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Recovery from disaster: Resilience, adaptability and perceptions of climate change

Final Report

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RECOVERY FROM DISASTER: RESILIENCE, ADAPTABILITY AND PERCEPTIONS OF CLIMATE CHANGE

Its effect on perceptions of climate change risk and on adaptive behaviours to prevent, prepare, and respond to future climate contingencies

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ABSTRACT

Disasters and climate change impacts have cross-scale effects, disrupting functioning across multiple levels of socio-ecosystems. Bronfenbrenner's bioecological systems theory was used to analyse individual and, by proxy, community resilience across Beechworth and Bendigo in Victoria and Ingham and Innisfail in Queensland, sites recovering from bushfire, drought, flood and cyclone respectively.

Project aims were to:

1) Identify private and public sector groups' beliefs, behaviours and policies that have supported community resilience to a disaster event;
2) Examine the commonalities of the experience for the four types of disaster and the possible impact of their respective intensities, duration and perceived frequency, as well as how well communities cope with the unexpected;
3) Assess the degree of community resilience in each of four study sites in disaster affected areas; and
4) Construct a model with findings to help implement appropriate and equitable emergency management policies and mitigation strategies for climate change events.

A key hypothesis underpinning our research was that individuals remaining in the disaster impacted communities were likely to be resilient to disaster.

A step-wise mixed methods research design was adopted.

1. Demographic data were used to profile communities for comparison, representativeness of samples, and comparisons of pre and post disaster impact upon communities.
2. Interview data from 186 participants from the four communities were used to a) identify factors that supported disaster resilience and b) explore attitudes to climate change.
3. Surveys, constructed from empirical interview data and the literature, were completed by 1,008 residents to generalize findings.
4. Rasch analyses quantified the factors identified, and structural equation modelling (SEM) assessed their links with disaster resilience using a model based on Bronfenbrenner's theory.

Results showed that resilience is both an individual trait and a process. The strongest direct predictor of resilience was adaptability and a sense of place. Indirect influences, mediated via adaptability, were: financial capacity, family and neighbour support, communications and climate change knowledge and trust in communication sources.

Community demographic data supported our hypothesis that individuals remaining in the community were resilient. They also suggested the four communities were resilient to disaster.

Results showed that:

- A sense of place kept people in a community and supported disaster resilience.
- Disaster resilience was a trait and a process developed through social relationships and supported by financial capacity.
- Household preparedness was highly predicted by financial capacity and by adaptability and resilience.
- Unique community characteristics made communities different in the levels of individual resilience to disasters and the factors supporting resilience.

- The relationship between climate change views and disaster experience was complex, needing further exploration in rural and regional Australia.
- Individual safety and wellbeing was likely to have been a strong contributor to community resilience and recovery.
- Support for individual and community resilience was found at several parts of the communities' socio-ecosystems.

Economic support assisted individual and community resilience, but social support was also critical. Initiatives designed to increase a sense of place need to have as much emphasis as those that focus on rebuilding the physical and economic infrastructure of a community.

EXECUTIVE SUMMARY

Disasters disrupt multiple levels of socio-cultural systems in which lives are embedded. In this study, we used Bronfenbrenner's bioecological systems theory to analyse individual and, by proxy, community resilience. Bronfenbrenner's theory provided a comprehensive framework to evaluate the interacting factors that support resilience across different disaster sites and communities. While Bronfenbrenner's theory has been used extensively, we believe that this is the first time it has been used to model disaster resilience.

Our study focused on four disaster-impacted communities: Beechworth and Bendigo in Victoria and Ingham and Innisfail in Queensland. Each site had experienced a different disaster, namely bushfire, drought, flood and cyclone respectively, 1 year, 8 years, 1 year and 5 years previously.

The aims of the project were to:

1) Identify private and public sector groups' beliefs, behaviours and policies that have supported community resilience to a disaster event;
2) Examine the commonalities of the experience for the four types of disaster and the possible impact of their respective intensities, duration and perceived frequency, as well as how well communities cope with the unexpected;
3) Assess the degree of community resilience in each of four study sites in disaster affected areas; and
4) Construct a model with findings to help implement appropriate and equitable emergency management policies and mitigation strategies for climate change events.

A key hypothesis underpinning our research was that individuals remaining in the disaster impacted communities were likely to be resilient to disaster.

A step-wise mixed-methods research design was adopted. Demographic data were used to profile communities for comparisons, determine representativeness of samples and to compare communities, pre and post disaster, for disaster impacts. Individual and group interviews were conducted with 186 people from the four communities to identify factors that helped individuals prepare, respond and recover from the natural disaster and to identify what supported disaster resilience. In addition, we explored attitudes to the notion of climate change. Surveys, informed by the interview data and the literature were then constructed and used on a sample of 1,008 people from the four sites in order to generalize results from the interviews. Rasch analyses were used to quantify the factors identified; these were then used in a structural equation model (SEM) to assess Bronfenbrenner's theory of influences upon disaster resilience. Structural equation modelling provided identification of the links between the various factors shown to support resilience. Our analyses were used to assess levels of individual resilience to, and preparedness for, disaster events by site and across all four sites.

Results of our SEMs showed that disaster resilience across all sites was both an individual trait and a process facilitated by adaptability and community factors. By far the strongest direct pathways to resilience arose from a sense of place and adaptability. Indirect influences upon resilience, mediated by adaptability, were financial capacity, family and friends' support, communications about the natural hazard and climate change knowledge and trust in climate change communication sources. The sources of support for individual and community resilience are distributed across Bronfenbrenner's ecosystem levels with a varying degree of importance. Across all research sites generic factors that enhance disaster resilience are

microsystem support; a sense of place; financial capacity and climate change knowledge; and trust for climate change communications.

We also demonstrated that communications, council disaster preparedness and response to the disaster, and local community group responses to the disaster supported community resilience, as indicated by individual's endorsement of community recovery and council function. These were most positive for Beechworth and Ingham, least positive for Bendigo.

Household preparedness is highly predicted by financial capacity, and by adaptability and resilience. As a result, lack of financial capacity renders individuals and households vulnerable to disasters. Financial support available to individuals from state and federal agencies and charity groups were not directly linked to individual resilience, but rather linked to potentially leaving the community. Therefore, we surmise that these factors were both individual and community resilience supports since without them individuals would have left the community, leaving it depleted in numbers and, in line with our hypothesis, rendering the community less resilient.

Individual safety and wellbeing is likely to be a strong contributor to community resilience and recovery. More research needs to be conducted to clarify this.

The demographic profiles of each of the four communities comparing pre disaster community data with post-disaster community data supported our hypothesis that individuals remaining in the community were likely to be resilient and that these communities were resilient to disaster since they had a stable population despite the impact of disasters. However, for the individuals who endorsed leaving the community, whose resilience was not supported by the other community factors, the financial support from state and federal bodies sustained them, helped them stay in the community, thus possibly increasing their disaster resilience.

It is important to note that the relationship between climate change views and disaster experience is very complex and needs further exploration, particularly in rural and regional areas of Australia.

Based on our findings, we make the following recommendations to emergency managers and policy makers:

- Unique community characteristics make every community different in the levels of individuals' resilience to disasters and the factors supporting resilience. Policies must be tailored to the needs of each community. These must identify and provided targeted assistance to the most vulnerable. Our research identified that those who were economically marginalised, older in age (over 55) and less well educated were at risk.

- Accurate and timely communications in advance are critical to preparedness and must be a core component of emergency management. One important and related finding from our research was that prior experience sometimes resulted in an unhelpful "wait and see" attitude which was detrimental to preparedness. Positive role models for disaster preparedness can increase individuals' disaster resilience through powerful social learning so their promotion should be a component of disaster policies and initiatives.

- As preparedness was predicted by financial capacity, policies and programs need to provide specific assistance to those whose financial circumstances prevent them from adequately preparing for disasters. This may take the form of

subsidised insurance to diminish dependence upon charity assistance for disasters.

- Prompt restoration of infrastructure and essential services were critical to community and individual resilience. Planning to strengthen these services, by examining system weakness and vulnerabilities, should be a priority.

- Policies and initiatives must also recognise the importance of social connectedness in building community resilience, by fostering stronger connections between neighbours and increasing a community's sense of place though local community programs.

- Education needs to play a prominent role in promoting adaptation to climate change and, as a corollary, enhancing disaster resilience. Our results showed gaps in awareness and understanding of climate change in the community, which will prevent appropriate adaptation to climate change risks, as well as significant mistrust of sources of climate change information. We suggest that schools are the most appropriate forum for climate change information, with up to date evidence-based information about the risks and responses needed for climate change. There is a corresponding need to ensure that current and future teachers are aware of climate change science by developing appropriate training in this regard to correct gaps in their knowledge and understanding.

1. INTRODUCTION AND PROJECT OVERVIEW

Climate change risk scenarios for the future (2030) show a high probability of increased average temperatures, sea level rises and water cycle implications across Australia, including higher intensity and frequency of floods, storm surges, droughts and a greater number of hot to very hot days (BOM and CSIRO 2012; Hennessy et al. 2007). Recent reviews of climate change science have resulted in bringing forward the predicted timing of such events (Steffen 2009). These predicted climate change impacts upon Australia mean that we urgently need to understand how individuals will cope and what will promote community resilience. Such knowledge is necessary to implement strategic policy responses to promote individual, community and national resilience to climate change events. The need to formulate policy to deal with climate change predictions has been identified (e.g. Bosomworth and Handmer 2008; Bosher et al. 2009; Council of Australian Governments 2009a).

Climate change brings both rapid and slow onset events, requiring differing responses to facilitate resilience. Rapid onset events, such as cyclones, require an immediate emergency management response, such as community evacuation plans, or preparedness in the form of mandated mitigation, such as storm shutters. Slow onset hazards on the other hand such as drought and famine may allow an individual or community the opportunity to change or modify existing behaviours and practices to reduce the impact of the hazard while the event is unfolding. Indicators of resilience in this scenario might include conversion to drought-resistant crop species, water conservation at individual or community level, or the development of more sustainable land use practices. Climate change, therefore, poses challenges through a range of impacts so that resilience at individual and community levels requires multilevel preparedness, responses and mitigation strategies.

Resilience has been variously defined depending on the level of analysis, for example, individual, community or ecological system. Most definitions incorporate a stressor and the notion of adaptation and return to pre-stressor levels of functioning (Norris et al. 2008b). Because climate change impacts involve both rapid and slow onset stressors, a resilience definition adopted here is: "*a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance"* (Norris et al. 2008b, p.130). This definition can be applied to individual and community resilience. Many studies support the notion that a person's resilience is promoted by two groups of generic factors:

(1) personal attributes such as social competence, problem solving, autonomy, self-efficacy and sense of future and purpose and
(2) contextual and environmental influences such as peers, family, work, school and local community (e.g. Handmer 2003; Paton and Johnston, 2001;Paton 2008; Rutter 1987; Rutter 1990; Sun and Stewart 2007; Werner 2000). This, however, cannot be said about community resilience.

Numerous studies which have examined individual's responses to rapid onset hazards such as cyclones, bushfires and tsunamis focused on a behavioural level of analysis and individual resilience (e.g. Brenkert and Malone 2005; Li 2009; Paton 2006; Paton 2008), although some investigators focused on family resilience (Patterson 2002) or school resilience (Wang and Gordon 1994). Few studies, however, have used a pluralistic community based research design (e.g. Bosher et al. 2009; Bruneau et al. 2003; Li 2009) which is essential for a better understanding of resilience at a community level (Norris et al. 2008a). Community resilience cannot be assumed from evidence of individuals' resilience because within a community the range of levels of

resilience is dependent upon individual susceptibility. More sophisticated measures are needed to link community level indicators with individual level indicators of resilience.

Empirical studies linking individual to community resilience are scarce world-wide, and non-existent in Australia, especially in relation to predicted climate change impacts. Some studies have examined how individual-level perceptions of community resilience (Kimhi and Shamai 2004; Pooley et al. 2006), sense of community (Paton et al. 2001), or collective efficacy (Benight 2004) correlate with individual-level outcomes, but no study appears to have examined how independently assessed community resources influence the post-disaster resilience of community or individuals. For example, how does the degree of pre-disaster economic diversity of a community affect the resilience of different groups of individuals post-disaster? This is problematic because developmental science and ecological science perspectives intersect to explain resilience at both individual and community levels (e.g. Cutter et al. 2008; Evans 2011; Masten and Obradovic 2009). Moreover, some studies have identified that an individual's resilience might in fact be a barrier to the development of community level resilience (Li 2009; Sapountzaki 2007). This is due to the interdependence of social and economic networks influencing community resilience to disasters (McIvor and Paton 2007; Stewart, Kolluru and Smith 2009). Research is needed to clarify these issues in Australia.

As resilience at individual and community level has repeatedly been found to rest on relationships between social and community factors (Luthar 2006; Walker and Salt 2006), a systems approach was adopted. It was acknowledged that individuals, households, organisations, communities and governments all interact in a systemic manner to support or impede resilience. Bronfenbrenner's bioecological theory (1979; 1989) provides a most suitable framework of analysis to explore these relationships. The use of this model, hitherto restricted to developmental studies, will allow us to measure the influence of microsystem, mesosystem and macrosystem factors upon an individual's resilience. An indication of community resilience will also be obtained through the interconnections of these factors across systems. Results can be used for strategic interventions and policies because the model can indicate where they will have maximum effect to build future resilience to climate change impacts. Further, such a model can be used to evaluate *interventions over time* in *longitudinal evaluations* as well as interventions in diverse types of community, for example, metropolitan areas. An advantage of Bronfenbrenner's theory is it allows influences across, between and within systems to be estimated and addressed.

Disasters and climate change impacts are cross-scale in their impact, disrupting functioning across multiple levels of socio-cultural systems in which individuals lives are embedded. For the purposes of this study, community resilience to disasters served as a proxy measure of resilience to climate change. The use of Bronfenbrenner's theory to analyse community resilience provides a comprehensive framework to evaluate the interacting factors that support resilience at the community level. This has not been attempted to date in the context of climate change, however, it is increasingly applied to socio-environmental interfaces (Pilon 2009) to understand the social dimensions of sustainability (Dillard, Dujon and King 2009).

