in the community. There are around 25 marae in and around Te Kuiti under the aegis of the Maniapoto Trust Board and participants emphasised how much they contribute to the community. The Trust Board also operates a community services organisation that provides social services, training and support.

In Dannevirke, one of the main issues raised by participants was the lack of jobs and economic diversification. The town is heavily reliant on agriculture which means local prosperity fluctuates with global commodity prices. They raised concerns with fresh water standards and the impact the new standards would have on farms – potentially putting farms out of business. It was felt local concerns were getting drowned out in the national debate on water quality. The quality of the schools was highlighted as a key strength of Dannevirke. The quality of education provided good opportunities for young people.

Ratings from the workshops

Holding collaborative workshops in the four case study towns proved to be an effective way to collect subjective ratings of resilience. Participants were able to provide numerical ratings for their individual towns and their wider regions. They provided ratings on a scale from 1 (least resilient) to 10 (most resilient) for all five dimensions of resilience, plus one overall rating across all dimensions. The tables below report the mean value for each town for each dimension, as well as the minimum and maximum overall resilience rating for each town. A full list of all the ratings for all participants

and dimensions in every town is provided in Appendix D. Further descriptive statistics on each town is included in Appendix A.

Table 6. Mean values of workshop ratings

	Huntly	Te Kuiti	Taumarunui	Dannevirke
Cultural	7.00	6.50	7.00	6.50
Economic	6.38	6.00	4.63	5.56
Environmental	4.88	4.83	7.75	6.13
Institutional	6.25	5.00	5.63	7.13
Social	5.63	7.17	7.13	7.19
Overall	6.75	6.17	5.63	7.38

Table 7. Minimum, maximum and average overall resilience rating for each town

	Huntly	Te Kuiti	Taumarunui	Dannevirke
Minimum	6.0	4.5	5.0	7.0
Maximum	8.0	7.5	6.5	8.5
Average	6.75	6.17	5.63	7.38

These ratings reflected the opinions and perceptions that local participants had of their towns towards the end of the three-hour workshops. Of the four towns, Dannevirke received the highest mean rating for overall resilience, as well as the highest ratings for environmental, institutional and social resilience. Taumarunui received the lowest mean rating of overall resilience; however, the only dimension in which it received the lowest rating was economic resilience.

Across all the towns, participants generally rated their social resilience highest out of the five dimensions, while the economic resilience ratings were generally lowest. The majority of the mean ratings were above 5.0, although it is not clear from this research whether the rating scale was anything other than relative. Participants from Huntly and Te Kuiti did rate their environmental resilience 4.88 and 4.83, respectively, while Taumarunui residents rated their economic resilience 4.63.

Test 1 examined the relationship between the overall rating and the ratings for the five dimensions by workshop participants. The ratings from all the participants were combined into a single data set, which produced an overall sample size of 22. This test treated the overall rating as the dependent variable and the ratings for the other dimensions as the explanatory variables, and estimated a linear regression. The goal was to identify which dimensions were most important to

participants when they gave their overall ratings of resilience. The table below presents the results of Test 1.

Table 8. Test 1: Model to estimate overall rating from dimension ratings

Variable	Coefficient estimates	Standard errors	Pr(>|t|)
(Intercept)	2.73	0.607	0.000369
Social	0.0674	0.129	0.610
Economic	0.300	0.134	0.0394
Cultural	-0.159	0.155	0.320
Institutional	0.576	0.110	0.000082
Environmental	-0.127	0.118	0.297
Adjusted R^2	0.794		

The results of this test showed that institutional and economic resilience were the most important dimensions to the ratings of overall resilience: they had the largest coefficients and the highest statistical significance.[6] In particular, institutional resilience – a dimension sometimes excluded in discussions of resilience or sustainability – was an important variable in this model. The result may be due to the significant role that local institutions, such as local government, play in rural communities. It may also be a function of the people invited to the workshops, who tended to be from local government, churches, healthcare organisations or other institutions. Not surprisingly, economic resilience is also a key variable in the model. This result is likely due to the importance of jobs and incomes in rural communities (as well as elsewhere). Participants' opinions on social and cultural resilience appear to be less important to their overall resilience rating of their towns. The model also showed good fit with the data, which, given the small sample size, is interesting.

It is likely that a larger sample size would produce different results. The sample size could be increased by having more participants in each workshop, holding more workshops or including more towns in a scaled-up research project. A larger sample would also allow researchers to test differences across locations and spatial scales. The most significant outcome of this pilot analysis is to demonstrate that it is possible to collect a measure of resilience and analyse the data meaningfully.

[6] Throughout this analysis, the statistical significance of results is downplayed. This is a pilot study with a small sample size, so assumptions underpinning the statistical tests are violated. The statistical tests have been done for two reasons. First, they demonstrate the method, which can be applied to a larger sample. Secondly, they provide a suggestion of which effects may be more important, although there is no attempt to conclude that the results are definitive.

Workshop ratings and external indicators

The next part of the analysis focused on determining whether the indicator data gathered could be used to model the resilience ratings. In other words, we wanted to test whether the official statistics available could be used to predict community resilience ratings. Linear regressions were performed to find relationships between the two sets of data, for all four towns. Test 2 compared the mean ratings of each dimension and overall resilience for each town to their corresponding indicator indices. The scatterplots for each dimension showed whether there were obvious relationships. In the scatterplots below, the mean rating score was plotted against the overall indicator index separately for each resilience dimension and for the overall resilience metrics.

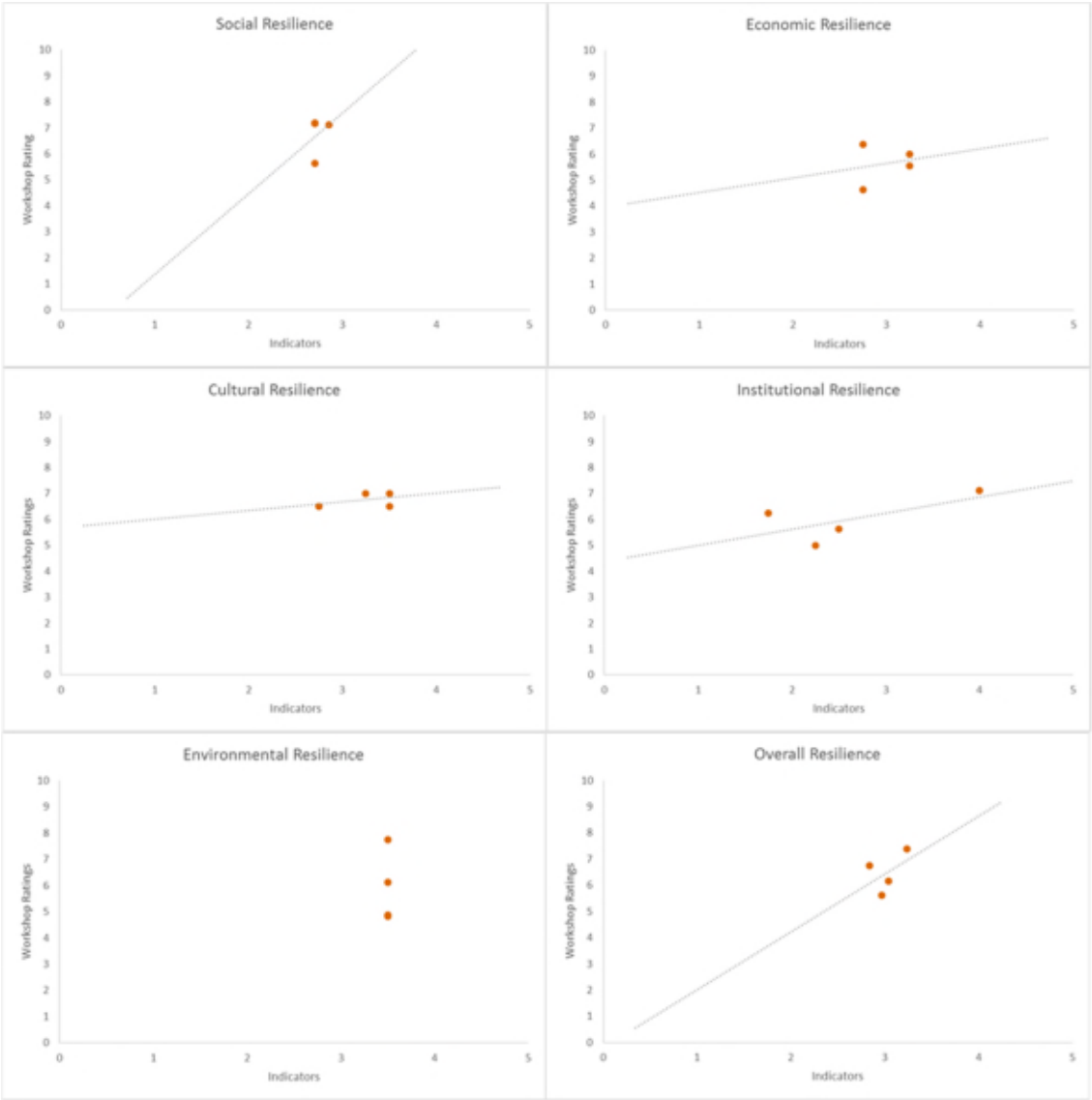


Figure 6 Scatterplots of ratings vs indicators by resilience dimension

Most of the scatterplots showed a positive relationship between a town's indicator score and its workshop ratings. The result indicated that participants largely perceived their town's resilience in a way that was consistent with statistical information about the town. While there was some consistency across these two sets of data, they did not correlate perfectly.