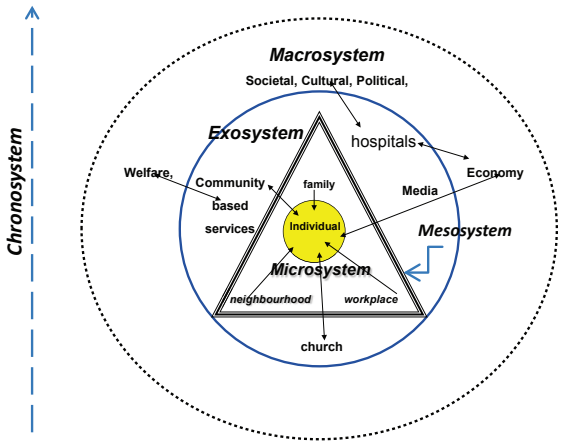

Figure 1.1 Conceptual scheme of Bronfenbrenner's systems and their interactions (Diagram constructed by author to illustrate Bronfenbrenner's theories)

Bronfenbrenner structures an individual's social context into five areas (Bronfenbrenner 1989):

Microsystem – where the individual participates directly.

Mesosystem – microsystem member interactions not interactions by the individual, for example, family member communications, family and work mates' communications

Exosystem – community entities and organisations, e.g. council, hospital that might be accessed by the individual or their family

Macrosystem – the politics, views and customs that represent the cultural fabric of the individuals' society.

Chronosystem – the elements of time as they relate to events in the individual's environment.

Our approach rejects a vulnerability focus for the more positive approach of resilience, variously understood but thought to include the capacity to cope and adapt (see Handmer 2003).

The project aimed to:

- Identify private and public sector groups' *beliefs*, *behaviours* and *policies* that have supported *community resilience* to a disaster event.

- Construct a model with findings to help implement appropriate and equitable emergency management policies and mitigation[1] strategies for climate change events.

The case study design of this project used a multi method approach for gathering data, with respect to specific instances of a case, thereby it is suited to the project's goals

[1] The term mitigation in this context refers to mitigation as: "…the amelioration of disaster risk through the reduction of existing hazards, exposure, or vulnerability, including the use of different disaster preparedness measures" (IPCC 2012, p36).

(Stake 1994). It was considered necessary to examine resilience over multiple sites and to include a mixed methods approach to determine not only the nature of the issues (qualitative), but the extent of the issues (quantitative), and the relationships between them (statistical modelling) to allow for levels of generalisation not possible from more narrowly focused case studies.

We investigated strategies implemented by individuals and community/local government groups in four different disaster impacted sites.

Our analyses were used to model levels of resilience to, and preparedness for, disaster events, so as to assess the degree of community resilience to disasters.

The resilience of a community to disaster impacts was considered to be a measure of the extent to which it can withstand, adapt to and/or recover from the adverse event in a *timely manner*. The four sites of interest in this report were chosen because they exemplify communities impacted by different types of disaster events with different levels of impact, but also because at the time of the research they were in different chronological stages after the impact of the hazard events.

The case study sites chosen were Beechworth and Bendigo in Victoria and Ingham and Innisfail in Queensland, each with a different disaster experience – bushfire, drought, flood and cyclone respectively. The time frames since experience of the events were: 1 year, 8 years, 1 year and 5 years respectively.

A step-wise mixed methods approach was taken to collect the data. Demographic data were used to profile communities for comparison, determine representativeness of samples, and to compare pre- and post- disaster impact on community profiles. Qualitative individual and group interviews were conducted at the locations to identify the types of issues that arose for communities regarding resilience to disasters and attitudes to the notion of climate change. Quantitative surveys were then conducted at the four locations to identify the extent that the experiences and attitudes reported could be generalized. Rasch analyses were used to quantify the factors identified; these were then used in a structural equation model (SEM) to verify Bronfenbrenner's theory of influences upon disaster resilience. Structural equation modelling provided identification of the links between the various factors shown to support resilience. Our analyses were used to model levels of individual resilience to, and preparedness for, disaster events.

1.1 Structure of the report

Chapter 1: Introduction and overview

Chapter 2: Literature review

Chapter 3: Project methods

Chapter 4: Demographic profiles of the Ingham, Innisfail, Beechworth and Bendigo

Chapter 5: Qualitative results

Chapter 6: Quantitative results

Chapter 7: Synthesis of all analyses

Chapter 8: Conclusions and recommendations

2. LITERATURE REVIEW

2.1 The utility of Bronfenbrenner's bioecological theory for examining community resilience to natural disasters

This review outlines conceptions of community resilience to natural disasters. In a context of predictions of heightened climatic uncertainty brought about by global climate change, there is an urgent need to examine and build community resilience to natural disasters such as floods, cyclones, fires and droughts.

The review begins with a brief description of climate change predictions and the need to build community resilience to prepare for an anticipated increase in natural disasters. Concepts of resilience follow, in particular community resilience, with a discussion of some issues arising in relation to the measurement of resilience. A theoretical lens based on Bronfenbrenner's bioecological systems theory is then proffered as best suited to examine and assess resilience at different scales. Diverse empirical studies examining resilience to natural disasters are then described, with the aim of documenting factors shown to enhance resilience, because the capacity of society to measure resilience is essential for assessing whether planning for resilience has been successful. Finally, gaps in the literature are discussed and future research suggested.

2.2 Introduction and background

The world's climate is experiencing marked changes. The IPCC, the world's authoritative scientific climate change scientific body considers it unequivocal that the world will experience warming in the 21st century as a result of anthropogenic greenhouse gas emissions (IPCC 2007a). This is set to be accompanied by an increase in the number and severity of natural disasters, such as floods, bushfires and droughts.

For Australia, climate change has a wide range of projected impacts. Details of these projections including spatial variations in projected changes are available at http://www.climatechangeinaustralia.gov.au/. The magnitude of change predicted depends on assumptions about the rate of emissions of greenhouse gases, as well as other variables. The relative uncertainty inherent in modelling processes, particularly at the regional level, make it difficult to give accurate downscaled predictions of climate change impacts on a fine scale. Nonetheless, at minimum, a 'wetter and warmer' to 'drier and warmer' Australia is foreseen, with an increased frequency and severity of droughts, heat waves and natural disasters such as floods (IPCC 2007b).

2.3 Resilience as a "mantra" for community protection against climate change induced natural disasters

The need to formulate policy to deal with climate change predictions has been identified (e.g. Bosomworth and Handmer, 2008; Bosher et al. 2009; COAG, 2009a). Australia needs to be prepared for climate change induced natural disasters, which might be rapid or slow onset events. Rapid onset events such as cyclones generate an immediate emergency management response, as well as mandated mitigation strategies aimed at building regulations; slow onset hazards, such as drought, may allow an individual or a community the opportunity to change or modify existing practices to reduce the impact of the hazard even while it is unfolding. Therefore, in response to climate change induced disasters resilience as an individual and community attribute is being explored.

Emergency Management (EM) has adopted resilience as a key feature for safeguarding communities or building safer communities. Disaster resilience is seen

as a quality, characteristic or result that is generated or developed by the processes that foster or promote it. When talking about resilience, the human role played in disasters is recognized in: taking responsibility for action, having a disaster plan, building capabilities to implement the plan, purchasing insurance and sharing information on recovery priorities. These are all steps that can enhance resilience and hence the ability of an individual, group, community or nation to deal with unique destabilising situations. In the current disaster management context, disaster resilience is also seen as the:

…'shield', 'shock absorber' or buffer that moderates the outcome to ensure benign or small-scale negative consequences. Indeed, the goal of disaster risk management is to guarantee minimal loss of life and livelihoods and to allow the affected community or system to return to 'normal' within the shortest possible time (Manyena 2006b, p.438).

Prosser and Peters (2010) claim that a disaster resilient community can be developed through thinking along the lines described by the Prevention, Preparedness, Response and Recovery (PPPP) model. This forms an approach to emergency management based on the need for:

- Prevention: to hinder, deter and mitigate disasters, while maintaining readiness to deal with disaster events.
- Preparedness: to protect our people, assets, infrastructure and institutions from disaster events; and to establish, train and exercise arrangements to respond to, and recover from a disaster event.
- Response: to respond rapidly and decisively to a disaster event and manage its immediate consequences.
- Recovery: to return national and community life to normal as quickly as possible after a disaster event, through the restoration of social, economic, physical and environmental wellbeing.

Current EM policy aims to use the PPPP model to work towards a more disaster resilient Australia, one that recognises current and future risks, reduces and manages those risks, is better adapted to change and able to recover from disasters (COAG 2009a).

Similar views have been observed overseas. Berkes (2007), Folke, Colding and Berkes (2003) and Tompkins and Adger (2004) assert that building resilience into community systems is essential in order to cope with climate change and concomitant natural disasters. Four clusters of variables spanning temporal and spatial scales relevant to building resilience are cited:

> (1) Learning to live with change and uncertainty by being prepared and learning from previous experiences
> (2) Nurturing ecological and social diversity for increasing options in the face of hazards and reducing risks much like a diversified investment portfolio
> (3) Increasing the range of knowledge for learning and problem-solving by incorporating both science and traditional local knowledge to derive the best response to surprise events such as extreme weather events and
> (4) Creating opportunities for self-organisation, including strengthening of local institutions and building cross-scale linkages and problem-solving networks, not simply relying in top-down approaches to management.

As Gunderson (2010) argues, community members that can conceptualize and look forward to the future are able to develop alternative plans for recovery and renewal that allow the system to develop in a new and different trajectory.

Resilience has been variously defined depending on the level of analysis, for example, individual, community or ecological system. Most definitions incorporate a stressor and the notion of adaptation and return to pre-stressor levels of functioning (Norris et al. 2008b). Because climate change impacts involve both rapid and slow onset stressors, the resilience definition adopted here is: "a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance" (Norris et al. 2008b, p.130). This definition can be applied to individual and community resilience.

2.4 Literature review search execution and article screening

The search was executed on 1 November 2010. The search engine Scopus was investigated for listings which contained the word "resilience" in their abstract, title or as part of their keywords; this resulted in 17401 items. This search was saved and it was further interrogated to extract articles including the word "disaster". This reduced the number of articles pertaining to disaster and resilience to 1252. Within this group, only the listings from the subject areas of psychology, social sciences, medicine and environmental science were retained, leaving 959 items. These items were further categorised to exclude those from earth and planetary sciences, accounting and business, agricultural and biological sciences and engineering. The 774 remaining items included peer reviewed publications from medicine, psychology, social science, environmental science, health professions, nursing as well as multidisciplinary articles. The citations and abstracts of the final *774 publications* were then reviewed by the lead author and the research assistant for relevance to the purpose of the study, namely either individual or community resilience. Finally, empirical studies reporting research in the context of flood, fire, cyclone/hurricane or drought were reviewed separately for the purpose of compiling empirically derived indicators of resilience at individual or community scales of measurement.

2.5 Definitions of important terms

2.5.1 Disaster

A disaster is defined as a "serious disruption affecting a community or population, causing deaths, injuries, or damage to property, livelihoods, or the environment, that exceeds the ability of the affected community to cope using its own resources" (UN/ISDR 2004, p.17). Natural disasters include earthquakes, tsunamis, floods, windstorms, famine, droughts, epidemics, mass displacement of people, conflicts and examples of man-made or technological disasters are industrial accidents, chemical spills, fires, explosions and the like. Geographical location is linked to earthquakes and tsunamis but climate change and environmental degradation are changing the occurrence of weather-related hazards such as floods, droughts, fires and hurricanes/cyclones.

2.5.2 Community

'Community' has been defined in many different ways from diverse disciplinary perspectives (Kumar 2005). A community can be a group of people coming together in physical, environmental, economic, relational, political or social ways (Kumar 2005). Individuals might belong to many different communities, depending on the context and emergent issue. For the purposes of this report, 'community' is defined in three ways: those who live in a similar region; those who relate to each other as a community; and those who come together in response to an issue such as a disaster. In relation to environmental and social change, each of these types of community enacts similar

processes, however, only the first, community defined by geography, is of a longer term nature. To support the choice of definition above, a discussion of the range and emergence of different of communities follows.

2.5.3 Community of place / community of interest

A community can be defined in physical or environmental terms as a group of people living in the same area ('geographic community') (Kelly 2000). Depending on the context or issue, a community of interest will emerge, which will be differentially bounded and delimited. For example, in terms of water management reform; this could be a town or region that relies on a particular source of water.

A community can also be defined as a group of people who have similar characteristics. In relation to drought management and access to water resources, this might be a group of irrigators who use the same water source for irrigation. It could also include locals as well as visitors who use a given river or lake for recreational activities. A community of interest can also arise in response to shared values about water (Stenekes et al.. 2008). This may include the values of particular indigenous groups or environmental groups. Kelly (2000) distinguishes communities of interest from geographical communities: "while territorial communities emphasise people's attachment to place, relational communities describe the social cohesion that manifests through social ties and networks that bind people together". Typically, however, "a community is an entity that has geographic boundaries and shared fate" (Norris et al. 2008, p.128).

2.5.4 Disaster communities

Focusing on disasters, many researchers tend to identify the physical location where a disaster took place along with its name as synonymous with a disaster community. The underlying assumption being that a common set of disaster behaviours exist that supersede differing types of disasters and local cultural differences. In other words, despite variations in a community's baseline, one expects a common set of community level patterns of disaster behaviours. With specific reference to communities impacted by a disaster therefore, Allen (2006, p.84) defines community as the "population living within the territorial bounds of a town or village administrative unit, which is considered to be exposed to a relatively high degree of environmental hazard risk".

Allen's (2006) definition is pragmatic and useful for the purpose of research. However, others proposed that disasters are also significant social constructs, formed within a particular social context (Kirschenbaum 2004; Quarantelli 1998). From this it follows that any individual or family who has links through diverse social networks to others involved in a disaster becomes part of the disaster community. This notion accounts for observations which show that, in practice, as with the recent extensive Queensland floods, disasters touch people who are not directly or physically involved in the actual disaster (Perilla, Norris, and Lavizzo 2002). Disaster boundaries might therefore be extended through such disaster based social networks.