The overall resilience chart, in particular, showed that the town with the highest mean workshop rating also had the highest score according to the indicator data. Notably, the town with the second highest workshop rating, Huntly, had the lowest indicator score. There are many possible reasons why participants of Huntly rated their overall resilience higher than the indicator-based metric. The indicators, the ratings or both could be poor measures of resilience. Alternatively, experimental errors, including sample selection bias or missing variables, could be affecting the results.

To investigate these relationships further, Test 2 used linear regression to analyse the relationships between the ratings and indicator indices. For each dimension, equations were estimated with the rating as the dependent variable (transformed to a scale of 10 to 100) and the indicator index (scale of 1 to 5) for that dimension as the independent variable. The analysis used all the participants' ratings from the workshops (N=22). The results of these models are presented in the table below. Environmental resilience was not analysed because data for the environmental indicators is collected at the Regional level, rather than the town. The two Regions for the four towns in the study also happened to have the same scores for the statistics collected. As a result, the environmental resilience indicator metrics for all four towns were identical. Environmental resilience was thus omitted from this test and all further analysis.

Table 9. Test 2: Indicator impact on ratings; linear models for each dimension

Model / Dimension	Intercept parameter (st. error)	Indicator parameter (st. error)	Pr(>|t|) for Indicator parameter	Adjusted R^2
Social	15.6 (131)	19.4 (47.8)	0.689	-0.0414
Economic	41.3 (40.6)	5.00 (13.2)	0.709	-0.0425
Cultural	57.1 (27.8)	3.06 (8.68)	0.728	-0.0435
Institutional	40.1 (9.08)	7.42 (3.05)	0.0244	0.19
Overall	-21.0 (43.4)	28.4 (14.2)	0.0582	0.126

In these five models, the Institutional indicator index and the Overall indicator index performed best at estimating their respective ratings from the workshops. The Economic and Cultural models suggest that indicators were poorly predictive of the workshop ratings. The magnitude of the parameters was also interesting. The rating scale, with a maximum value of 100, had a range of about 20 times the indicator scale, with its maximum value of 5. As a result, 1 point on the indicator scale was equal to about 20 points on the rating scale. The estimated parameters, however, were either less than 10 or close to 30. The result suggested that the nature of the subjective ratings

could be further studied to assess their effective ranges and the extent to which they could be treated as interval data.

The overall resilience rating from the workshops were not a mathematical average of the ratings for each dimension but a rating provided independently by participants. The previous model suggested that a weighted average performed better than a simple average for relating ratings on individual dimensions to the overall rating, with weightings estimated by the parameters in the model.[7]

The next test (Test 3) considered the individual indicators rather than the indices, in order to provide a more detailed picture of the relationship between indicators and ratings. Each individual indicator was modelled against the rating for the dimension related to the indicator, mostly using the raw statistics rather than any transformation. All of the indicator statistics were in the form of percentage points, except for median income. For the sake of consistency and ease of interpreting results, the median income figure was converted into the percentage of the median income across the whole country. The indicator figures were thus mostly between 1 and 100 percentage points; population change also included negative figures. The workshop ratings were also on a scale to 100, as before.

Linear regression was used to test the relationship between the ratings for each dimension to each indicator. The aim was to find the indicators that best predicted how a person would rate their town's social, economic, cultural and institutional resilience. With the small sample size, each indicator was modelled in a separate regression. The table below shows the output for these models, with each line representing a different model.

[7] One could calculate an Overall resilience indicator using the weights from the earlier linear model, and then compare that weighted indicator to the participants' own overall ratings.

Table 10. Test 3: Indicator impact on ratings; linear models for each indicator within each dimension

Model / Dimension	Indicator	Intercept parameter (st. error)	Indicator parameter (st. error)	Pr(>|t|) for Indicator parameter	Adjusted R^2
Social					
	Population change	60.0 (5.18)	-1.32 (0.671)	0.063	0.120
	Secondary school qualifications	1470 (794)	-42.1 (23.8)	0.0927	0.0916
	Tertiary qualification	112 (102)	-6.11 (14.4)	0.676	-0.0407
	Phone access	-17.9 (49.2)	1.15 (0.653)	0.0928	0.0915
	Internet access	46.0 (65.9)	0.418 (1.21)	0.732	-0.0437
	Volunteering	62.6 (21.7)	0.329 (1.14)	0.776	-0.0456
Economic					
	Unemployment rate	55.9 (13.2)	0.0713 (1.15)	0.951	-0.0498
	Median income	23.3 (66.1)	0.430 (0.852)	0.619	-0.0368
Cultural					
	Religious affiliation	87.5 (33.3)	-0.375 (0.602)	0.541	-0.03
	Māori population	62.0 (13.2)	0.106 (0.285)	0.714	-0.0428
	Te reo speakers	60.9 (10.7)	0.480 (0.841)	0.574	-0.0332
	Born overseas	66.9 (21.2)	-0.0143 (2.20)	0.995	-0.05
Institutional					
	Voter turnout	34.0 (15.0)	0.618 (0.335)	0.080	0.102
	State owned houses	72.0 (5.35)	-0.814 (0.344)	0.028	0.18
	Self-rated poor health	150 (45.9)	-8.15 (4.20)	0.0662	0.117

These results showed that some of the indicators were good predictors for how residents would rate the dimensions of resilience. There were social and institutional indicators that showed good correspondence with the dependent variables, the workshop ratings, again with the caveat about sample size. For the Social rating, population change, secondary school qualifications and phone access all showed good fit. The result for population change fit the general concern in rural communities with maintaining the population and avoiding depopulation. The secondary school

qualification result had a negative sign, suggesting that more high school completion led to lower social resilience rating; this result would need further investigation. The institutional indicator models suggested that higher voter turnout, lower proportions of State-owned housing and better self-rated health all linked to higher ratings for the Institutional dimension. The indicator data did not predict either Economic or Cultural ratings.

The next step was to model the Overall resilience rating as a function of the indicator data. In Test 4 the Overall rating was the dependent variable and each model had one indicator. The indicator data were in percentage points as before, the Overall ratings were on a 100-point scale. Indicators were chosen from all the different resilience dimensions. The results are presented in the table below.

Table 11. Test 4: Models of Overall resilience rating as function of indicators

Model / Indicator	Intercept parameter (st. error)	Indicator parameter (st. error)	Pr(>|t|) for Indicator parameter	Adjusted R^2
Population change	66.7 (4.70)	0.0782 (0.609)	0.899	-0.0491
Secondary school qualifications	247 (708)	-5.49 (21.3)	0.799	-0.0465
Tertiary qualification	109 (84.6)	-6.06 (11.9)	0.618	-0.0367
Phone access	-9.07 (40.6)	0.999 (0.539)	0.0785	0.104
Internet access	-88.7 (42.7)	2.83 (0.78)	0.00166	0.367
Volunteering	106 (15.7)	-2.1 (0.823)	0.019	0.208
Unemployment rate	72.5 (9.43)	-0.572 (0.825)	0.496	-0.0254
Median income	-31.7 (42.9)	1.26 (0.553)	0.0336	0.167
Religious affiliation	28.1 (24.9)	0.69 (0.451)	0.141	0.06
Māori population	92.8 (8.41)	-0.589 (0.181)	0.00398	0.313
Te reo speakers	85.0 (7.26)	-1.53 (0.568)	0.0137	0.231
Born overseas	87.7 (15.9)	-2.26 (1.65)	0.186	0.0399
Voter turnout	51.3 (11.4)	0.337 (0.255)	0.202	0.0339
State owned houses	73.6 (3.99)	-0.559 (0.257)	0.0418	0.151
Self-rated poor health	97.1 (36.1)	-2.84 (3.30)	0.400	-0.0126

This test found that Overall resilience had a different relationship to the indicators than the individual resilience dimensions. For Overall resilience, the best-fitting indicators were phone access, internet access, voluntary work, median income, identifying as Māori, speaking te reo and State-owned housing, with weaker relationships between the Overall ratings and religious affiliation, being born overseas and voter turnout. Population change was not strongly predictive of Overall ratings, although it was strongly predictive of the Social ratings. State-owned housing remained a strong predictor, but the other institutional indicators were weaker at predicting Overall ratings than they were at predicting Institutional ratings. Median income became important, and cultural indicators were also good predictors of Overall ratings. These findings were consistent with the earlier analysis, which found that the ratings for individual dimensions were only weakly linked to the rating for Overall resilience. It was therefore unsurprising that the ability of indicators to predict dimensional ratings would tie only weakly to predictions of Overall resilience.

Testing the idea of thresholds

As discussed earlier, the resilience literature included the idea of thresholds below which a community's resilience is compromised. While the ratings were a way to quantify resilience, the study also aimed to understand how to categorise rural communities as resilient or not-resilient – that is, vulnerable or declining – based on indicators. The 10-point scale used in the workshops did not contain an explicit threshold that participants could use to anchor their impressions. They were not asked to label their communities as 'resilient' or 'declining', but rather to provide a rating from less resilient to more resilient. Thus, the workshop ratings did not provide the binary indicator required to analyse threshold effects. Instead, the research team had relied on expert judgement to categorise the four town as either resilient or not-resilient. When the towns were selected, they were chosen so that the sample contained one resilient town and one not-resilient town in each of two regions. Huntly and Dannevirke were chosen as the resilient towns; Te Kuiti and Taumarunui were chosen as the not-resilient communities. Importantly, the workshops confirmed the categorisation of these towns. Huntly and Dannevirke were the two towns with the highest mean ratings of overall resilience for the four towns, and Te Kuiti and Taumarunui had the lowest ratings. Those results were provided in an earlier table. With the categorisation confirmed by the participants' ratings, a binary 'resilient' variable was created: Huntly and Dannevirke were assigned a '1' and Te Kuiti and Taumarunui were assigned a '0'.