Geographic physical destruction remains important because the extent of physical damage, by creating economic, environmental and human losses, also has an impact on the social networks of interactions in such communities (Kirschenbaum 2004). A disaster community therefore, has a specific geographic disaster epicentre but is perceived and experienced through a complex web of social networks. As Kirschenbaum (2004) eloquently argues, a disaster community depends on a core of social networks connecting those directly or indirectly affected by a disaster. Importantly, these social networks can affect collective community behaviour which might have an impact on community resilience to disasters. Studies have suggested social networks impact on, among other things, local governance (Beall, 2001; Schafft

and Brown 2000), health levels (Berkman 2000), child survival (Adams, Madhavan and Simon 2002) and even happiness (Fowler and Christakis 2008).

2.5.5 Resilience

The concept of resilience has been widely discussed and debated over the last half century. Many definitions have been proposed to capture resilience from a range of academic perspectives: ecological science, social science, human-environment system and natural hazards (Norris et al. 2008; Zhou et al. 2010). Zhou et al. (2010) identified at least twenty-eight definitions of social resilience while Norris et al. (2008) cite twenty-one definitions based at the individual, community, and city scales and from physical, social, ecological and psychological perspectives. An additional confounding issue encountered in the literature is that the terms community and social resilience are sometimes used interchangeably. An understanding of the term's meaning, consistent with its original use, will be easier after considering the term's history.

2.5.6 History of resilience the concept

Resilience is derived from the Latin word *resilio*; meaning 'to jump back' (Klein, Nicholls and Thomalla 2003).Psychologists have used the term to describe individual's coping with trauma and major life events (Bonanno 2005). Other disciplines have used it to connote similar ideas. In Business Management it is described as the capacity to use disruptive events to slingshot an organisation forward (Parsons 2010) and as the ability of companies to return to pre-disaster levels of performance (Sheffi 2006).

The field in which it was originally used, though, is still contested with some saying ecology (Batabyal 1998), while others saying physics (Van der Leeuw and Leygonie 2000). The term gained currency in ecology following the 1973 release of Holling's *Resilience and Stability of Ecological Systems* (Blaikie and Brookfield 1987; Adger 2000; Van der Leeuw and Leygonie 2000; Stockholm Environmental Institute 2004) when it was used it to describe the ability of an ecosystem to absorb and adapt to change while maintaining its existing state of functioning. In the late 1980s, the ecological concept of resilience was applied to understand interactions between people and the environment (Janssen and Ostrom 2006). In that context, the resilience was used to understand the complexity of community-environment interactions, and the complexity of change. However, the earliest studies using the term resilience are found in the disciplines of psychology and psychiatry in the 1940s work of Norman Garmezy, Emmy Werner and Ruth Smith which was focused on understanding the development of psychopathology in children 'at risk'(Waller 2001; Johnson and Wielchelt 2004). These children were 'at risk" of psychopathological disorders due to long-standing stressors such as parental mental illness, perinatal problems, inter-parental conflict, poverty or a combination of the above (Werner 2000). These studies concluded that, in the face of stressors sustained over a period of time, resilience was achieved in children and youths through interplay between adaptive behaviours and particular personality attributes.

Today, resilience is being applied across a number of fields, including disaster management. Nelson, Adger and Brown (2007) argue that resilience provides a useful framework to analyse adaptation processes to disaster and to identify appropriate policy responses in the face of increasing climate change. The adoption, on 22 January 2005, of The Hyogo Framework for Action 2005–2015—also known as 'The Hyogo Declaration'—by the United Nations International Strategy for Disaster Risk Reduction (UNISDR) is a move that has led to an increased focus on what affected communities can do for themselves and how best to strengthen them.

To enhance resilience it is necessary to have a good initial understanding of what it is, its determinants (Klein et al. 1998), and how it can be measured, maintained and

improved (Klein et al. 2003). Resilience has been generally defined in two broad ways: as a desired outcome(s) or as a process leading to a desired outcome(s) (Kaplan 1999; Winkworth, Healy, Woodward, and Camilleri 2009).

Resilience can be investigated at diverse levels: for example individual, community, organisation or ecosystem. Which level one chooses for investigation depends on the issue or question of interest. Conceptually, the simplest level of investigation is located within an individual.

2.5.7 Individual resilience

Bonnano's (2004) definition of resilience postulates that resilience is the ability of an individual to maintain healthy psychological and physical wellbeing despite exposure to adversity. However, there are limitations to this definition in that it does not include the wider community aspects that appear to influence resilience. Therefore, resilience is better described as "the capacity for successful adaptation, positive functioning or competence despite high-risk status, chronic stress, or following prolonged or severe trauma" (Egeland, Carlson and Stroufe 1993, p.517). For humans, adaptation is defined as the process of adjustment to actual or expected climate change, and its effects, in order to moderate harm or exploit beneficial opportunities (Hennessy et al. 2007; IPCC 2012). The difference between adaptation and resilience is, however, that the former refers to strategies in response to potentially harmful circumstances, which in themselves might have unforseen, even negative long term psychological ramifications (Patt and Schroter 2008) whereas the latter, according to literature spanning several decades, is always indicative of thriving or positive psychological and physical health despite adverse circumstances.

In accord with the above definition, Norris et al. (2008, p.133) further propose four indicators of resilience as a manifestation of an individual's adaptation:

(1) Absence of psychopathology;
(2) Healthy patterns of behaviour;
(3) Adequate role functioning at home, school, and/or work; and
(4) High quality of life.

Norris et al. (2008) stress the quicker one returns to pre-event functioning, the greater their resilience. Note here the term functioning rather than state. Functioning does not imply return to status quo but rather healthy functioning which may be different from pre-stressor functioning but is none the less adaptive.

In consideration of temporal aspects, Bonanno (2004) differentiated between recovery and resilience trajectories in relation to psychological resilience. The former involves a period of dysfunction lasting several months or more, followed by a gradual return to pre-event functioning. Resilience, on the other hand, may involve transient disturbances, lasting as long as several weeks, but generally involves a stable trajectory of healthy functioning. Individual resilience is often regarded as a personality trait, such as "hardiness" (Kobasa 1982) or "sense of coherence" (Antonovsky 1987). As a personality trait, resilience includes variables such as the will to live, perception of a situation as challenging, sense of commitment and control, sense of meaning, self-efficacy, and learned resourcefulness (Antonovsky 1987; Kobasa 1982). In addition to personal traits, social relations (such as social support, warmth, and caring) have been empirically identified as crucial to the ability to cope with stressors (Cicchetti and Garmezy 1993; Cowen, Wyman, Work, and Iker 1995). These findings are somewhat similar to results studies that focus on resilient families (Walsh 1998).

Resilience within an individual is also believed to be a process rather than a steady state (Winkworth et al. 2009), with a person's level of resilience potentially varying over their lifetime (Hegney et al. 2007). Polk (1997) emphasizes the psychological growth which occurs as a result of living through adversity and which is available to the individual when future stressors are encountered. Similarly, Aldwin (2007), whose work originates from studies into stress, adaptation and coping, identifies the concept of resilience as appearing to be more than stoicism or survival; it assumes post-stress growth. This dynamic aspect of resilience, i.e. the interaction with the environment and the variation over the lifespan, has regularly been highlighted (Garmezy and Rutter 1983; Connor and Davidson 2003). Gillespie, Chaboyer and Wallis (2007) conducted a concept analysis study of resilience which led them to argue that resilience is the process of struggle against hardship and can be learned at any age. This presents the notion of the concept as an acquired skill, one that is likely to be complex, as Masten and Obradovic (2006, p.22) argue. For them it is not a single trait or process, but a "complex family of concepts". Further, Gillespie et al.'s (2007) conceptual model of resilience postulates that the constructs of self-efficacy, hope and coping are defining attributes of resilience. In sum, it is likely that resilience is an outcome resulting in spite of experiencing a range of stressors over a period of time, in individuals with the capacity to adapt and learn so that they maintain healthy functioning.

In an historical review of the construct, Tusaie and Dyer (2004) concluded that variables found to be influential in the development of resilience could be divided into intrapersonal and environmental variables. Variables that were intrapersonal included cognitive variables (intelligence, optimism, creativity, humour and a belief in one's self) and competencies (coping strategies, social skills, above average memory and educational abilities). Environmental variables included perceived social support. The authors also emphasise the importance of recognising the dynamic, interactive nature of resilience and the interplay between an individual and their broader environment. Luthar and Cicchetti (2000) assert that the challenge for resilience researchers is to identify the underlying mechanisms or processes of resilience and to ensure that resilience-enhancing interventions are soundly based on both theory and prior research findings. To do so, they contend resilience researchers must first empirically identify protective variables from multiple levels of influence (community, family and individual) which might mitigate the negative effects of adverse life circumstances. Further, Luthar and Cicchetti (2000, p.878-879) argue that interventions designed to enhance resilience must carefully match goals and techniques with the "life circumstances and everyday ecologies of the individuals served". Thus, the development of resilience is thought to be based on the synergy between individuals and their environments and experiences.

Empirical evidence to support the above proposals is patchy. The measurement of an individual's resilience is rather difficult because of variations in the definitions used in various studies, variations in age groups and contexts studied, and the preponderance of qualitative studies examining resilience (Atkinson, Martin and Rankin 2009). However, the extensive literature on resilience has identified a consistent set of findings about the elements that comprise resilience (Masten and Obradovic 2006). Concept analysis of resilience research by Polk (1997) isolated dispositional, relational, situational and philosophical variables significant for resilience. These include good health, intelligence, easy-going temperament, sociability, self-efficacy, confidence, optimism, hope, social support, problem-solving ability, an internal locus of control, appraisal skills, flexibility in goal setting and the ability to mobilize available resources. Combinations of these variables have been found to be instrumental in promoting positive trajectories in children who have been abused or neglected, in patients diagnosed with coronary artery disease and in populations exposed to war, trauma or terrorism in relation to post-traumatic stress disorder (Atkinson et al. 2009). For

resilience to disasters, Norris and Stevens (2007) similarly endorse these ideas but with a caveat that economic resilience, in terms of physical capital, employment opportunities and health services, is necessary to support individual resilience. Individual resilience therefore appears to be enmeshed in community level resilience variables and be a necessary part of the social networks in the community to reduce risk (Norris et al. 2007). Further, Norris et al. (2008) argue, people must be informed and allowed to participate in mitigation efforts, with community level system changes taking place before, as well as after disasters to promote safety, calming, efficacy, hope, and connectedness in the aftermath of mass trauma.

2.5.8 Community resilience

By contrast to individual resilience, community resilience is described differently in various studies and defined more loosely (Kulig 2000). Moreover, there is limited empirical data to inform our knowledge of community resilience. In general, the descriptions of community resilience take three different forms:

a) Resistance, which refers to the ability of a community to absorb perturbation (Geis 2000);
b) Recovery, which focuses on the speed and ability to recover from the stressors (Adger 2000; Breton 2001; Patton and Johnston 2001) and
c) Creativity, which addresses the ability of a social system to maintain a constant process of creating and recreating, so that the community not only responds to adversity, but in doing so, reaches a higher level of functioning (Kulig 1996; Kulig and Hanson 1996).

Adger (2000) defines social or community resilience as the ability of communities to withstand external shocks to their social infrastructure. Social resilience like 'individual resilience' must take into account the economic, institutional, social and ecological dimensions of a community (Adger 2000). Community (social) resilience is clearly related to population and its stability. As such, it is also linked to individual resilience. Population movement can be evidence of instability, or the converse, depending on the type of migration. In the face of significant external stress such as a natural hazard impact, population displacement is often an indicator of the breakdown of community social resilience.

"Displacement migration may be caused by a deleterious state of affairs in the home locality (such as loss of assets) and often has negative impacts on social infrastructure in both sending and receiving areas. Where migration is circular in nature and stimulated by the demand to move caused by attractive circumstances elsewhere, often in urban areas, the resource flows associated with remittances can often enhance resilience. Migration, whether circular or in the form of displacement, has both economic and social dimensions" (Adger 2000, p. 355-6).

As a result of a wide ranging literature review in relation to community resilience to disasters arising from natural or manmade disasters, Norris et al. (2008) assert that community resilience is a process. While their investigations excluded chronic environmental hazards such as drought, because the way such stressors unfold over time are different enough to warrant boundaries of the potential applicability of theory and research, they argue that community resilience understanding applies equally well to most types of collective stressors and adversities because the data informing their proposal were gathered from various types of stressors and fields of study. They also cite evidence that disaster location (developed country, developing country) is a stronger predictor of sample-level effects than either disaster type (mass violence, natural, technological) or sample type (child, adult, rescue/recovery) (Norris et al.

2002).They describe two approaches evident in the literature of community resilience: community resilience that prevents disaster-related health or mental health problems of community members and community resilience as it applies to effective organisational behaviour and disaster management. Norris et al. (2008) argue that community resilience involves a set of adaptive capacities and it is a strategy for promoting effective disaster readiness and response, the latter a view also shared by Berkes (2007).

In the wake of Hurricane Katrina, Colten, Kates, and Laska, (2008, p.38) quote and support the definition of community resilience that the federal program Community and Regional Resilience Initiative (CARRI) formulated: "a community or region's capability to prepare for, respond to and recover from significant multi hazard threats with minimum damage to public safety and health, the economy and national security". They emphasise that this goes beyond infrastructure to include individuals' capacity to respond and remain resilient, as Godschalk, (2003, p.140) stresses: "Building a disaster resilient city goes beyond changing land use and physical facilities. It must also build the capacity of the multiple involved communities to anticipate and respond to disasters". Following the lessons learnt from Katrina, Colten et al. (2008) describe resilient communities as those that have: integrated emergency institutions and communications; formal disaster plans; trained emergency responders; a reserve of personnel, material and financial resources; public education and information about risks and potential hazards and long term planning for recovery and vulnerability reduction. One of the crucial elements of community resilience Colten et al. (2008) emphasize is a built environment infrastructure that is capable of withstanding the assault of severe weather hazards and the availability of enough safe neighbourhood refuge shelters in the form of public buildings such as schools, community halls and public civic centres.

Summarising much of the above, Prosser et al. (2010, p.11) maintain a disaster resilient community is "...one that works together to understand and manage the risks that it confronts, but is also aware of the responsibility of all levels of government" adding "an associated challenge will be that of coordinating a whole-of-government approach across federal, state and local governments".

A more stringent conception of community resilience, one closer to the original meaning of the term resilience, is offered by Zhou et al. (2010, p.28). They developed a spatial/temporal/attribute model for community resilience that draws on geographic principles. They claim that using this model, local resiliency with regard to disasters means that a locale is able to withstand a natural hazard without suffering devastating losses, damage, diminished productivity, or quality of life and without much assistance from outside the community. They define disaster resilience as "the capacity of hazard-affected bodies (HABs) to resist loss during disaster and to regenerate and reorganize after disaster in a specific area in a given period".

To assess whether community resilience definitions are accurate, ways of measuring community resilience must be available. Community or social resilience can be assessed at the macro, sociological level through proxy indicators, such as institutional change, economic structure and demographic change. Economic growth, stability of livelihoods, and equitable distribution of income and assets within populations are all proxy measures of community resilience; because of interdependencies at the macroeconomic level, economic resilience depends not only on the capacities of individual businesses, but also on the capacities of all the entities that depend on them and on which they depend (Rose 2004). Not only is the volume of economic resources important to economic resilience but also on their diversity. Dependency on a narrow range of natural resources can increase variance in income across a community and decrease community resilience (Adger 2000; Zhou et al. 2010). Extreme events, such

as droughts, floods, or infestations increase the risk of being dependent on particular resources and therefore decrease resilience. In addition, economic resilience is critical for supporting individuals' psychological resilience because mental health issues related to disaster experiences require formal ongoing support available where there are sufficient economic community resources (Norris and Stevens 2007). Formal sector employment, recorded crime rates and demographic variables as well as mobility and migration can also be used to provide a sense of social or community resilience (Adger 2000)

In considering resilience two matters emerge:

> a) Recovery: how well do people bounce back and recover fully from challenge (Masten 2001; Rutter 1987)? People who are resilient display a greater capacity to quickly regain equilibrium physiologically, psychologically and socially following stressful events, thus also supporting community resilience;
> b) Sustainability: the capacity to continue forward in the face of adversity (Bonanno 2004), which is a particularly important aspect of community resilience, especially in the face of climate change induced natural disasters.

To probe this aspect of resilience we need to know how well people sustain health and meaningful positive engagement within a dynamic and challenging environment. Healthy communities confer a capacity for resilience to their constituents. Community resilience is best assessed by applying ecological principles to the analysis of social systems in terms of these two defining features of resilience: recovery and sustainability (Zautra, Hall and Murray 2008; Gunderson 2010).

The foregoing discussion about individual and community resilience suggests that Bronfenbrenner's model is a suitable lens through which to measure resilience. This is because it links the micro-individual level- to the macro- social /ecological by permitting a modelling of influences on developing resilience.

2.6 Bronfenbrenner's bioecological model of development and resilience

Bronfenbrenner's bioecological systems theory (1979; 1989) is useful for organising variables that enhance individual resilience because each factor can be placed around an individual according to the proximity of the factor in relation to the individual's ecosystem. Using this framework we can evaluate within person characteristics, such as adaptive coping, self-efficacy and optimism as well as variables that are external to the person, such as family support, neighbourhood networks, health provision, state government financial support, federal government financial support and so on and their effectiveness for promoting individual resilience.

Resilience, like development, is said to arise from processes of interaction across multiple levels of functioning, e.g. from genes to neural systems to relationships to individual-media interaction (Masten and Obradovic 2007). Further, a living system must maintain its own functioning or equilibrium and also adapt to environmental conditions. The individual is continually interacting with people, objects, information, and other aspects of the unfolding contexts in which the individual's life is embedded.

Bronfenbrenner's human development model is based on the hypothesis that a child's wellbeing is influenced by its social context and the function and quality of relationships it has with individuals, family, community groups and institutional systems (Bronfenbrenner 1979; Bronfenbrenner 1989; Sun and Stewart 2007). Figure 2.1 shows a conceptual summary of the model, indicating the different levels of influence,

or proximal processes, Bronfenbrenner proposed would impact upon the development of an individual. The individual is thought to develop in a way that is reflective of their interactions within their environment or social contexts (Bronfenbrenner 1979; Bronfenbrenner 1989; Bronfenbrenner and Ceci 1994).

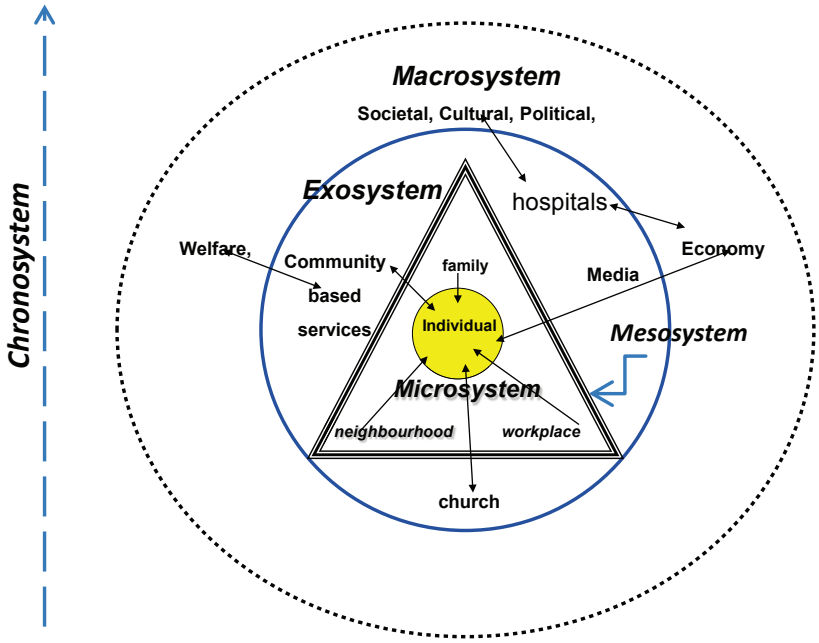

Figure 2.1 Conceptual scheme of Bronfenbrenner's systems and their interactions (Diagram constructed by author to illustrate Bronfenbrenner's theories)

Bronfenbrenner structures an individual's social context into five areas (Bronfenbrenner 1989):

Microsystem – where the individual participates directly.

Mesosystem – microsystem member interactions not individual interactions

Exosystem – entities and organisations that might be accessed by the individual or their family

Macrosystem – the politics, views and customs that represent the cultural fabric of the individuals' society.

Chronosystem – the elements of time as they relate to events in the individual's environment.

The processes and experiences that the individual is exposed to either directly or through proximal interactions with the various systems above are thought to interact with their genetic predispositions to structure their perceptions and responses, their behaviours, their adaptation, coping to stress and resilience, their acquisition of knowledge and skills, the quality and nature of their relationships and the construction of their own physical, social and symbolic environments (Bronfenbrenner and Ceci 1994).

In Bronfenbrenner's model, the individual interacts directly with people, ideas, and things in his or her microsystem, which include family, peers and school systems. A

person is also influenced indirectly by the connections of family members, teachers, and others to additional systems, e.g. a parent's work place or a teachers' union, known as "exosystems". On the largest scale operates the macrosystem such as community, media and national policy.

Human development is also subject to the next level, the mesosystem. This describes how the different parts of an individual's microsystem work together. For example, if a child's caregivers take an active role in a child's school, such as going to parent-teacher conferences and watching their child's soccer games, this will help ensure the child's overall growth. In contrast, if the child's two sets of caretakers, mom with step-dad and dad with step-mom, disagree how to best raise the child and give the child conflicting lessons when they see him, this will hinder the child's growth in different channels.

The exosystem level includes the other people and places which an individual may not interact with often but that still have a large effect on her, such as parents' workplaces, extended family members, the neighbourhood, etc. For example, if a child's parent gets laid off from work, this may have negative effects on the child if her parents are unable to pay rent or to buy groceries.

Bronfenbrenner's final level is the macrosystem, the largest and most remote set of people and structures/organisations from a developing person but which still have a great influence over them. The macrosystem includes things such as the relative freedoms permitted by the national government, cultural values, the economy, wars, etc. These things can also affect resilience either positively or negatively. Macrosystem variables such as type of government, media, cultural biases and mores and religions do have a functional presence in the expectations, values, hopes, training, and knowledge that individuals and local families in communities carry with them all the time, particularly in their memories and know-how which can facilitate the process of resilience (Masten and Obradovic 2007).

An ecological understanding of human development and resilience requires an examination of the influence of community, subculture, and culture on basic psychological and interpersonal processes throughout the lifespan. The extent to which interpersonal and psychological processes facilitate adaptive, positive development varies with relational, familial, social, and cultural contexts and includes bidirectional processes of influence between contexts and the individual. For Bronfenbrenner (1979, p.3) the environment (e.g. home, school, work, community, city, state, nation) within which an individual is located, is conceived of as "a set of nested structures, each inside the next, like a set of Russian dolls". Others concur with this approach.

2.7 Bronfenbrenner's bioecological theory for assessing resilience to a natural disaster

In discussing emergency and disaster risk management planning for the promotion of community resilience to disasters, Cottrell and King (2010) argue for a need to take into consideration community variables that yield a picture of the community at a micro, individual level: characteristics of citizens such as psychological and demographic descriptors, as well as at a macro, community level: characteristics which might include economic, infrastructure, environmental and social infrastructure indicators. They recognize that support for resilience to disaster can be conferred from any level in a geographical community and therefore propose that data is gathered to plan for effective interventions and post-event impact assessments. They invoke a model that parallels Bronfenbrenner's bioecological framework rather closely.

Keim (2008) concurred with the above, urging effective preparation for and response to the increasing threat of natural disasters posed by climate change require integration of resilience variables across interdependent systems and across scales. Because adaptation must occur at the community level, local public health agencies are important organisations to build human resilience to natural disasters (Keim 2008). Illustrating the importance of this, Rodríguez and Aguirre (2006) focused on how hospitals prepared for, responded to, and coped with Hurricane Katrina, USA. Katrina magnified the existing problems and deficiencies of the health system and disrupted the external systems supplying hospitals with key services and resources needed for the organisations to function; increased the number of patients that required medical care and directly affected the physical plants of the hospitals, challenging their functionality. Rodríguez and Aguirre (2006) concluded that for a disaster resilient health care system, highly implicated in community resilience at individual and community levels, planning, access to adequate resources, networking, effective communication and coordination, and training and education of doctors, nurses, technicians, and medical staff are essential in the development of infrastructure that will be able to provide the critical services to populations affected by future disasters. The use of models like Bronfenbrenner's is helpful for the purpose of such planning (Masten and Obradovic 2007). Harney (2007) also argues for Bronfenbrenner's framework, emphasising that it can highlight the interrelationships between individuals and the contexts in which they reside, their communities, and the reciprocal interactive processes occurring between macro- and micro-level contexts. In sum, it is highly likely that community resilience and individual resilience are interdependent and mutually supportive and best examined using a theoretical model such as Bronfenbrenner's.

2.8 Measuring resilience: Theoretical considerations and the interconnectedness of individual and community resilience

Techniques designed to measure resilience need to address the question of resilience of what and to what (Carpenter et al. 2001) and take into account the effects of culture, both historical and contemporary, and experiences (Clauss-Ehlers 2008). Scalar and temporal issues permeate resilience research (Cutter, et al. 2008; Nelson et al. 2007). Questions of how to translate models and data between scales (up scaling and downscaling) and how to characterise the relationships of different components and domains across time and space are critical to the ability to develop assessment tools and to model change and impacts. For example, at the individual level, issues of livelihood come into play, yet at the regional scale the Gross Domestic Product (GDP) is often used as an indicator of resilience (Pelling 2003). Sudden hazards, hurricanes/cyclones, require an immediate response and time for modification in behaviours and practices in the preparedness (pre-event) or post-event (mitigation) phases. Indicators of resilience to such rapid onset events could be community evacuation plans, clear and trusted communication systems, or mandated mitigation such as storm shutters. Hazards that manifest over time, such as climate change, sea level rise, drought and famine, paired with less definitive spatial patterns, sometimes also referred to as ''pressures'' (Cutter et al. 2008), lead to resilience indicators based on adaptive capacity concepts. This is because slow onset events allow an individual or community the opportunity to modify practices to reduce the impact of a hazard as the hazard develops. Indicators of resilience to climate change threat might include for example, conversion to drought- resistant crop species, water conservation and so on. Nelson et al. (2007, p.406) maintain adaptive capacity is specific to "(a) the length and frequency of perturbations, (b) the spatial scale at which perturbations occur, and (c) the organisational scale of focus. Therefore, the scale at which adaptive capacity is analysed has implications for evaluating resilience". The type of resilience we want to assess necessitates a particular scale of measure. For example, Nelson et al. (2007) cite that community adaptation to drought in northeast Brazil entailed livelihood

diversification and agricultural risk management practices by private citizens and on a community scale tapping into collective memory of prior drought events and putting into place irrigation scheme projects by government groups.

A resilient community demonstrates competence characteristics including the ability to recognise, evaluate, and address emerging issues, in other words have a level of preparedness, and is composed of individuals with a willingness to work towards the common good. It is not just rallying together, but also trusting and having members who are willing to work for the common good (Stewart, Kolluru and Smith 2009). Characteristics of community competence include collective action and decision-making, problem solving skills, creativity, and empowerment, all of which are based on collaboration and individuals' characteristics and resilience. However, none of this is possible unless there are also exosystem structures in functional operation such as the reopening of entities like grocery stores, health clinics and banks, so citizens regain their sense of community and start to recover. Stewart et al. (2009) contend that the economic system operates on micro, meso and macro levels before, during, and after disasters and argue that economic resilience must be developed on all three levels.