With the resilience indicator created and confirmed, the next step was modelling the indicators against the binary dependent variable. For this modelling, a binomial logit model was used. The results are provided in the table below.

Table 12. Test 5: Models of binary resilience as functions of indicators

Model / Indicator	**Intercept parameter (st. error)**	**Indicator parameter (st. error)**	**Pr(>|z|) for Indicator parameter**
Overall rating	-10.5 (4.69)	0.161 (0.0701)	0.0214
Population change	1.49 (2.23)	0.231 (0.287)	0.420
Secondary school qualifications	-178 (304)	5.33 (9.13)	0.559
Tertiary qualification	-1.72 (35.0)	0.243 (4.93)	0.961
Phone access	-2.24 (19.0)	0.0302 (0.257)	0.906
Internet access	-4420 (8180000)	82.2 (152000)	1
Volunteering	572 (249000)	-31.7 (13800)	0.998
Unemployment rate	-2.43 (4.39)	0.206 (0.363)	0.571
Median income	-11.1 (21.2)	0.146 (0.277)	0.6
Religious affiliation	0.919 (11.2)	-0.0171 (0.207)	0.934
Māori population	579 (927000)	-11.3 (17900)	0.999
Te reo speakers	4.025 (5.68)	-0.299 (0.403)	0.457
Born overseas	4.23 (8.03)	-0.438 (0.827)	0.596
Voter turnout	0.229 (5.02)	-0.00542 (0.116)	0.963
State owned houses	1.10 (2.45)	-0.0716 (0.143)	0.617
Self-rated poor health	1.082e-14 (15.9)	-9.654e-16 (1.45)	1

These results showed that some of the indicators were better than others for predicting whether or not a town is resilient. None of these indicators had a strong effect on resilience, however this is likely due to the small sample size. The relationship between the binary resilience variable and the overall ratings was tested and it was found that the overall ratings were a good predictor of resilience. This confirmed the initial hypothesis that Huntly and Dannevirke were resilient and Te Kuiti and Taumarunui were not-resilient. These binary models were used to find a threshold for the resilience variable.

For Test 5, the overall ratings out of 10 were converted to percentages for the sake of consistency across all explanatory variables. All of the indicators had a range between zero and 100 per cent,

except for population change which was between -50 and 50 per cent. The intercept parameter and indicator parameter values from the logit models were used to calculate the odds of a town being resilient for each possible value in the indicator range. For this analysis, the threshold was defined by finding the value for each indicator when the odds of being resilient are equal to one. This defined the threshold as being the point where the probability of the resilient variable is equal to 0.5.

The threshold was found for selected indicators: overall rating, population change, tertiary qualification, phone access, median income, Te reo speakers, born overseas and state owned houses. The graphs of cumulative density functions (CDFs) for these indicators are shown below, with the dotted lines on the charts representing the threshold of resilience for each indicator.

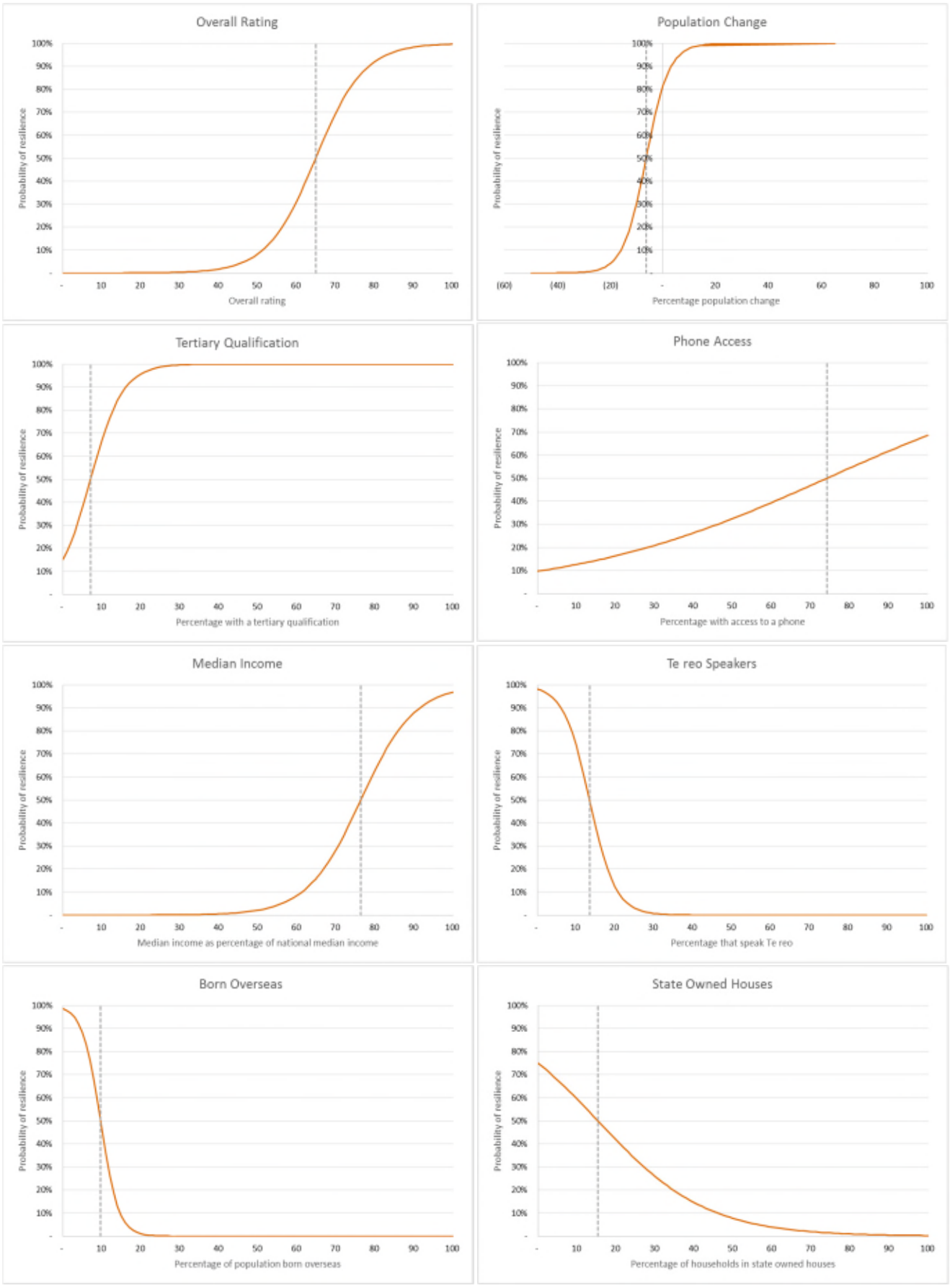


Figure 7 CDFs and resilience thresholds for multiple indicators

Table 13. Thresholds for each indicator, with actual values for each town

Indicator	Threshold	Huntly	Te Kuiti	Taumarunui	Dannevirke
Overall rating	64.94	67.5	61.67	56.25	73.75
Population change (% change 2006 – 2013)	-6.47	0.09	-5.29	-11.01	-9.08
Tertiary qualification (%)	7.10	7.14	6.81	7.38	7.07
Phone access (%)	74.14	69.00	75.20	72.61	79.73
Median income (% of national median)	76.36	73.68	78.95	71.75	81.05
Te reo speakers (%)	13.43	16.00	14.06	14.97	7.77
Born overseas (%)	9.64	10.40	11.33	8.65	8.21
State-owned houses (% of households)	15.32	23.46	18.56	15.71	3.08

For overall rating, the threshold was 65 per cent. Overall rating had a positive relationship with resilience, meaning any town with a rating over 65 per cent was resilient. A town with an overall resilience rating lower than 65 per cent was not-resilient based on this threshold. Of the communities in the pilot study, Huntly and Dannevirke had mean overall ratings over this threshold (68 per cent and 74 per cent respectively) and therefore could be categorised as resilient. Te Kuiti and Taumarunui had mean overall ratings below this threshold (62 per cent and 56 per cent respectively) and therefore could be categorised as not-resilient.

Population change also had a positive relationship with resilience, though interestingly the threshold was negative six per cent for change over the period 2006 to 2013[8]. This implies that a town's population could decrease, but as long as that decrease was less than six per cent over seven years the town is still resilient. A town with a population decrease greater than six per cent over the period was not resilient based on this threshold. Of the communities in the study, Huntly and Te Kuiti had a population change of above negative six per cent over the period (one per cent and negative five per cent respectively) and therefore were resilient based on this indicator. Taumarunui and Dannevirke had population change below this threshold (-11 per cent and negative nine per cent respectively) and were therefore not-resilient when it comes to population change.