At the microeconomic level, resilience is bolstered through activities like reinforcing building to improve resistance, conserving resources to better adapt to a situation, and leveraging flexible technologies to better identity alternative sources of supply when local outlets are impacted. While all levels of governments can work with individual businesses to improve microeconomic resilience, meso and macroeconomic resilience focuses more on the interaction of economic sectors and markets. For instance, access to imports represents inherent resilience on the meso and macro levels. Additionally, improving the accuracy and quality of information as it relates to impacted industries/markets demonstrates adaptive resilience on the meso and macro levels. (Stewart et al. 2009 p.356).

The measurement of community resilience, Folke et al. (2002, p.438) argue, needs to include:

> (1) "The magnitude of shock that the system can absorb and remain within a given state;"
> (2) "The degree to which the system is capable of self-organisation;" and;
> (3) "The degree to which the system can build capacity for learning and adaptation".

Such considerations present the issue of what methods are best suited for the assessment of resilience. Flint and Luloff (2005) suggest a mixed methods approach to investigating resilience and adaptive capacity. Powell (1999) and Klein (2009) view qualitative methods in a favourable light. Importantly, Powell (1999) and AHPRC (1999) suggest that qualitative methods at the local level are what will develop more relevant understandings of change in a given context. Given these views, what of the notion of developing indicators of resilience?

Indicators can be selected from information about the population (in the case of socio-economic indicators), developed from either primary (e.g. questionnaires) or secondary (e.g. census) data sources. An indicator must be quantifiable (generally), and needs to be standardised, in order to enable comparison between places and events or over time. Since indicators are derived from societal characteristics, because they describe an idea, construct, theory or model about an aspect of society, the use of indicators must begin with sound theoretical model or construct that is to be examined (King 2001; King and McGregor 2000; Zautra et al. 2008). In addition, a clear understanding of whether an indicator is causal or associative is needed, particularly when assessing

the predictive potential of theoretical models. Key to these matters is temporal issues related to the nature of indicator and sampling techniques. Longitudinal data are always preferable to cross-sectional data for the purpose of prediction and direction of causality. A more thorough depiction of community resilience therefore requires a mix of strategies (Cottrell and King 2010) and also a sound theoretical model (Zautra et al. 2008). Review of the substantial community indicators literature shows that many analogies have been applied to clarify the meaning of indicators, and that indicators have been used to serve different overlapping primary functions including description, simplification, measurement, trend identification, clarification, communication, and catalyst for action (Phillips 2005).

Several researchers have attempted to measure resilience. Cutter et al. (2008) used a theoretical model (DROP: disaster resilience of place) to select indicators to measure community resilience. These indicators were based on different types of resilience thought to contribute to overall community resilience and required different forms of measurement. The types of resilience that Cutter et al. (2008) proposed would act in concert to produce a resilient community of place were: ecological (e.g. biodiversity, governance and management plans; social (e.g. communications, risk awareness, and preparedness, disaster plans, the purchase of insurance- some of these depend on the demographics of the community); economic (e.g. measures of property loss and the effects of business disruption post-event); organisational, including institutions and organisations (e.g. assessments of the physical properties of the organisations such as number of members, communications technology, number of emergency assets such as vehicles, hospital beds, and measures of organisational response to disasters such as leadership); infrastructure (e.g. physical systems themselves such as the number of pipelines, exit/delivery road miles), and community competence, (e.g. local understanding of risk, counselling services, mental health, quality of life, and emotional health). Glavovic, Saunders, and Becker (2010) endorse these views adding also that governments need to mainstream climate change adaptation, which suggests an additional level of measurement.

Following a rationale echoed elsewhere (Bruneau et al. 2003); Cutter, Burtony and Emrichz (2010) developed a set of indicators for measuring baseline resilience of communities using indicators that have been empirically identified to foster resilience. These indicators are based on social, economic, institutional, infrastructural, ecological, and community elements. Their approach stems from the sound notion that, by establishing baseline conditions, it is easier to monitor changes in resilience over time in particular places and to compare one place to another. Their variable selection was based on empirical justification of the variable's relevance to resilience in the US, and on the availability of consistent quality data from national data sources. They tested their model in various communities in the US and found spatial variations in disaster resilience particularly evident in the rural/urban divide, metropolitan areas having higher levels of resilience than rural counties. They also noted that some social, economic, institutional, infrastructure and community capacities as assessed by their model vary widely.

It is important to note that Cutter et al.'s (2010) assessment framework while very comprehensive, did not include ecological measures which often underpin sustainable agricultural practices and livelihoods (Zhou et al. 2010) that have flow on effects to the whole community, or perceptions of quality of life known to underpin individual resilience (Zautra and Bachrach 2000). It could be argued that the impact of ecological variables upon the local economy is indirectly accounted for in their model through their assessment of economic resilience by the measure: single sector employment dependence. The gap in quality of life perception measures, however, is problematic because it is conceivable that there are cases of wealthy, highly organised and disaster

protected communities whose residents nonetheless suffer mental health consequences from the impact of a hazard such as a cyclone, earthquake or other sudden or gradual impact event. All the variables Cutter et al. (2010) use are macro-level measures, based on community scale measures. Their community capital construct, a factor that has significant impact upon resilience at individual as well as at the community level, is a composite of place attachment (measured by immigration and persons living in the community from birth), political engagement (measured by voter participation levels) the number of religious civic and advocacy organisations in the community and the percentage of persons in a community employed in a professional capacity (e.g. scientist, engineer, reporter, lawyer, teacher, doctor, artist). As such, it does not give any indication of individual resilience within a community, a factor critical for community preparedness and recovery post-disaster, ultimately supporting community resilience.

As Norris et al. (2008 p.128) argue: “a collection of resilient individuals does not guarantee a resilient community”. Stewart et al. (2009 p.354) concur stating that while “each citizen, private sector firm, and public sector entity is challenged individually to be resilient, communities cannot expect uncoordinated efforts to improve functioning and adaptation to the consequences of disasters”. Community resilience they contend can only be fostered if the relevant stakeholders, who operate within its economic and social systems, are also resilient. Relevant stakeholders are private and public organisations and infrastructure and their management which might operate at local, state and federal levels (Berkes 2007). These conceptions fit in well with Adger’s (2000) notions of community resilience. Further, since scholars such as Nelson et al., (2007); Stewart et al., (2009); and Zhou et al., (2010) agree that resilient communities integrate the adaptive capabilities of relevant stakeholders to manage the impacts of a disaster and create a positive trajectory of functioning and adaptation, it follows that if the nodes of action, the individuals, are not resilient themselves, then processes leading to resilience will be slower, if not stalled.

Norris et al. (2008a, p.3) sum the basis of a resilient community as being “manifest in population wellness, defined as high and non-disparate levels of mental and behavioural health, functioning, and quality of life” characteristics aggregated at population level from individual resilience. Thus, if individual community members do not contribute to community competence via resilient functioning at individual and family level then infrastructure, social, economic, institutional, and even ecological dimensions of community will be less able to buffer hazards and stressors. On the other hand, it is important to augment the social resilience of communities with economic resilience because the economic systems will provide the resources to adapt and act in ways that remedy the impact of the disaster (Pfefferbaum et al.. 2005). The key message here is that economic community resilience and resources can help support individuals’ resilience (mental health, quality of life perceptions and collective self-efficacy) but individual resilience alone is not sufficient to promote community resilience if the infrastructures, governance and economic underpinning of communities are not present.

2.9 Issues arising from attempts to measure community resilience

The indicators and scale used to measure community resilience need to be carefully thought out to avoid contradictory results. For example, researchers constructed inventories to examine individual's perceptions of their own health and wellbeing (Andrews and Withey 1976; Campbell and Converse 1972). In these efforts, individuals were asked to rate their wellbeing and satisfaction with their own lives. Interestingly, this work uncovered distinct differences between perceptions of quality of life as defined by the subject in contrast to those defined by social indicators. The disconnect

between the two sets of findings suggests the need to incorporate ways of estimating both the social and psychological wellbeing of individuals with community indicators.

The effective measurement of community resilience requires the assessment of social networks. The ability of a geographical community to survive a disaster depends on the size of social networks in its neighbourhoods and on the interconnection between the social networks (Wallace and Wallace 2008). Without social control, for example, even the highest level of policing would not be able to keep violent crime rates low. Even very high levels of public health activity would be unable to keep diseases in check without the support of the social fabric of neighbourhoods. Most importantly, social networks play key roles in disasters to pick up the pieces and save families and the community. The neighbourhood forms a critical level of organisation between the individual or family level and the municipality and metropolitan region (Wallace and Wallace 2008).

To illustrate this, Zautra et al. (2008) compiled a list of attributes and processes necessary for resilient communities of geographic location derived from a range of research studies. They describe resilient communities as having: neighbours that trust one another and interact on a regular basis, residents who own their houses, remain in the area for a length of time, have a sense of community and cohesion and work together for the common good with involvement in community events and affairs and place which also have formal and informal civic spaces for gathering.

When assessing a community's resilience, therefore, there is a need to include indicators at diverse scales of measurement, perhaps by triangulating community level indicators from the perspective of stakeholders with those emanating from the perspective of individual citizens.

2.10 Indicators

The search for suitable indicators needs to be confined to those pertaining to disaster resilience of a community. Several types of resilience are distinguished in the literature requiring different forms of measurement and temporal scales, depending on whether they pertain to ecological, social, economic, infrastructure or institutional resilience and community competence (Cutter et al. 2008).

"The conditions defining resilience are dynamic and ultimately change with differences in spatial, social, and temporal scales. A community may be deemed resilient to environmental hazards at one time scale (e.g. short-term phenomena such as severe weather) due to some mitigation measures that have been adopted, but not another (e.g. long-term such as climate change)." (Cutter et al. 2008, p.603)

Bonanno and Mancini (2008) reviewed the available evidence on variables that predict resilience to traumatic events, such as natural disasters, and distilled a number of variables that promote resilience. They found them to be heterogeneous and to include a variety of person-centred variables (e.g. temperament of the child, personality, coping strategies), demographic variables (e.g. male gender, older age, greater education), and socio-contextual variables (e.g. supportive relations, community resources).

Adger (2000) referred to community resilience in terms of resource dependency, that is, the quantity and quality of resources on which a community relies and the extent to which these can be modified. Breton (2001) and Murphy (2007) claim that resilience is dependent upon a stock of human and social capital, consisting of people, networks, of local voluntary associations, through which members of the community can be mobilised for action, and an adequate services infrastructure. Cutter et al. (2008) assert that social or community resilience can be increased through improvements in communications, risk awareness, and preparedness, through the development and

implementation of disaster plans, the purchase of insurance, and the sharing of information to aid in the recovery process. Some of these are a function of the demographic characteristics of the community and its access to resources.

Clauss-Ehlers and Lopez-Levy (2002) saw to community resilience as culture-dependent, affected by ethnicity and social class (Clauss-Ehlers 2008). In their study of Latino and Mexican youth living in the United States, they identified three variables crucial to community resilience: the obligation to nuclear and extended family members; the authority of the elder community members; and the character of relationships, which are valued for their own merit and not as a means to some other end. Such propositions require measures that include contextual or ecological considerations.

The foregoing shows that the selection of indicators depends on the scale chosen for measurement, individual or community. Indicators should also include cultural, demographic, psychological as well as socio-contextual variables. Given that individual and community resilience appear to be interconnected, a theoretical model capable of incorporating analyses of individual and community indicators is preferable.

2.11 Support for the use of Bronfenbrenner's theoretical model for assessing disaster resilience

A number of researchers have cited support for using Bronfenbrenner's theoretical lens in the study of resilience. Kiter Edwards (1998) argued for the use of Bronfenbrenner's theory in examining psychological resilience to disaster because family processes and characteristics, as well as particular features of the disaster event, can be incorporated into the model and their impact assessed. Measures like suddenness of impact, duration of the event, degree of climatic discomfort or evacuation shelter conditions, perception of future risk of the disaster and the like can be incorporated into the assessment of resilience via this model.

Masten and Obradovic (2007), Sun and Stewart (2007) and Mowbray et al. (2007) described the linkage between the individual and family to the larger social environment of neighbourhood entities, such as the school and the neighbourhood social network, and how they influence individual resilience and family function. Bürgin and Steck (2008) concurred, stressing that individual characteristics or indicators of resilience do not overcome the effects of high environmental challenges like poor parenting, antisocial peers, low resource communities and economic hardship. Swick and Williams (2006) similarly advocate an ecological approach to support stress affected families and build resilience.

Tummala-Narra (2007) stresses that for many ethnic minorities, notions of resilience shaped largely by middle class European and North American values may not capture positive adaptation to adverse and traumatic experience that is culturally recognised and understood. Therefore, to study responses to trauma of those from different ethnic groups Bronfenbrenner's model offers a more complete framework of interpretation.

In describing psychological trauma, trauma recovery, and resilience, Harvey (1996) stressed the relevance of the ecological tenets of community psychology to the study and promotion of resilience in trauma survivors (Harvey 2007). Both Harvey and Bronfenbrenner emphasized the interdependence of person and context in the individually varied responses to traumatic events (Harvey 1996; Harvey 2007).

Bates and Pelanda (1994) maintained that ecological models offer a promising theoretical advancement in the interdisciplinary study of disasters and mental health because they acknowledge the interplay of forces that influence individual stress and

coping, recognizing human behaviour as an integrated negotiated response to individuals, families, organisations and institutions that exist within a constantly changing physical environment (Bates and Pelanda 1994; Kiter Edwards 1998; Waller 2001). In disaster situations, for example, disaster victims may have to negotiate harsh weather conditions (extreme exposure to heat or cold), health hazards (toxins, disease, wounds), and crowded or otherwise inadequate living conditions. More detrimental effects on wellbeing, even fatalities, may occur for events that have no warning phase because people do not have time to prepare for the impact, as in the recent flash flooding that took place in Queensland in 2011.

Berger (2005) used Bronfenbrenner's to develop an application to build community resilience and reduce trauma in disaster affected individuals. They concluded that adopting a multi-systemic approach was effective, not only in dealing with individuals and families, but also in changing the mood and functioning of the community. Ager, Stark, Akesson and Boothby (2010), Kumfer and Summerhays (2006), Landau, (2007), Mertensmeyer and Fine (2009) and Ungar (2010) cite similar theoretical frameworks for assessing, initiating and sustaining change in traumatised individuals and families.