Tertiary qualifications, phone access and median income all also had a positive relationship with resilience. The threshold for tertiary qualifications was seven per cent, and any town with a higher percentage of population with a tertiary qualification than this was resilient. Based on this Huntly, Taumarunui and Dannevirke were resilient and Te Kuiti was not-resilient. The threshold for phone access was 74 per cent so any town with more than 74 per cent of its population having access to a phone was resilient. Based on this Te Kuiti and Dannevirke could be categorised as resilient, while Huntly and Taumarunui were not-resilient. The threshold for median income was 76 per cent. Any town with a median income more than 76 per cent of the national median could be categorised as resilient. Based on this, Te Kuiti and Dannevirke were resilient and Huntly and Taumarunui were not-resilient.

Te reo speakers, born overseas and state owned houses all had a negative relationship with resilience. This means that the higher the percentage value for each of these indicators, the lower the likelihood of that town being resilient. The threshold for te reo speakers was 13 per cent, so any town with fewer te reo speakers than that was resilient. Of the case study towns, only Dannevirke had fewer than 13 per cent te reo speakers and was therefore resilient. Huntly, Te Kuiti and Taumarunui all had a higher percentage of te reo speakers so were categorised as not-resilient. The threshold for born overseas was 10 per cent so any town with a lower proportion of population born overseas was resilient. Based on this threshold, Taumarunui and Dannevirke were resilient and Huntly and Te Kuiti were not-resilient. The threshold for state owned houses was 15 per cent and any town with fewer state owned houses than this was resilient. Only Dannevirke had fewer state owned houses than this and therefore was resilient. Huntly, Te Kuiti and Taumarunui were categorised as not-resilient based on this threshold.

Table 14 provides a summary of the results of the binary analysis, showing which towns appeared to be resilient according to the indicators and the Overall rating. The table shows that the indicators provided a somewhat inconsistent picture of resilience across the four towns. Dannevirke appeared resilient according to nearly every indicator. Taumarunui appeared resilient on the fewest indicators, but still has a few ticks on the table. Huntly and Te Kuiti appeared similarly resilient on a simple count of the results.

[8] The two most recent censuses. Censuses are usually every five years, however the 2011 census was delayed until 2013 due to a major earthquake in and around Christchurch in February 2011. See http://www.stats.govt.nz/Census/2011-census.aspx for more information.

Table 14. Resilience of each town, by selected indicator

Indicator	Dannevirke	Huntly	Taumarunui	Te Kuiti
Overall rating	✓	✓		
Population change		✓		✓
Tertiary qualification	✓	✓	✓	
Phone access	✓			✓
Median income	✓			✓
Te reo speakers	✓			
Born overseas	✓		✓	
State owned houses	✓			

Second workshop in Taumarunui

Following the four workshops, a second workshop was held in Taumarunui. Community groups within the town who had not attended the first workshop had heard about it and were interested in having input. A new set of attendees was invited, and a second workshop was held with 10 participants. This second Taumarunui workshop was run with the same agenda as the other workshops, asking the same questions and gathering the same qualitative and quantitative data.

At the second workshop held in Taumarunui, many of the same themes were canvassed. The strong community spirit, the centralisation of government agencies and the loss of agricultural land to forestry (which provides far fewer jobs) were all repeated. There were a couple of new themes issues elicited from the second workshop. In addition to discussing the strength of the community-iwi relationship, it was also discussed as a challenge for the community. The relationship is not always straightforward. In addition, where the first workshop described the location of the town at the juncture of several districts as a strength, the second workshop described the isolation of the district as causing problems. Aside from those differences the themes discussed between the two Taumarunui workshops were the same. The list of issues, strengths and concerns identified at each workshop is included in Table 30 in Appendix C.

The resilience ratings from this workshop were added to the original dataset of workshop ratings. The same analysis was run on the updated dataset. The results were largely unchanged. Generally, the results were only slightly different to the initial analysis. The results of this analysis are presented below.

Table 15 below shows the number of participants at each workshop. The first Taumarunui workshop had four attendees, and the second had 10. The results that follow are based on combining the ratings given by all 14 participants at both Taumarunui workshops.

Table 15. Number of participants at each workshop

Town	Number of participants
Huntly	4
Te Kuiti	6
Taumarunui	14
Dannevirke	8

Table 16 below shows the mean values of all the ratings given for each dimension of resilience in each town. Table 17 shows the mean, minimum and maximum values for the overall resilience ratings in each town.

Table 16. Mean values of workshop ratings

	Huntly	Te Kuiti	Taumarunui	Dannevirke
Cultural	7.00	6.50	6.64	6.50
Economic	6.38	6.00	3.86	5.56
Environmental	4.88	4.83	7.93	6.13
Institutional	6.25	5.00	5.39	7.13
Social	5.63	7.17	6.68	7.19
Overall	6.75	6.17	5.75	7.38

Table 17. Minimum, maximum and average overall resilience rating for each town

	Huntly	Te Kuiti	Taumarunui	Dannevirke
Minimum	6.0	4.5	4.0	7.0
Maximum	8.0	7.5	9.0	8.5
Average	6.75	6.17	5.75	7.38

Compared to the initial analysis, Taumarunui's mean ratings for most of the dimensions were lower after the second workshop. Cultural, economic, institutional and social mean ratings were slightly lower. Environmental resilience and overall resilience were both higher after the second workshop.

The new ratings did not differ from the initial ones by very much. Taumarunui still had the lowest mean overall resilience rating of the four towns. The range of overall ratings was much larger after adding the ratings from the second workshop. The minimum overall rating went from five to four, while the maximum changed from 6.5 to 9.

Table 18. Ratings from first and second workshops in Taumarunui

Dimension	First workshop (n=4)	Second workshop (n=14)
Cultural	7.00	6.64
Economic	4.63	3.86
Environmental	7.75	7.93
Institutional	5.63	5.39
Social	7.13	6.68
Overall	5.63	5.75

Test 1 examined the relationship between the overall ratings and the ratings for the five dimension by workshop participants. The results are shown in Table 19 below.

Table 19.Test 1: Overall rating by dimension ratings

Variable	Coefficient estimates	Standard errors	Pr(>|t|)
(Intercept)	1.73	0.641	0.0123
Social	0.232	0.136	0.100
Economic	0.171	0.144	0.246
Cultural	-0.0827	0.175	0.640
Institutional	0.554	0.129	0.000223
Environmental	-0.0754	0.115	0.519
Adjusted R^2	0.773		

The results of this regression were similar to the earlier one. Institutional remained the most important dimension to overall resilience, however Economic was more important in the first analysis than it was in this test.

The mean ratings from the workshop were plotted against the indicator indices for each dimension to understand how they related to each other. The scatterplots are shown below.

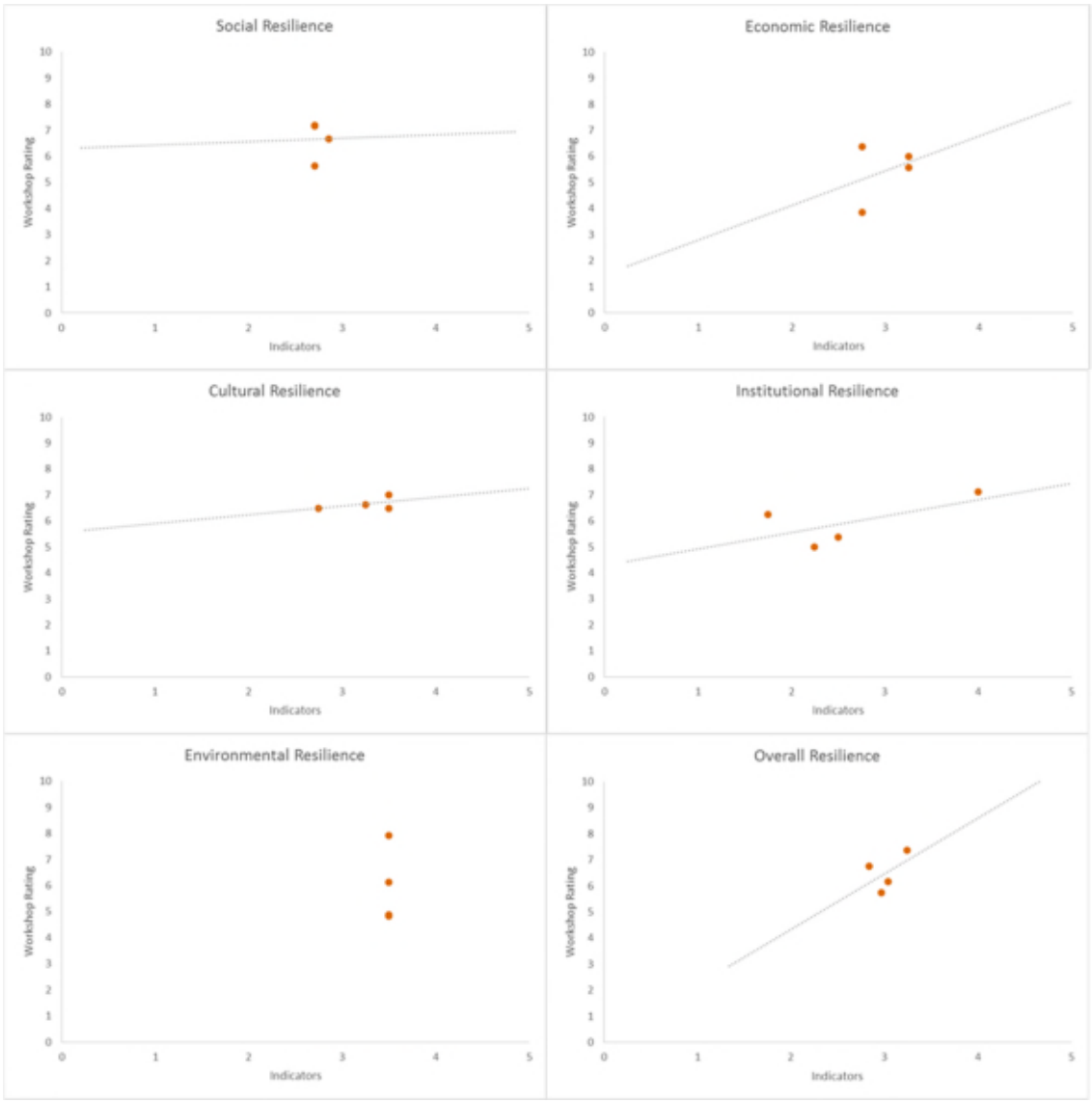


Figure 8 Scatterplots of workshop ratings and indicator indices by resilience dimension

The scatterplots show that there does still appear to be a positive relationship between the workshop ratings and the indicator indices for most dimensions. Again, Environmental resilience was omitted from the rest of the analysis as the data was not meaningful at the town level.

Test 2 investigated these relationships further, with a linear model run for each dimension of resilience and overall resilience. The results of Test 2 are shown in Table 20 below.

Table 20. Test 2: Ratings by indicator index; linear models for each dimension

Model / Dimension	Intercept parameter (st. error)	Indicator parameter (st. error)	Pr(>|t|) for Indicator parameter	Adjusted R^2
Social	96.3 (91.2)	-10.3 (32.8)	0.756	-0.0300
Economic	-29.2 (32.0)	26.7 (10.7)	0.0187	0.143
Cultural	57.6 (25.1)	2.69 (7.82)	0.733	-0.0293
Institutional	36.4 (8.37)	8.11 (2.95)	0.00997	0.175
Overall	-42.2 (48.8)	34.9 (16.1)	0.0381	0.107

In these five models, Economic, Institutional and Overall indicator indices performed best at estimating their respective ratings from the workshops. In the initial analysis, Economic did not appear to be a good predictor of the ratings, however in this one it appeared to perform well.

Table 21. Test 3: Ratings by indicators; linear models for each dimension

Model / Dimension	Indicator	Intercept parameter (st. error)	Indicator parameter (st. error)	Pr(>|t|) for Indicator parameter	Adjusted R^2
Social					
	Population change	62.1 (5.74)	-0.687 (0.647)	0.296	0.00417
	Secondary school qualifications	826 (771)	-22.8 (23.2)	0.333	-0.000997
	Tertiary qualification	132 (80.8)	-8.95 (11.3)	0.433	-0.0121
	Phone access	-20.9 (49.5)	1.19 (0.664)	0.0831	0.0667
	Internet access	29.3 (53.6)	0.714 (0.999)	0.480	-0.016
	Volunteering	73.8 (16.2)	-0.300 (0.782)	0.704	-0.0283
Economic					
	Unemployment rate	67.7 (13.7)	-1.50 (1.14)	0.196	0.0236
	Median income	-87.3 (48.4)	1.82 (0.639)	0.00805	0.186
Cultural					
	Religious affiliation	84.4 (29.6)	-0.332 (0.540)	0.543	-0.0205
	Māori population	63.8 (11.5)	0.0518 (0.236)	0.828	-0.0317
	Te reo speakers	62.3 (9.49)	0.300 (0.703)	0.674	-0.0271
	Born overseas	64.1 (17.4)	0.235 (1.87)	0.901	-0.0328
Institutional					
	Voter turnout	35.5 (15.2)	0.517 (0.335)	0.133	0.0428
	State owned houses	71.0 (5.25)	-0.883 (0.336)	0.0135	0.160
	Self-rated poor health	99.2 (41.9)	-3.79 (3.90)	0.339	-0.00183

Test 3 examined the relationship between the workshop ratings for each dimension and the indicators that make up the respective dimensions. It appeared that some indicators corresponded well with the workshop ratings, however the caveat about sample size remained in this analysis. In the Social dimension, phone access showed good fit again, while some of the indicators that showed good fit in the first analysis no longer appeared to correspond well. For the

Economic rating, median income showed good fit. The Institutional models showed that lower proportions of state-owned housing could be linked with a higher rating of Institutional resilience.

Table 22. Test 4: Overall resilience ratings to indicators; linear models for each indicator

Model / Indicator	Intercept parameter (st. error)	Indicator parameter (st. error)	Pr(>|t|) for Indicator parameter	Adjusted R^2
Population change	68.4 (5.32)	0.598 (0.600)	0.326	-0.000123
Secondary school qualifications	-407 (719)	14.1 (21.6)	0.518	-0.0188
Tertiary qualification	172 (72.8)	-15.1 (10.2)	0.147	0.0378
Phone access	-29.7 (45.0)	1.25 (0.604)	0.466	0.0965
Internet access	-81.5 (42.4)	2.71 (0.789)	0.00179	0.258
Volunteering	101 (13.4)	-1.8 (0.656)	0.00911	0.179
Unemployment rate	76.3 (10.6)	-1.08 (0.882)	0.229	0.0161
Median income	-37.3 (38.0)	1.33 (0.501)	0.01256	0.164
Religious affiliation	18.7 (29.3)	0.821 (0.535)	0.135	0.0420
Māori population	94.9 (10.2)	-0.656 (0.210)	0.00395	0.220
Te reo speakers	86.8 (8.69)	-1.77 (0.644)	0.01	0.175
Born overseas	71.7 (17.8)	-0.877 (1.90)	0.648	-0.0261
Voter turnout	52.7 (13.9)	0.244 (0.307)	0.434	-0.0121
State owned houses	72.5 (4.87)	-0.635 (0.312)	0.0508	0.0920
Self-rated poor health	59.0 (38.0)	0.428 (3.54)	0.904	-0.0328

Test 4 examined which indicators fit well with the overall ratings of resilience from the workshops. The best fitting indicators from this test were internet access, volunteering, median income, Māori population, te reo speakers and state-owned housing. This was largely consistent with the initial analysis, the only change being phone access which seemed to be a good predictor in the initial analysis but not as good in this test.

Table 23. Test 5: Binary resilience as function of indicators; logit models for each indicator

Model / Indicator	**Intercept parameter (st. error)**	**Indicator parameter (st. error)**	**Pr(>|z|) for Indicator parameter**
Overall rating	-7.96	0.114	
Population change	1.50 (2.23)	0.231 (0.287)	0.420
Secondary school qualifications	-178 (304)	5.33 (9.13)	0.559
Tertiary qualification	-1.72 (35.0)	0.243 (4.93)	0.961
Phone access	-2.24 (19.0)	0.0302 (0.267)	0.906
Internet access	-4420 (8180000)	82.2 (152000)	1
Volunteering	572 (249000)	-31.7 (13800)	0.998
Unemployment rate	-2.43 (4.39)	0.206 (0.363)	0.571
Median income	-11.1 (21.2)	0.146 (0.277)	0.6
Religious affiliation	0.919 (11.2)	-0.0171 (0.207)	0.934
Māori population	579 (927000)	-11.3 (17900)	0.999
Te reo speakers	4.03 (5.68)	-0.299 (0.403)	0.457
Born overseas	4.23 (8.03)	-0.438 (0.827)	0.596
Voter turnout	0.229 (5.02)	-0.00542 (0.116)	0.963
State owned houses	1.10 (2.45)	-0.0716 (0.143)	0.617
Self-rated poor health	1.082e-14 (15.9)	-9.654e-16 (1.45)	1

Test 5 examined the relationship between the binary resilience variable and the indicators. As the binary resilience variable for Taumarunui did not change, all of the results for the indicators were the same as before. The only change was to the relationship between binary resilience and overall ratings of resilience.

Figure 9 below shows the new threshold of overall ratings that indicate whether or not a town is resilient. This threshold increased from 65 per cent to 70 per cent in the second analysis. Again, this did not change the results as Taumarunui is still not resilient based on this threshold.

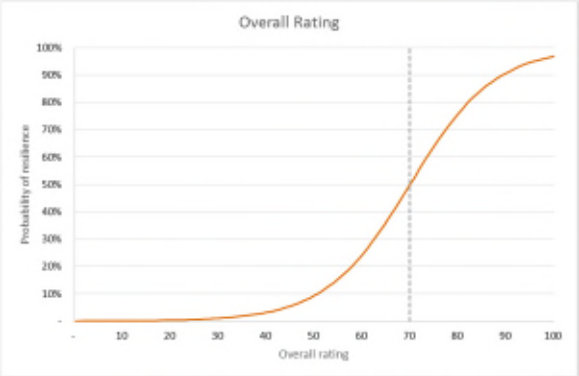


Figure 9 CDF and resilience threshold for overall ratings

6. Discussion

The overall structure of the analysis is presented in Figure 10. The research obtained to data sets: the workshop ratings and the indicators. These two sets of data were compared with the Overall resilience ratings from the workshop participants. From there, the Overall resilience ratings and the indicators were compared with the binary resilience categories. Figure 10 also reports the strength of the relationships among the different data sets and variables. The external indicators showed some agreement with the ratings of resilience dimensions from the workshops. For the Overall ratings of resilience, both the ratings for individual resilience dimensions and the indicator data were somewhat predictive. In turn, both the Overall resilience ratings and the indicators provided support for the binary categorisation of resilience.