At a different level, Stewart et al. (2009) discuss the interrelationships between public and private organisations to support community resilience and described a model of interaction that paralleled Bronfenbrenner's framework. Community resilience is embedded within its economic and social systems. While each citizen, private sector firm and public sector entity is challenged individually to be resilient, their efforts need to be coordinated to function and adapt to the consequences of disasters. For a response to a disaster to be adequate for community recovery and resilience, urgent decision-making needs to bring public and private sectors together to collaborate at the local, state, and federal levels. As such, this invokes the role played by politics (a macrosystem issue) as well as the roles played by exosystem and mesosystem organisations to promote the resilience process. The response to disasters begins at the local level and must become a local/state level event before garnering the resources of the federal government. Stewart et al. (2009) describe how private-public interaction can vary relative to government levels. First, federal agencies should typically interact with industry associations or large firms which have a national presence. Second, state level agencies should interact with industry associations that are important to the state's economy and firms which have the capacity to respond to regional level disasters. Third, local level governments should interact with local and/or regional companies to build resilience within supply chains that have a vested interest in the local community.

2.12 Empirically derived "generic" resilience indicators to disaster

The most rigorous assessments of resilience should include pre and post individual/community snapshots of resilience indicators to disaster or indeed any stressor; therefore, longitudinal data are required. These, however, are generally not easily obtained, particularly in relation to disasters or, more specifically, climate change induced disaster scenarios.

At present, the best we have at our disposal worldwide are case studies of disaster impacted communities which measure resilience at various levels, individual, family community and so on. However, few if any are of a longitudinal nature such that community preparedness, recovery and resilience can be estimated. In most published studies of community resilience to disaster and traumatic events, the research design has taken either a sociological, macro perspective or a psychological, micro perspective. Rarely, if ever, have the two been used at the same time to triangulate findings even when Bronfenbrenner's theory, or similar analytic framework, is cited as the conceptual framework with which to measure resilience. Therefore, the indicators

and studies cited below are either examples of macro sociological indicators of resilience or micro, individual psychological indicators. These are derived using a range of methodological approaches, in different contexts and with variable samples. The lack of methodological consistency across the studies makes it difficult to extract resilience indicators with great certainly at any scale.

Notwithstanding the above, Kiem et al. (2010, p.40) reviewed recent case studies of Australian communities impacted by natural hazards and summarised the integrated findings on community resilience. They noted that those living in a community that has experienced, and is predicted to experience future natural hazards, are more likely to be involved in processes adaptive to the risks inherent in their locale, and be prepared for extreme events. They summarise that a resilient community is most likely to be:

Convinced: about the reality of climate change and the need for action;

Informed: about what is likely to happen, and realistic about the uncertainties;

Prepared: to act to respond to climate change;

Responsive: to new knowledge about the risks from climate change and the potential for response;

Connected: knows about and supports its vulnerable members;

Flexible: willing to take on board new ways of doing things, even transformational changes.

Therefore preparedness, conceptual as well as physical, is an important factor supporting resilience; it also seems to support adaptive capacity[2]. Others also endorse the view that public preparedness for disaster (mental/ physical) enhances adaptive capacity and resilience (Rodríguez, Trainor, and Quarantelli 2006).

Such contentions are plausible because evidence of decreased adaptive capacity is observed in those who had suffered personal property loss and social community loss (Caldera et al. 2001; Norris 2002; Armenian et al. 2002; Middleton and Willner 2002). Davidson and McFarlane (2006) found that disasters associated with psychological impairment, impeding individual resilience and possibly community resilience if widespread, include those with at least two of the following characteristics: a disaster with a high prevalence of physical injury; threat to or actual loss of life; widespread property damage; serious ongoing financial difficulty; or involvement of human carelessness or intent. Further, Regehr, Roberts and Bober (2008) conclude from a review of a number of empirical studies that acts of God are viewed differently and affect communities differently from man-made disasters and, therefore, response and recovery from a disaster depends on the nature of the disaster faced by a community.

Frequency of the disaster can affect adaptive capacity, such that the greater the number of disasters sustained the more difficult for a community to be resilient to them. For example, a community subjected to prolonged drought might not be able to sustain an additional disaster event such as fire.

Future uncertainty can affect individual and community adaptive capacity, and hence the resilience of the individual and the community.

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[2] Adaptive capacity: the ability to take action to avoid or reduce the impacts, or to take advantage of the benefits, of climate change (after Parry et al., 2007), or the degree to which a system can build and increase the capacity for learning and adaptation (Folke et al.2002). In other words, it is more than willingness to adapt, or adaptability.

Prior levels of functioning of a community and an individual will affect adaptive capacity and hence resilience.

Gaillard (2007) set out to address the response of traditional societies in facing natural hazards through the lens of the concept of resilience, based on a review of case studies available in the literature. These were mainly based on the experience of volcanic eruption or earthquake and one case study of hurricanes. Resilient societies were defined as those able to overcome the damage caused by the occurrence of natural hazards, either through maintaining their pre-disaster social fabric, or through accepting marginal or larger change in order to survive. Gaillard (2007) concluded that resilience of traditional societies and degree of cultural change and adaptation depend on four variables: the nature of the hazard, the pre-disaster socio-cultural context and capacity of resilience of the community, the geographical setting, and the rehabilitation policy set up by the authorities. These variables vary in time and space, from one disaster to another, but show the multi-factorial nature of resilience and the importance of viewing it through a lens such as Bronfenbrenner's framework.

One of the initial variables that has an effect upon community response and concomitant effects upon recovery and resilience is communication and access to information (Norris and Stevens 2007). Information may be the primary resource in technical and organisational systems that enable adaptive performance (Norris et al. 2008). Longstaff (2005, p.55) argued that information increases survival only if is ''correct and correctly transmitted''. In emergencies, when time is limited, it is also important that the information is received from trusted sources. Closer, local sources of information are more likely to be relied upon than unfamiliar, distant sources. ''A trusted source of information is the most important resilience asset that any individual or group can have'' (Longstaff 2005 p. 62).

Beyond the immediate response to a disaster, a period of recovery ensues and this period will be subject to various influences. The process of recovery will vary depending on the personal, cultural, social, economic and political variables at play (Caruana 2009) as well as the extent of the exposure to the disaster and the number of stressors experienced during the disaster (Verger et al. 2003).

The majority of those who survive a natural disaster report distress of some degree soon after, but most symptoms will resolve a year or so after the traumatic event (Bonanno and Mancini 2008; Gordon 2005; Kazantzis, et al. 2009; Norris et al. 2008). A range of conditions manifest in higher than average rates in post-disaster populations including depression, anxiety disorders, complicated grief, substance abuse and somatic or physiological responses (Smith et al. 1989). However, only 10–12% develop a chronic condition (i.e. lasting longer than 3 months) consistent with a diagnosis of Post-Traumatic Stress Disorder (PTSD) (Friedman, Ritchie, and Watson 2006). And for some, the experience will represent an opportunity for personal growth, resulting in positive psychological outcomes, such as the development of deeper relationships, compassion, spirituality as well as an enhanced appreciation of life (Tedeschi and Calhoun 2004). These characteristics are typical of more resilient individuals.

Children and teenagers are particularly susceptible to transmission of secondary trauma following disasters. The mental health of parents, separation from parents in the immediate aftermath, and disturbed family functioning may be more important determinants of a child's response than their own direct exposure to the disaster (McFarlane 1987). In a study of adolescent survivors of Hurricane Katrina, researchers found that the more a family relied on external help in the aftermath, the greater likelihood of a negative impact on adolescent mental health. Young people whose families relied heavily on relief agencies displaying lower self-esteem, greater psychological distress and symptoms of depression (Vigil and Geary 2008). Therefore, the

ecology of the family and the competence of family functioning, are strong indicators of resilience.

Governmental support and resources have been demonstrated to be key supports to resilience during the recovery period once initial donated supplies dwindle away (Regehr et al. 2008). Tobin and Whiteford (2002) found that individual community members' resilience and economic recovery was linked to their perceptions of risk and actual health status, with disease being more prevalent in those who were evacuated from their homes.

Individual perceptions of coping self-efficacy (i.e. the perceived capability for managing post-traumatic recovery demands) have been shown to be important in psychological recovery, and hence resilience, following a range of natural disasters (Benight and Bandura 2004; Benight et al. 1999a; Benight et al. 1999b; Benight et al. 2000; Benight and Harper 2002; Masten and Obradovic 2007; Murphy 1987).

Benight (2004*)* reported a study that went beyond personal coping self-efficacy to assess collective self-efficacy perceptions of a disaster community. The study was based on the assumption that a perception that a community would not be able to effectively respond (i.e. low collective efficacy) in the case of a disaster could lead to a greater sense of personal vulnerability, and hence lower adaptive capacity, and resilience. Conversely, communities judged to have higher levels of collective efficacy would be perceived to be more effective at exerting appropriate informal social control in order to coordinate available resources in the most effective manner (e.g. emergency supplies, human capital). Collective efficacy perceptions are therefore considered to be related to psychological distress levels. The results of the study based on a sample of 50 participants from a community that was subject to fire and flash flooding show that collective efficacy serves as a buffer under conditions of high resource loss. When resource loss is high, individuals who perceived low collective efficacy report significantly higher distress levels compared with those with strong beliefs in this community attribute. Sampson, Raudenbush and Earls (1997) also found the perception of collective efficacy of communities supported corresponding resilience of their constituents. These studies highlight the contextual and integrated nature of resilience development and support Bronfenbrenner's framework in assessing resilience as a developing process.

What appears to be largely missing from the research, with its individualistic and pathology-based focus, is a multi-systemic approach, exploring the role of family and community in fostering healing and promoting resilience. The importance of the family as a facilitator of recovery for individuals has only recently been recognised (Landau, Mittal and Wieling 2008; Rowe and Liddle 2008; Walsh 2007) and there is now greater acknowledgement of the importance of looking at the family impact of trauma especially in children and adolescents.

Mason et al. (2010) used Bronfenbrenner's framework to develop a social-spatial research design to understand the effects of place involvement (neighbourhood) on urban adolescents' mental health and self-regulatory patterns. The sample which resided in high risk neighbourhoods with low levels of economic resources showed that the places where adolescents spend most time appeared to have an effect on their psychological self-regulation and mental health.

In Australia, Hegney et al. (2007) studied a rural Queensland community who were experiencing extreme drought to explore what variables enhanced their perceived community resilience. The 14 participants in this study endorsed an interactive process between themselves and their community as a factor supporting their resilience, personal self-efficacy and adaptable optimistic, future- focused perspective, strong

social networks, a connection to the land and sense of place were also variables the small sample cited as being conducive to a resilient trajectory. The study supports Bronfenbrenner's framework as a theoretical lens.

Greene and Greene (2009) note that natural disasters do not necessarily result in negative psychological outcomes, with only an estimated 15% of people experiencing symptoms of post-traumatic stress—disorientation, depression, anxiety, or suicidal thoughts. Internal proactive coping and having adequate social supports are indicators of resilience. They support Bronfenbrenner's view in that they argue that an individual's resilience is linked to internal, personal processes and external, environmental variables, bridging the gap between micro- and macro-level variables.

De Terte, Becker and Stephens (2009) developed a multidimensional generic model of resilience to traumatic events such as disasters that has application to a range of disciplines concerned with resilience. This model, while still untested, attempts to address any interdisciplinary barriers that exist, by ensuring that individual, family, community, and societal attributes are considered holistically as part of resilience building. De Terte et al. (2009) cite indicators derived from others' research: internal, within person, variables of resilience such as cognitive components of resilience, optimism, problem-solving skills, perseverance, and resourcefulness (Polk 1997), and external variables: physical, psychological, social, and economic resources that exist within, or are available to a community (Berkes 2007; Klein et al. 2003; Mowbray et al. 2007; Norris et al. 2008; Paton 2006). Examples of social support include a health provider, emergency management office, or local authority management of resources and recovery processes. In partial support of their contentions, Chang (2002) showed higher levels of optimism were associated with lower psychological difficulties and greater life satisfaction when confronted with stressors, while Tidball and Krasny (2007) found community activities, like the development of urban gardens and green spaces, foster resilience through the development of social networks. Nelson et al. (2007) cite several case studies which link social networks to more effective management during, for example, droughts in developing countries.

If the above studies were methodologically consistent and could be aggregated it is possible that resilience indicators at the individual level would include optimism, proactive or problem solving coping, cognitive flexibility, perseverance, perceived community efficacy and family support. At the level of community, strong social networks, accurate and timely communications, economic, social and infrastructure resources as well as effective governance would appear to be implicated in promoting resilience. Since, however, the body of research is not easily synthesised into a coherent picture of resilience, the context-specific empirical studies revealed by the literature search are presented below to illustrate variables found to support resilience either at individual or community level. Of these, none are considered to be without limitations either stated and outlined by the authors or inherent in the sampling methods and research design. Nor was it always clear what definition of resilience the studies adopted. Notwithstanding these caveats, they provide insights to variables promoting resilience to particular natural disasters. The most important issue emerging from these studies is that individual and community resilience are not easily separated from one another, being highly interdependent, and need to be examined in context.

2.13 Drought

2.13.1 Community resilience

To understand how resilience to drought was generated in four drought impacted northern California communities, Langridge, Christian-Smith, and Lohse (2006) conducted research into who achieves access to water, why, and with what impacts.

They did this through mapping the patterns of access both spatially and historically. They found that opportunities for access are facilitated not only by social processes, such as the politics of water access, but also by the geographic location and climate of a region and the ecological integrity of the resource base. Legal water rights are extremely difficult to alter, and given the variety of mechanisms that can generate access, the study suggests that strengthening and diversifying a range of structural and relational mechanisms to access water can enhance a community's resilience to water scarcity. In short, Langridge et al. (2006) concluded secure access to a stable water supply is critical for community resilience to drought. The study also illustrates the need to examine resilience from multiple perspectives; in this instance, what Bronfenbrenner would term macrosystem and chronosystem perspectives were included to extract relevant variables that support community resilience.

Zhou et al. (2010) carried out a rigorous study of drought resilience in Xinghe County of northern China, based on a geographical conception of community resilience which included temporal, spatial, economic, environmental, social and institutional variables. They interviewed 60 households in 13 different towns of Xinghe County asking questions about: the income source and the percentage of each source in the total income; the measures taken to recover from the drought loss, especially the crop yield loss and economic loss; and the crop planting processes and strategies. Results showed the households adjusted their strategies to participate in other industries to compensate for economic loss from drought. When there was enough rain, most of labourers took part in agricultural activities, deriving their income from agricultural products.

In other words, income diversity was one of the adaptive strategies employed to enhance resilience of the towns in agricultural drought. Further, it was enhanced by collective memory lessons (also identified by Berkes (2007) as being instrumental to resilience building) from the experiences of historical, frequent drought events. After several times of drought, the resilience of towns became stronger and had less dependence on the rainfall. Zhou et al. (2010, p.37) summarised:

“There is an increasing need to build disaster resilience at different spatial scales, in which they have significant roles for local, regional, or national policy-makers. For example, building drought resilience at household scale can give a reference for households to arrange their agricultural activities, such as growing several kinds of crops, engaging in fishery or stock raising, to increase the income diversity. While building local drought resilience can help local government to make reasonable policy to improve their capacity to resist drought and recover from the loss of drought in shorter time, such as establishing more factories to increase the income of non-agricultural industry”.

Nelson et al. (2007) argued that community adaptation to drought in northeast Brazil entailed livelihood diversification and agricultural risk management by private citizens: in addition humanitarian relief and irrigation scheme projects by government groups were also necessary as adaptive measures to enhance local adaptive capacity. Nelson et al. (2007) stress that the source of their resilience was lessons learnt from prior drought events.

Within the Australian context, reporting on a drought stricken rural Queensland community, Hegney et al. (2007) found that residents (N=14) attributed their community resilience to an interactive process between themselves, supported by personal self-efficacy and an adaptable optimistic, future- focused perspective. They also endorsed strong social networks, a connection to the land and sense of place.

Kiem et al. (2010a) examined the drought impacted areas of Mildura and Donald in Victoria using a qualitative methodology that included interviews with 35 key community stakeholders representing local and regional organisations, government agencies, local councils, private business, and the community and farming enterprises within each or both of the case study areas. Their findings suggest that resilience in drought impacted Australian communities can be increased by supporting optimism and helping farmers to envision alternative futures. Adaptive strategies such as crop diversification, new crops and industries, the researchers urge, should be presented in ways that engage rural communities and farmers in positive and proactive change. The use of social and recreational activities (e.g. sport) to nurture the wellbeing of families and counter mental health issues (which result from financial and future uncertainties and growing socio-economic disadvantage) was also evaluated positively as supporting community resilience through individual connectedness to social networks.

Osbahr, Twyman, Adger and Thomas (2010) reported on research which sought to document successful adaptive behaviours by analysing livelihood adaptive processes to manage the effects of climate change and variability in drought and flood prone communities from four regions across South Africa and Mozambique. Based on institutional divisions in the communities, 63 focus groups participated in a series of exercises covering response to disturbance, sources of income, support networks, and farming practice. These were followed by 121 household questionnaires, open and closed questions, and in-depth interviews. The main unit of analysis was the household, defined as those living in the same compound, and who contributed food or income to the unit. Information on assets such as labour, land use, understanding of risk, change and uncertainty, information transfer, social networks, characteristics of institutions, and household capacity was collected through these interviews with a translator. Data were collected over the 2002-4 agricultural seasons and responses recalled by interviewees for the 10 year period prior to the fieldwork. Summary of adaptation characteristics across the study areas: Changes to agricultural practice, e.g. structured agricultural experimentation (within farming association) ; commercialising livelihoods e.g. Investment in poultry, livestock, collective attempt to buy game farm; changing off-farm roles e.g. regular migrant work and long-term jobs, changes in use of social capital e.g. building of agricultural cooperatives, evolved traditional noncash exchange mechanisms, interactions between traditional leaders and local administration. The authors stress that the livelihood development processes can boost local resilience and enhance local capacity to manage drought and heavy rains.

2.13.2 Individual resilience

Dean and Stain (2010) conducted a study in NSW with 111 adolescents using a mixed methods research design. Findings suggest that the ongoing economic impact of the drought entangled with the emotional effects that this has on family functioning filters down to the adolescents acting as a stressor and eroding their resilience. They found that, by contrast to previous studies, drought had a cumulative effect on the ability of adolescents to cope with the stress of a natural disaster. These adolescents have shown significantly higher levels of distress and behavioural difficulties than adolescents in the general population. They reported increased emotional distress to that reported in earlier research conducted in the same region. Increased experience of drought was associated with increased emotional difficulties. Higher levels of problematic behaviour, peer relationships and hyperactivity were associated with drought-related variables such as family concerns, financial stress, climate change, mental health impacts and an environment where death and loss is perceived. Distress levels for older adolescents were more affected by loss of friends from the area than the younger adolescents. Resilience for rural adolescents is supported by and includes strong positive feelings about their communities and family connections. For rural residents, being able to sustain a rural lifestyle is a major factor for individual and

community resilience. Residence within small towns is associated with a strong attachment to place. In this current research, these strong positive feelings to living in a small rural community are still evident, but the reported levels of distress indicate that the long duration of the drought might be challenging this resilience. These adolescents considered the drought in the context of more global influences such as climate change.

2.14 Floods

2.14.1 Community resilience

Chang (2010) conducted a quantitative study post flooding disaster in Carlisle, UK, to investigate community cohesion, a factor important for community recovery and resilience through the effects of collective purposive action and coping. Although the responding sample was small (n=96) and there were a number of limitations to the methodology such as the timing of the survey and the sampling methods, two results emerged which have salience in the context of community recovery: a) community members felt their community cohesion was strengthened after the flood by a degree depending on level of exposure to flood damage; b) community cohesion was not predicted by any demographic characteristics or the length of residence in the community. Perceptions of a sense of place and community involvement were facilitative of community cohesion. This would tend to suggest that community resilience can be enhanced by community awareness programs and activities that enhance links to neighbours and other community members, and not be limited by variables such as long term residence in a community. Clearly, Bronfenbrenner's theory is upheld.

Community cohesion as described in Chang's study has strong overlaps with collective efficacy which Benight (2004) defined as the shared belief that a group can effectively meet environmental demands and improve their lives through concerted effort. In Benight's study, collective efficacy (as perceived by the individual) interacted with resource loss after a flood to predict recovery from symptoms of posttraumatic stress. Persons with high collective efficacy were less adversely affected by their losses than were persons with low collective efficacy. Benight noted in his sample that people responded successfully to a variety of problems after the floods by creating an organised crisis committee to speak, decide, and act on behalf of their small rural community. Previously, Sampson, Raudenbush and Earls (1997) defined collective efficacy as a composite of mutual trust and shared willingness to work for the common good of a neighbourhood in the context of the threat of crime. Communal mastery, (Hobfoll et al. 2002) defined as the sense that individuals can overcome life challenges and obstacles through and because of their involvement in close social networks is another construct that overlaps with community cohesion and collective efficacy, its perceived existence fostering in individuals the capacity for meaningful and purposive action, and adaptive coping and wellbeing in the face of stressors. Such findings are in line with earlier thinking about community resilience which conceived resilience as an adaptive process highly enmeshed with an individual's perceptions of their capacity to effect recovery and mitigate against future threat through personal and collective action (Brown, and Kulig 1996/97). They highlight the importance of context, as conceived by Bronfenbrenner, in facilitating individual resilience.

Saut et al. (2007) conducted a study to investigate the case of Naga City, in the Philippines to examine how people deal with floods. Naga Municipality tried to diminish the impact of floods by relocating people to higher land. The study examined the types of building materials used in the construction of the higher level dwellings as well as surveying the residents for their coping mechanisms to the floods. The results showed that by building on higher ground, using water resistant materials for their dwellings and

preparing for the floods by storing their perishables and valuables on higher levels in their buildings the resilience of the city was enhanced. Such built environment approaches are recognised elsewhere. Manojlovic and Pasche (2008) examining flooding that occurred in Europe by the River Elbe (2002, 2006) recommend structural changes be made to the buildings subject to flooding to increase the resilience of the particular communities. Clearly this is in part an economic resource issue and partly a built environment legislation issue. The strength of the exosystem to support both community and individual resilience is once more illustrated.

Mitchell et al. (2010) reported the findings of a case study of a flooding prone community in Kaitaia, New Zealand. Resilience was enhanced by several variables and processes: Community members need to be well informed about the potential disaster risks and be aware of the levels of risks inherent in their strategies to respond; city council planning for a coordinated response to flooding, involving active participation of community members and organisations, helps to respond to a disaster, promotes community resilience to the disaster. Smith (2010) similarly reported a case study in New Zealand showing that community resilience is affected by pro-active planning and quick execution of a city council community recovery plan. Federal assistance to help relocate flood prone homes helped the long term resilience of the case study City of Charlotte and Mecklenburg County, USA. However, access to substantial local funding, the technical expertise, and the political support was required to implement the recommendations delineated in their recovery plan. Smith (2010) was at pains to note that the case study highlighted a common reality that planning for disaster recovery occurs after a disaster strikes. Smith (2010) emphasised the need to more effectively explain the value of pre-event planning for post-disaster recovery to local officials (including land use planners), state and national agencies, professional associations, non-profits, and the private sector (including the insurance industry).

López-Marrero (2010) analysed the strategies of adjustment implemented by members of two flood-prone communities in Puerto Rico, and concluded from interviews completed with 24% of the households in each community that access to resources – material, economic and human has facilitated resilience in these flood prone communities but beliefs that precipitation and floods were decreasing in occurrence, and a reliance on structural state interventions for flood protection, reduced householders' perceived risks associated with future floods and diminished their willingness to undertake precautionary preparedness measures. The study highlights the need to implement public information and education programs to communities at risk of future natural disasters. It also shows the delicate balance that must be maintained by government bodies when giving support since there is a risk of creating a state of dependence and eroding personal resilience.

Gissing, Keys and Opper (2010, p.41-42) examined flood research in the Australian context and argue that community resilience to floods is in part effected through preparedness. This includes taking note of flood warnings. They noted previous research that found the "weaknesses in Australian flood warning practices are cultural rather than technical, with flood warning products under-used by a combination of poor attention given to flood warning practice and a response-biased (as distinct from preparedness-focused) culture in which proactive flood emergency management is not valued." They refer to post-flood research which provides evidence for the utility of preparedness for flooding which can save up to 80% of potential flood damages.

2.14.2 Individual resilience

Armaş and Avram (2009) attempted to predict resilience to floods in a sample of 153 Romanian (Danube Delta) residents. They used a survey instrument to map various attitudes and flood risk perceptions in order to reveal the conscious and unconscious

attitudes towards flood risk and predict resilience to the impact of floods. The study was based on the hypothesis that different degrees of psychological vulnerability set the stage for behavioural patterns that generate certain adjustment mechanisms and strategies. Results indicated the persons characterised by inner control had a significantly reduced general anxiety level in comparison to those with control factor placed externally. Those with greater locus of external control, also had lower educational and income levels, tended to rely on the external variables for support, have a stronger belief that floods will leave a major mark on their general lifestyle and the recovery of losses will be more difficult and a higher fear concerning the security of the family. Armas and Avram (2009) suggest that such an external focus of control leads to lower resilience characterised by non-action and non-adaptive behaviours. Given their correlational predictive nature, study results need to be interpreted with caution.

Support for Armas and Avram's (2009) proposals however, can be drawn from Endfield's (2007) work. Using archival data from flood records in Mexico, Endfield (2007) also showed that the degree of impact of a flood was a function of public expectation, preparedness and also the particular socio-economic and environmental context in which the event took place, the study emphasising the importance of psychological vulnerability and structural variables.

Population wellness, or its absence, can be an indicator of community resilience, rather than individual resilience, if the study captures the range of citizens' exposure to the hazard. In a study of a flood in eastern Kentucky, Norris, Phifer and Kaniasty (1994) differentiated between primary victims (those with personal losses), secondary victims (others living in the flooded counties), and non-victims (persons living in neighbouring, non-flooded counties). They found that residents across the community feel less positive about their social networks and surroundings, less enthusiastic and energetic, and less able to enjoy life after the flood. Verger et al. (2003) found that 5 years after a flood experience in France, individuals' post-traumatic stress symptoms were linked to the level of exposure and the number of stressors during exposure that individuals experienced.

Apan et al. (2010) investigated flood prone area of Queensland, Charleville and Mackay, to understand, among other issues, the community's resilience and viability. Apan et al. (2010) aimed to identify the characteristics of resilience and adaptive capacity to flooding of households, businesses and institutions and to that end they used a mixed method approach to target household residents, businesses and government institutions with structured questionnaires and semi structured face-to-face interviews. Findings of the study document that Charleville individual residents' resilience was supported by strong personal networks, high levels of a sense of belonging in the community and participation in community activities. Charleville residents also believed that they have a responsibility to prepare for floods. Similarly, Mackay households were found to have high sense of belonging to the community. However, in both locations businesses did not appear to be resilient, though the study was not sufficiently detailed to make clear conclusions about this.

2.15 Fire

2.15.1 Community resilience

Hawe (2009) investigated community resilience after the Victorian 2009 bushfires. In this review Howe notes that while the interventions suggested are derived from a model of action based on best practice in the community development literature no studies have been conducted to evaluate the intervention. In other words, it is not known how effective the strategies might be to build and maintain community resilience

post-fire disaster. The author laments the lack of empirical evidence to support the strategy and urges future research to be conducted to extract best practice.

Bushnell and Cottrell (2007) examined a community in north Queensland to ascertain their awareness and preparation for bushfires. Using a mixed method approach involving interviews and a survey instrument, their results led them to conclude that education and information to the community would likely raise their levels of preparedness and agency in relation to bush fire risks and this in turn would enhance the community's resilience to bushfires.