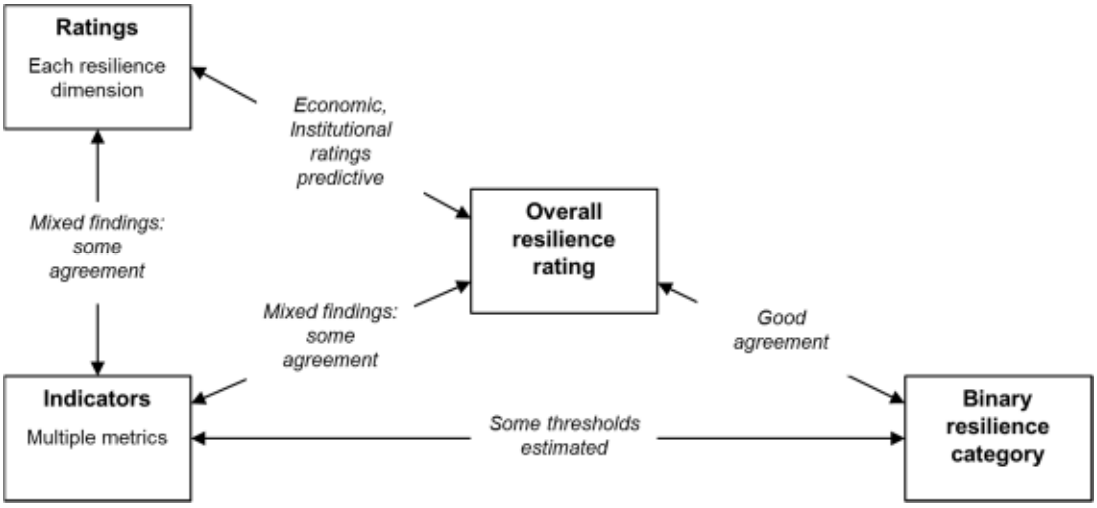


Figure 10 Summary of datasets and research findings

The research has demonstrated that it is possible to establish thresholds for different aspects of resilience that should be met for a rural community to be resilient. While the thresholds developed here are indicative only due to the pilot nature of this project, the research showed that it is possible to link data on outside indicators of resilience to meaningful measures of resilience as reported by residents of rural communities. Several of the indicators examined were found to be useful predictors of residents' perceptions of the resilience of their community.

Where those relationships exist, a threshold can be determined by logistic regression of the minimum value of a given indicator for the town to be resilient. This first requires that towns be classified as 'resilient' or 'not resilient', or at least as 'more resilient' or 'less resilient'. This can be done either as an expert judgement or based on the ratings of participants themselves. In this case the initial judgement of researchers matched how participants in the workshops rated their towns' resilience. While not all indicators were useful, the research elicited several relationships between resilience and externally measured variables. The most significant outcome of this pilot analysis was that it is possible to collect a measure of resilience in this way and to perform analysis on the results.

The data on indicators of resilience were available at a suitable level of granularity for most indicators of resilience. Data on environmental resilience of rural communities was not available at a town level. However this is not a significant limitation since environmental resilience was not one of the aspects that strongly influenced participants' ratings of the overall resilience of their towns. Furthermore, the relationships demonstrated between particular variables and towns reinforced the narratives heard in the workshops. For example, median income suggested that Te Kuiti and Dannevirke were the more resilient of the four towns. In the workshops, participants in Te Kuiti spoke of the strength of their local institutions and were generally optimistic about the resilience of the town. In Dannevirke, the strength of the agriculture sector was discussed as providing economic resilience to the town. These narratives were supported by the median income indicator.

Self-rated resilience proved to be a meaningful measure. Participants' overall rating of their town's resilience reflected both their expressed concerns and the underlying state of their town as described in the official data. Not all aspects of resilience were equally useful. Ratings of institutional and economic resilience matched well with ratings of overall resilience and this likely reflects participants understanding of the idea of resilience. Self-ratings have limitations – ratings will vary depending on who is taking part which calls their accuracy and comparability into question – however it is inherent in the notion of resilience itself that it is the local residents themselves who are either resilient or not resilient. Their perceptions, while potentially divergent, are a key part of defining the resilience of the town.

The workshop method used to obtain ratings of resilience had several advantages. First it engaged local residents and provided for their participation. Workshop participants were eager to share their thoughts about their community. Secondly, the issues-based discussion usefully engaged participants in thinking about a variety of aspects of resilience ahead of establishing the ratings, ensuring that the ratings were well considered and thought through. Discussion with participants after they provided the ratings showed that they had given a lot of thought to why they rated their

community's resilience the way they did. Lastly, the qualitative discussion provided a great deal of background on the local issues, history and geography that put the ratings in their proper context.

One of the themes at the workshops was a concern about a narrow economic base. It was a common theme that cut across both more-resilient and less-resilient towns. Contrary to what might be expected, it did not appear that a narrow economic base or concern about it was useful for distinguishing towns' resilience. Even resilient towns expressed concern about being overly reliant on one industry or wishing for a greater diversity of jobs. Aspects of this concern that were discussed at the workshops included:

- Concern about being heavily dependent on agriculture (Dannevirke and Te Kuiti)
- Concern that many industries had left the town (Taumarunui and Huntly)
- Explicitly wanting more economic diversity (Taumarunui, Te Kuiti)
- Concern about the general lack of jobs (Huntly).

The results concerning Māori, iwi and te reo appeared somewhat inconsistent. Participants in each town described local iwi as making a significant positive contribution to the resilience of the community, through provision of social services and inspiring a sense of cultural identity and purpose in youth. In the workshop discussions, participants highlighted the benefits of strong Māori institutions and community participation, such as active and welcoming marae, successful kohanga reo and substantial treaty settlements focused on local economic development. On the other hand, some indicators that correlated with resilience ratings suggested different trends. In particular, the proportion of the population who identified as Māori correlated negatively with the Overall resilience rating, that is, a town with a higher proportion identifying as Māori was less likely to rate themselves as resilient. Here over-interpretation of causal linkages should be avoided. The analysis shows only a correlation; it does not explain any causative effects. One explanation is that, while Māori institutions are working to improve community resilience, tangata whenua are significantly more likely than non-Māori to have poorer social and economic outcomes. For example, the average life expectancy for non-Māori is 7.1 years higher than for tangata whenua (Statistics New Zealand, 2015). The Māori employment rate in 2016 was 60.3 per cent compared to 66.2 per cent for all ethnicities (Statistics New Zealand, 2017). The overrepresentation of tangata whenua in poor social outcomes means that communities with more people who identify as Māori are also more likely to be less resilient at a given point in time. The underlying causes of this divide are beyond the scope of this research, but the relationship between self-report resilience and indicators related to iwi, tangata whenua, te reo and Māori institutions requires further study.

Operationalising some form of community resilience framework does not come without significant risks. A major epistemological question relates to the quantifiability of community resilience. As has previously been discussed, the resilience of particular place-based communities may not adequately recognise the processes operating at other scales and as such communities cannot develop their own adaptive capacity divorced from national and international forces (MacKinnon and Derickson, 2013; Robinson and Carson, 2015). In an attempt to overcome this significant criticism in framing the measurement of the resilience of communities, the framework proposed here is bounded by the external factors of influence (see Figure 1). These concerns are recognised

but the potential to utilise such a framework to understand the strengths and weaknesses of a community through measurement and enquiry, in order to celebrate and improve where possible, will provide benefits that outweigh postulation regarding the various contexts within which the community operates (McCrea et al., 2014; Steiner and Markantoni, 2014).

A more fundamental criticism of the present research would take issue with linking the concept of resilience to an explicit categorisation, the opinions of individuals or indicators derived from official statistics. Such a criticism might suggest that resilience is a complex concept that defies categorisation or reduction to a simple binary, and that it cannot be captured with a few numbers or observed at a single point in time. It is difficult to see how these criticisms are anything but a rejection of 'resilience' as a useful concept. 'Resilient' is a term used to describe rural communities. For that term to have any meaning, it must refer to something outside itself – an opinion of community members, a judgement by outsiders or an observable attribute of the community's economy, society, culture, environment or institutions. Once it is accepted that some other piece of information must link or relate to the concept of resilience, then the question is not whether the data are collected and analysed, but how. The present research has demonstrated a way to undertake that work.

Future iterations of this research could be improved. In future, participants' answers to the quiz questions about the official data could be recorded. In presenting the information on the official data through a quiz format, the answer provides a relevant dataset on how participants perceive their town as compared to the official data. For example, on population change, workshop facilitators felt that participants were far more pessimistic than the official data suggested, believing the fall in population was significantly greater than it actually was. However, as the responses were not recorded researchers could not track whether this was an accurate perception or whether it persisted across multiple towns. The results of subsequent analysis showed that population change was not a useful predictor of overall resilience of the rural communities we considered, although it was a good predictor of ratings of social resilience. Future work could also consider in more depth how participants weight different dimensions of resilience into their overall score.

Another improvement concerns the variables studied. The resilience literature has discussed proximity to a major centre as one of the possible determinants of community resilience. While this was not one of the factors analysed, it is one that should be considered in future research. Given the locations of the four towns considered, proximity to a major centre could be playing a significant role in affecting ratings of resilience. Huntly and Dannevirke are both near to large population centres (less than 60km from a centre of more than 50,000 people). Dannevirke was the most resilient of the four towns, both on the official indicators and the self-ratings. Its proximity to Palmerston North could be an additional factor strengthening its resilience. Huntly, on the other hand, appeared to have a mix of positive and negative indicators; one possible explanation for its perceived resilience despite some of the negative indicators is the additional opportunities and services afforded by proximity to Hamilton (32 km away). The results suggest that proximity should be considered in future work. Other variables that could be investigated include levels of social welfare money going into communities, youth unemployment, creation of new jobs and businesses and participation in volunteering.

7. Conclusion

The research was a pilot study, so the main goal was to demonstrate that the method was feasible. A secondary goal was to generate initial findings, which the study has done, although with considerable caveats. There are several ways in which the research can be strengthened. The most obvious way is to pursue a large study that would capture more data and support better analysis. There are several dimensions to extend: the study could recruit more people per community with either workshop or survey techniques; it could increase the number or communities studied, and include more regions in New Zealand including regions in the South Island and even communities in other countries; and it could increase the number of indicators assessed in order to develop a more complete understanding of the links between indicators and ratings.

A second avenue for further work, once more data were available, would be to analyse the resilience threshold more closely. In the present research, the threshold effect was estimated based on a 50 per cent probability for the binary indicator. Although the resilience indicator is a binary variable, there is no reason that the threshold needs to be 50 per cent. An alternative is to use a similar process of expert judgement to assign communities a resilience status, and then estimate thresholds based on a probability of 30 per cent or 70 per cent. Using a consistent threshold would still enable researchers to align the different indicators with each other based on values that support resilience and values that do not. This avenue of work would still accept the resilience description and the idea of thresholds.

A third way to extend the work would be to develop other metrics for the idea of resilience. In the present study, resilience was measured in two ways; expert judgement and the results of community workshops. Other methods could be developed for creating an independent assessment of resilience (that is, independent from the official statistics used to investigate various thresholds). That binary assessment, or some categorical assessment, could then be compared to official statistics or community opinion. This extension would essentially expand on the method of identifying resilient and not-resilient communities.

The research confirmed three ideas about resilience presented in the resilience framework from Fielke, et al. (2017). It confirmed the idea that resilience can be quantified, and that the dimensions of resilience can be quantified separately. It did this through the selection of indicators across each of the dimensions that can be meaningfully compared to the subjective opinions of experts and community members. It also confirmed the second idea that total resilience is a function of the separate dimensions of resilience. The way the different dimensions interact to form total resilience is still not defined, and future research could explore how individuals weight different dimensions onto overall resilience. This work does, however, show that each of the dimensions contribute in various ways to the total resilience of a community. Finally, the work confirmed the idea of thresholds of resilience. It demonstrated that it is possible to find thresholds within indicators wherein a community will cross from resilient to not-resilient (or vice versa). This analysis defined the threshold at a 50 per cent probability of a town being resilient and from there found the range of values for each indicator at which a town is resilient and not-resilient.

This work confirmed that it is possible to test the concept of resilience by comparing subjective opinions with official statistics. The results from this pilot study may not be representative of the true resilience status of these towns, nor are these results necessarily able to be applied to other rural communities in New Zealand. The analysis, however, provides a method for conducting this type of research and lends itself to expansion in a number of ways. Any extension of this work will allow for a greater understanding of resilience and the ways in which it can be measured in rural communities.

Appendix A – Raw indicator data

Table 24. Indicator data by town

	Huntly	Te Kuiti	Taumaranui	Dannevirke
Social indicators				
Population (2013)	6879	4188	4485	4956
Population (2006)	6873	4422	5040	5451
Pop. Change (2006-2013)	6	-234	-555	-495
Pop. Change (2006-2013) (%)	0.09	-5.29	-11.01	-9.08
Annual pop change 2006-2013 (%)	0.01	-0.88	-1.84	-1.51
Number of dependants (<15 and >65)	2823	1677	1923	2082
Number of 15-65	4056	2511	2562	2874
Dependency ratio (%)	41.04	40.04	42.88	42.01
Education level (stated)	4158	2643	2847	3396
Education level (finished secondary incl O/S qualification)	1392	882	945	1128
Education level (finished secondary incl O/S qualification) (%)	33.48	33.37	33.19	33.22
Education level (finished tertiary)	297	180	210	240
Education level (finished tertiary) (%)	7.14	6.81	7.38	7.07
Total households stating for telecommunication	2226	1464	1698	1983
Access to phone (households)	1536	1101	1233	1581
Access to phone (%)	69.00	75.20	72.61	79.73
Access to internet (households)	1203	783	873	1140
Access to internet (%)	54.04	53.48	51.41	57.49
Total stated something for unpaid work	4257	2724	2919	3441
Any volunteering	768	543	702	600
Volunteering (%)	18.04	18.04	24.05	17.44
Economic indicators				
Labour force total numbers	435	165	252	210
Unemployed numbers	2736	1902	1902	2229
Unemployment rate (%)	15.90	8.68	13.25	9.42
Median income	21000.00	22500.00	20450.00	23100.00
Highest percentage of personal income grouped ($)	30001-50000	30001-50000	30001-50000	30001-50000
Above category (%)	31.42	35.11	30.15	33.79
Industry diversity ANZSIC06 no industries employing over 10% of workers	4	1	5	3
Occupation diversity ANZSCO count of occupations with over 20% of workers	0	1	0	1

Cultural indicators				
Religious affiliation number (all)	2805	2046	2190	2772
All population stated	5994	3762	4080	4584
Spiritual affiliation (%)	46.80	54.39	53.68	60.47
Māori population (%)	49.45	54.91	53.48	31.84
Te Reo (%)	16.00	14.06	14.97	7.77
Born overseas (%)	10.40	11.33	8.65	8.21
Institutional indicators				
Court convictions (local court per capita Census pop)	5.63	5.68	5.02	2.76
Local election voter turnout (district) 2016 (%)	30.6	38.4	46.5	53.5
State owned households 2013 (%)	23.46	18.56	15.71	3.08
Self rated health (regional council) 2012 poor (%)	11.67	11.67	10.29	10.29

Table 25 Environmental indicator data by region

Environmental indicators	**Waikato**	**Horizons**
erosion t/year/person in regional council (2012/3)	16.39814183	55.77168372
Indigenous vegetation cover % (2012/3)	20	22
Air quality exceedances MfE state of our air (% of sites exceeding 2 day PM10 concentration) 2015	0	0
Bacteria (*E. coli*)	worst 50%	worst 50%
Waste tonnes to landfill	228723	unknown

Appendix B – Huntly workshop agenda

1. Introduction / housekeeping
2. Activity 1: Press conference – telling a story about Huntly
3. Activity 2: Likes and dislikes – what about the town makes you:
    - proud
    - happy
    - worried about the present
    - concerned about the long-term
4. Discussion about likes and dislikes
5. Break
6. Activity 3: Pub quiz Huntly
7. Activity 4: Rating Huntly's resilience
8. Discussion about the ratings
9. Wrap-up

Appendix C – Issues raised by workshop participants by category

Table 26. Dannevirke – comments collected at workshop

Things that make me happy to live here	Worried that these long-trends are going badly	Things that make me proud to live here	Issues that are causing problems right now
schools – doing well; good parent support thriving marae masses of services for elderly lack of traffic droughts are less severe connectedness convenience of town, parking, getting around focused council *infrastructure volunteers + organisations friendliness, even for new people	small business in main street closing people not as involved in clubs public hospital access – emergency services economics poverty healthcare depends on locums, short-term GP services erosion family violence	infra-structure power good – Scanpower Scanpower trust – pride aerodrome one of the nicest in country school – changed structure, change in leadership in the high school commercial business e.g. engineering Bill Phillips (economist) went to Dannevirke School fantastic community spirit young people who have good values e.g. trustworthy	young adults leaving town drugs (P) via gangs threat from earthquakes (building issues) impact of logging on roads fresh water environment standards central government dictates gangs – gang connections Tararua nutrient management not severe – caught up in national debate one plan – nutrient lowering – fewer animals – poorer economy

location – central rural environment mild climate 2 kohanga 2 treaty settlements – 2 conflicting Iwi lack of pollution – light air local institutions provide local options for kids – jobs plenty of activities for children people have more time for each other generous spirit housing affordability educational choices – youth + adults	nutrient management could put farms out of business at the mercy of international markets local government not like the surrounding districts – what if we have to change risk – central government not understanding small electricity provider – Scanpower central government – big is not always beautiful heavily dependent on farming sector – weakness, volatility would be great to have another industry with lower – skill jobs on-line shopping – impact on shops	high level of volunteerism high standard of education newspaper marae has been done up Ross Shield – Hawke's Bay Rugby	inequality drugs can't be sick after 5 o' clock water quality rules "bad" kids dumped on Dannevirke Schools not a lot of new capital injection into farms missing out – potential tourist industry we get everything from Remuera to 'Once Were Warriors' Is there – confused situation – gangs? significant number of people live hand – mouth

fantastic network of churches – 7 churches			

Table 27. Taumarunui – comments collected at workshop

Things that make me happy to live here	Worried that these long-trends are going badly	Things that make me proud to live here	Issues that are causing problems right now
people are robust, say what they think location – at a crossroads; river river – tourism (fully allocated) 22% Lake Taupo river – not suitable for irrigation climate is a strength – good farming lots of good people involved in school – put $ in good watering holes, clubs	need more long-term economic activity/diversity Need to decentralise government activity Core industries gone Milling, freezing works hospital lost sports – used to be 7 rugby clubs – now 1 Talk, no action with Maori fewer frosts; more disease; more animal health – eczema + parasites	town is optimistic friendliness community – good people tight knit community very welcoming community strong community spirit provides good services innovative – e.g. Forgotten World + tourism retirees coming back high school good	town needs a major overhaul Napier / Palmy also finding it hard to get/keep staff youth chasing big $ - even casual labour hard earthquake prone buildings can be hard to get professionals to come regulations – national – local regulatory hurdles youth – no skills – bad attitude – worse in last 4 years

arts – good performing + visual arts arts – people support Maori treaty settlements town has 500 year flood protection – well protected environment benign warmer, still wet can still farm in drought not clear that it's now worse	environmental volatility	golf course good opportunities are there – there are 7 tourism operators) Maori – meeting pt of 3 tribes. Signed co-op treaty in 1800's Maori: river Amazing history. Maori – strong history. Many marae. 3 tribes Maori: river is a legal person. Tourists love it	infrastructure is limited – opportunities being missed standard of services not supporting tourism – e.g. accommodation – need more services

Table 28. Te Kuiti – comments collected at workshop

Things that make me happy to live here	Worried that these long-trends are going badly	Things that make me proud to live here	Issues that are causing problems right now
it's just a damned great place to live! no traffic lights it's so easy to get anywhere else – if you have a car! a community that has strong linkages engaged business community supporting town 2 hours from anywhere central employment opportunities you can almost always get a park where you want easy to get to and from the variety of people	farm workers meat works – other ethnicities transient poorly supported to integrate not being under the radar – changes our community make up farms external owners – less connection to community level of rates lack of public transport rationalising of government services the line $ cost rates $ no movie theatre	cultural Waitomo choir the name "Te Kuiti" good schools whanau supporting whanau strong sense of "community" community house genuine civic interest in youth close to really interesting places – caves – coast variety of cultures living side by side there's a proud history of success – achievement –rowers, shearing, Prime Ministers and rugby players	lack of facilities for young people rates! The lines company! water quantity, allocation water quality transport isolated communities limited support for multicultural activities lower level of medical services level of lines company charges access to specialist health services housing – old/cold – lack of supply temporary workers dislocation underutilised hospital

the viaduct – the marae (my marae) surrounded by whanau - you know everyone sitting up the top of Awakino hill and admiring the view you can know a wide variety of people the people, the people, the people great doctors an active “neighbourhood watch” medical centre connected to hospital sense of community – know people good dentist + cheaper the hills the Mangaokewo Reserve		very successful “social sector trials” outcome the Te Tokohanganui Marae greater personal connectivity new university student bus service we’ve survived the transformation from being a government office town	lack of people to volunteer if you are poor can be difficult to get to Waikato hospital access to rental accommodation has suddenly got harder rationalising of government services access to higher level services – hospital, etc. rural internet opportunities for women working at senior level

choice of schools – Te Reo, St Jo, state schoolscommunity agencies – people know what's available open air heated swimming pool bus to Waikato university trust between people			

Table 29. Huntly – comments collected at workshop

Things that make me happy to live here	Worried that these long-trends are going badly	Things that make me proud to live here	Issues that are causing problems right now
Rail trail Transport connections Tourism is big and has bigger potential Hakarimata trail We're going to boom in next 10-20 years Possibility of turning Huntly station into a museum	Ageing population Subsidence from mines Lack of jobs Solid energy has mineral rights – which prevents land-use change Railway line prevents change River pollution	Marae capital Kingitanga capital River Lakes Services Huntly offers There are good jobs Gives kids life skills Infrastructure – road and rail Facilities are very good Good schools College Primary x5 Rakaumanga immersion school	Hungry children Poverty and deprivation. Lacking: Deodorant Bedding Tampons Toothpaste Hygiene Gangs Mental health Substance abuse Drugs (P, marijuana) Alcohol Drugs easier to get than food

		Academies (within the college) Hands on learning Community Spirit Great employers Innovative community / pragmatic Gateway programme Location is stunning – very central Coalmining history -> camaraderie Good size	Government doesn't understand the dynamic of small towns Scale – sometimes two to three people who need help (Changing those people can have knock on effects). Govt doesn't want to act at that scale Lack of funding Domestic Violence 1 to 6 generations of family dysfunction Transport limited. E.g. Meremere There's a tourist bus in But no regular bus out for locals OSH restrictions Housing shortage Government silos Government inertia

			CYF inaction Grey market economy – cash jobs

Table 30. Taumarunui – comments collected at second workshop

Things that make me happy to live here	Worried that these long-trends are going badly	Things that make me proud to live here	Issues that are causing problems right now
Low stress living in Taumarunui – parking; access to services There is a positive "vibe" in the town. People/groups are working together. Better social cohesion Positive attitude that things are starting to happen Rural lifestyle Accepting Outdoor activities are: high quality; easy to access; free Family + business connections plan social involvements within the community Great number of interest groups (community spirit)	Services – centralisation Business attraction + retention Population Monopolisation of decision making, especially policy, by academic, city based people Loss of essential services in the town? Has always been on the brink with this. People attraction + retention Employment Health-care Dependency on primary industry which will make declining job opportunities	Good people pioneering attitude. Your word is your word Community & Iwi working together Friendliness History Natural playground Integration with IWI – no big issues that divide us Mood is becoming more optimistic about future Community spirit Can-do attitude Friendly people giving good service and other community involvement	Pasture – Pine trees Isolation (geographical black-hole) Value added Challenging Maori/Iwi relationships Attitudes Difficult boundaries: iwi, electorates, health Loss of agricultural land to long-term forestry which will affect community resilience e.g. Carbon forests Increasing drug usage in the young (P) Perceptions Lack of employment opportunities for the young

Grass roots activities – hunting; fishing Down-to-earth The wide range of family friendly outdoor activities Community spirit Familiarity	Reduction in town's economic viability and sustainability (population jobs) Rural health services, incl. maternity Falling population – businesses on main street struggling/closing – also effects of online shopping Qualifications not coming back Digital communication Lack of rental housing	Interesting cultural history (Maori) stories need to be told Great place to work, live + play Frontier town	Not enough of locally produced products being processed in Taumarunui Schools full of hungry children Lack of focus for youth Strong division between those in poverty + those not Too many small organisations struggling to carry out relatively small projects - if joined with others – more success + funding options Over regulation affecting voluntary efforts Not enough decent restaurants

Appendix D – All workshop ratings

Table 31 below gives the full list of ratings given for every dimension and overall resilience for each town. Participants also rated the resilience of their region; these ratings are listed in Table 32.

Table 31. Ratings workshop participants gave for their town

Huntly	**Social**	**Economic**	**Cultural**	**Institutional**	**Environmental**	**Overall**
4 attendees	4.5	5.0	6.0	5.0	3.0	6.0
	5.0	6.0	7.0	5.0	4.0	6.0
	6.0	6.0	7.0	7.0	6.0	7.0
	7.0	8.5	8.0	8.0	6.5	8.0
Te Kuiti						
6 attendees	5.0	4.0	4.0	3.5	4.0	4.5
	6.0	4.0	5.0	4.0	4.0	5.5
	7.5	4.5	6.0	5.0	4.5	5.5
	8.0	7.0	7.5	5.5	5.0	7.0
	8.0	8.0	8.0	6.0	5.5	7.0
	8.5	8.5	8.5	6.0	6.0	7.5
Taumarunui						
4 attendees	6.0	3.5	6.5	4.0	7.0	5.0
	7.0	4.0	7.0	6.0	7.5	5.0
	7.5	5.0	7.0	6.0	8.0	6.0
	8.0	6.0	7.5	6.5	8.5	6.5
Dannevirke						
8 attendees	5.0	4.0	4.5	5.0	5.0	7.0
	7.0	5.0	5.0	6.0	5.0	7.0
	7.0	5.0	5.5	7.0	6.0	7.0
	7.0	5.5	6.0	7.0	6.0	7.0
	7.0	6.0	6.0	7.0	6.0	7.0
	7.0	6.0	8.0	8.0	7.0	7.5
	8.0	6.0	8.0	8.0	7.0	8.0
	9.5	7.0	9.0	9.0	7.0	8.5

Table 32. Ratings workshop participants gave for their town's region

Huntly	**Social**	**Economic**	**Cultural**	**Institutional**	**Environmental**	**Overall**
3 responses	8.0	8.0	7.0	8.5	7.0	7.5
	8.0	8.0	7.0	9.0	8.0	8.0
	8.0	9.5	9.0	9.0	8.5	9.0
Te Kuiti						
6 attendees	4.0	4.0	4.0	4.0	3.5	4.5
	4.0	4.5	4.0	4.0	3.5	5.0
	4.5	5.5	5.0	5.0	4.0	6.0
	5.0	5.5	6.5	5.5	4.5	6.5
	7.0	6.0	7.0	6.0	4.5	7.5
	7.0	6.0	8.5	6.5	6.0	7.5
Taumarunui						
4 attendees	5.5	5.0	6.0	4.0	6.0	6.0
	6.0	5.0	6.0	5.0	6.0	6.5
	7.5	6.0	7.0	6.0	7.0	7.5
	7.5	8.0	7.0	7.0	7.0	7.5
Dannevirke						
8 attendees	6.0	4.0	5.0	6.0	5.5	7.0
	7.0	5.0	5.0	7.0	6.0	7.5
	8.0	7.0	5.5	7.0	6.5	8.0
	8.0	7.0	6.0	7.0	8.0	9.0
	8.5	7.0	7.0	8.0	8.0	9.0
	9.0	8.0	7.5	8.0	8.0	9.0
		8.5	8.0			

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