Pooley, Cohen, and O'Connor (2010) conducted a very small qualitative (N=6) study investigating the bushfire in Darlington, Western Australia. The indicators for community resilience post disaster that were reported were : sense of community, individual adaptive coping individual self-efficacy, perceived community competence, social networks and social supports forming spontaneously as needed. It is of interest that fire preparedness in rural Australian communities seems to be left to males to manage (Eriksen, Gill and Head 2010; Eriksen and Gill 2010) and its priority lags behind other priorities when vegetation and trees are considered for the aesthetic and shading functions that they provide. The relative costs (monetary and time) of preparing for potential fires are also a barrier for rural landholders. This is lamentable since effective preparedness goes some way towards facilitating community resilience.

2.15.2 Individual resilience

Winkworth et al. (2009) examined the recovery of people affected by the Australian Capital Territory (ACT) bushfires (known as the Canberra Bushfires) to glean information about what helped and what hindered community disaster recovery, including the role of social networks and supports and community engagement activities. The report is rather unclear and seems to move between present and past research findings but it does indicate that survey responses from 482 respondents cited strong family, friend and neighbourhood support networks as facilitators of recovery. The researchers also cite wider intra-community activities as being supportive of community recovery, however, it is very unclear exactly how this result was obtained beyond suggesting that interview data were the source of this finding.

Social ties are an important informal communication network. Correct information during a bushfire is particularly important to enable people to make informed decisions about what actions should be undertaken and when. During the Bitter Root Valley fires in Western Montana, residents responded to the general confusion of whether to evacuate or not by monitoring various conditions to judge the level of risk and then disseminating this information, which was tailored to the needs of others in the community, through various information networks (Halvorson 2002). Bitter Root Valley is an example of a community able to respond effectively to bushfires. Community members, particularly those born and raised there, relied on these social ties for support and, as a group; they were independent from outside groups. For example, many evacuated residents did not utilise the Red Cross shelter because they sought accommodation with friends and family, or camped with other families by the river (Halvorson 2002). In the bushfire recovery phase there was a similar "pulling together" within the Bitter Root Valley community. A strong sense of community emerged both during the bushfire and after, and the experience of dealing with the fire hazard gave an additional sense of identity to the community (Halvorson 2002). Therefore, a strong sense of community and informal and formal community support networks, and preparedness, resulted in effective response and recovery efforts, and resilience (Halvorson 2002).

2.16 Hurricane/cyclone

2.16.1 Community resilience

Davison and Emmer, (2008) used data derived from the Florida Hurricanes of 2004 and 2005 and the Gulf of Mexico regional governance structure to develop a resilience index as an indicator of a community's ability to reach and maintain an acceptable level of functioning and structure after a disaster. The index is comprehensive, based on retrospective examination of the effects of the Florida hurricanes upon several different coastal communities. It is based on an examination of each community's:

Social systems (for small communities) such as faith based networks, cultural identities;

Critical facilities functioning capacity (e.g. hospitals, sewage systems, transportation evacuation routes);

Transportation access facilities in case of emergency;

Floodplain management plans for natural hazards;

Mitigation measures (e.g. flood proofing of non-residential buildings, elevation of residential buildings, education programs, relocation of buildings and infrastructure) and;

Business equipment and plans (e.g. generators, back-up options).

While the authors state that the index is yet to be officially tested it does provide a comprehensive list of indicators derived from emergency management that support community resilience to hurricane/cyclone and flooding hazards.

Smith and Thomsen (2008) also emphasize the role of social systems in supporting community resilience to natural hazards in small coastal communities, such as Innisfail, which was subject to a very destructive cyclone in 2006. They refer to the perceived utopia of coastal areas driving a "sea change" phenomenon in Australia, where some local municipalities are experiencing annual growth rates of around 4%. Coupled with surges in visitor numbers during holiday periods such social intrusions erode local community identity. Community identity and a "sense of place" (Chamlee-Wright and Storr 2009a) exert substantial power to mobilise individuals into proactive action in recovery efforts, enhancing community resilience.

Campbell, Thomas, Hunter and Levesque (2007) published a study that examined community resilience post event, ranked and compared the risks posed by hurricanes to the coastal towns of Rhode Island, USA, from an evacuation and engineering perspective. They concluded that resilience was linked to the material and conceptual resources available within reach of the community. At the sub-group level within a community, resilience was relative to the exposure to threat experienced, which in turn varied according to location, relative to the threat agent's pathway, magnitude and scope over time and the dependence on public means to evacuate, if required to.

Chamlee-Wright and Storr (2009a) found that in the absence of abundant material resources cultural resources take on greater importance for people. This was the reason given by Hurricane Katrina survivors who returned to New Orleans. Place attachment is the positive cognitive and affective bond that develops between individuals and their environment. Homeownership, length of residence in the neighbourhood, perceptions of neighbourhood cohesion and the frequency of community activities are positively correlated with place attachment, identity, and dependence; a strong sense of place can motivate individuals to get involved in

collective community improvement efforts and differences in sense of place can lead individuals to react differently to potential (environmental) threats to their communities. Place attachment forms when an individual perceives that a particular locality satisfies their needs and desires. Disasters can potentially lead to a decline in place attachment to the recently destroyed location if it no longer provides for the needs of an individual.

Chamlee-Wright and Storr (2009b) found that the church provision of club resources and goods can foster social cooperation and community redevelopment in the wake of a disaster. In particular, they investigate the swift recovery of the community surrounding the Mary Queen of Vietnam (MQVN) Catholic Church in New Orleans East after Hurricane Katrina. Utilizing a unique bundle of club goods provided by the MQVN Catholic Church, residents in the New Orleans East Vietnamese-American community:

(a) Rebuilt their distinct ethnic - religious-language community;
(b) Overcame the social coordination difficulties created by Katrina, and;
(c) Engaged in successful political action to protect their community.

This is an example of mesosystem interactions supporting community resilience.

Kapucu (2008) conducted a multi method study which included a survey sent to emergency managers to assess how the experience of 4 hurricanes in Florida affected community preparedness. They did this by examining how effectiveness in coordinating community disaster response efforts affects future public preparedness. Their findings suggest that pre-season planning by local emergency managers, open communication between emergency managers and elected officials, and the use of appropriate technology to communicate during the response phase all had a significant impact on community responses. Thus exosystem organisation and coordination perceptions by individuals had an effect on preparedness which in turn translated into a higher likelihood of community resilience. However, Kapucu (2008) also notes that the ongoing public disregard of safety warnings about impending disasters, which they do not believe to be as serious as the emergency managers claim, needs to be addressed with better education and community programs.

Pyles and Cross (2008) surveyed the perceptions of African-American residents in New Orleans post Katrina to explore the role of social capital, particularly civic engagement and social trust, in community resilience and revitalization efforts in a primarily lower socioeconomic status African American neighbourhood (n = 153). Findings reveal high levels of participation in neighbourhood cultural, recovery and political activities were linked to ratings of happiness, older age and higher incomes. The authors note that more than 2 years after Katrina many individuals and businesses were yet to return to their communities with African Americans disproportionately affected in health, financial, employment and housing indicators of resilience. Their results are supported by other researchers examining the role of social capital in supporting family resilience following Katrina.

Hawkins and Maurer (2010) used longitudinal qualitative methods to track 40 families post Katrina to examine sources of social capital during the response and recovery phase of the hurricane. Their results indicate residents, especially those with low incomes, relied on, and built upon, all levels of social capital for individual, family, and community survival. Participants described a process through which close ties (bonding) were important for immediate support, but bridging and linking social capital offered pathways to longer term survival and wider neighbourhood and community revitalisation, validating the cross linking influences that occur from microsystem, mesosystem and exosystem sources. Connections across geographical, social, cultural and economic lines provided access to essential resources for families and enhanced

their adaptive capacity for resilience. The study focused on the sense that families made of their experiences after the disaster.

Marchand (2008) compared two case studies with a more or less comparable physical environment but entirely different socio-economic setting: New Orleans in the Mississippi Delta, USA and the Godavari Delta in coastal Andhra Pradesh, India. The results of this comparison showed that in both countries the less advantageous sections of society are the most vulnerable, but prior experience with similar events assisted in the preparedness process and facilitated evacuation and rescue operations in India. Moreover, macro-economic resilience was greater in India than in the United States, where socio-economic variables prevented US citizens from returning to work while residents of the Indian delta returned to their occupations as soon as the clean-up was completed. This is an interesting and pertinent finding but the authors did not explore the reasons for these differences in the study. The study also shows how the political variables at play during the disaster affected the timely response and rescue operations. Responses to disasters vary according to the dominant political philosophies (Albala-Bertrand 1993). Recent large disasters (Hurricane Katrina, Hurricane Nargis) have shown the role played by politics in supporting community recovery and resilience (Pelling and Dill 2010). Political procrastination and the lack of timely government response for reconstruction following Hurricane Katrina events and other disasters, illustrated the importance and power of macrosystem variables for exacerbating (or not) disaster impacts upon a community. In relation to adaptation to climate change, the broader context within which natural disasters such as droughts, floods and cyclones are embedded and likely to be exacerbated and the power of national and international politics becomes critical (Adger 2010; IPCC 2007). Politics strongly impact upon, and sometimes determine, the level of community preparedness, a factor known to support community resilience (e.g. Cutter et al. 2008; Glavovic 2010; Gunderson 2010; Mora 2006; Prosser et al. 2010).

Marchand (2008) also points out that resilience is enmeshed with the fabric of social life itself, with politics, power, history and environment. Manyena (2006a) further highlights issues arising from the failure of politics to support community resilience to disasters, in this case food insecurity and malaria. These arise from a study looking at the role of Rural District Councils (RDCs) in Zimbabwe in facilitating disaster risk reduction. Local authorities are critical in building disaster resilient communities, because being close to community pressures, they can design properly tailored long-term solutions to disasters and development problems. Manyena (2006a) argues that RDCs in Zimbabwe not only have inadequate financial and human resources at their disposal to tackle community resilience, but also unstable political systems which exacerbate and increase the difficulties they face in their task.

2.16.2 Individual resilience

Pfefferbaum et al. (2008) conducted focus group interviews with children and adolescents (9-17 years old) who had been displaced by Hurricane Katrina and found that family attitudes, economic support and positive community perceptions were instrumental in helping to build children's adjustment and resilience post-relocation.

Laditka et al. (2009) reported findings of a study that showed the interconnections between community and individual resilience and the importance and interconnectedness of the exosystem (economic resources) and microsystem (teamwork , planning). The study carried out individual, in-person, semi-structured interviews with 38 nursing and other nursing home staff caring for sheltered, frail, Hurricane Katrina evacuees. The participants highlighted the importance of having sufficient economic resources in supporting community resilience. Laditka et al. (2009)

concluded that planning, teamwork, and adequate supplies and staffing supported the wellbeing of residents as well as the functioning of the nursing staff.

2.17 Summary

Climate change is thought to increase the number and severity of natural disasters. Governments and emergency managers are seeking ways to enhance individual and community resilience to such events.

Perspectives on resilience include the ability to withstand and respond positively to stress or change. Disasters are inherently cross-scale in their impact, disrupting functioning across multiple levels of the interdependent socio-cultural systems in which individual human lives are embedded. To conclude that an entity (individual, community) is resilient one must decide (1) whether there has been exposure to significant adversity or risk and (2) whether the person or entity is functioning effectively post stressor.

Many studies support the notion that an individual's resilience is promoted by two groups of generic variables:

> (1) Personal attributes such as social competence, problem solving, autonomy, self-efficacy and sense of future and purpose and;
> (2) Contextual, environmental influences such as peers, family, work, school and local community.

Research linking individual to community resilience is very scarce world-wide and non-existent in Australia, especially in relation to predicted climate change impacts. Some studies have examined how individual-level perceptions of community resilience (Pooley et al. 2010), sense of community (Paton 2008), or collective efficacy (Benight 2004) correlate with individual-level outcomes, but no study appears to have examined how independently assessed community resources influence the post-disaster resilience of community or individuals. For example, how does the degree of pre-disaster economic diversity of a community affect the resilience of different groups of individuals post-disaster? This is problematic because developmental science and ecological science perspectives intersect to explain resilience at both individual and community levels (e.g. Cutter et al. 2008; Evans 2007; Masten and Obradovic 2007). Moreover, some studies have identified that an individual's resilience might in fact be a barrier to the development of community level resilience (Li 2009; Sapountzaki 2007). This is due to the interdependence of social and economic networks influencing community resilience to disasters (Stewart et al. 2009). Research is needed to clarify these issues in Australia.

Cutter et al. (2010) have begun to develop a database of community indicators to gather a baseline of US community functioning. This is to be used to assess community resilience to (future) disasters. Such an approach will offer a clearer indication of community resilience since a longitudinal perspective can elucidate variables that support the critical recovery period, as well as the response to a disaster. Flint and Luloff (2005) have stressed that research needs to focus on the recovery period post-disaster where there is currently an empirical gap. This is critical in order to understand the interdependence of individual and community resilience and because the response phase may or may not support the community's long term recovery and resilience.

As resilience at individual and community level has repeatedly been found to rest on relationships between social and community variables (Luthar 2006; Walker and Salt 2006), Bronfenbrenner's bioecological theory (1979, 1989, 2005) provides a most

suitable framework of analysis to explore these relationships. The use of this framework permits the measure of influences of microsystem, mesosystem and macrosystem variables upon an individual's resilience. An indication of community resilience can also be obtained through the interconnections of these variables across systems. Results can be used for strategic interventions and policies because the model can indicate where they will have maximum effect to build resilience to future climate change impacts. Further, such a model can be used to evaluate interventions over time in longitudinal evaluations as well as interventions in diverse types of community, for example, metropolitan areas. An advantage of Bronfenbrenner's theory is it allows influences across, between and within systems to be estimated.

Literature on hazard mitigation planning indicates that reducing disaster impacts through proactive hazard mitigation planning is more sustainable and cost-effective than responding to disasters through insurance policies and post-disaster reconstruction (FEMA 2004). Such plans can prepare for effective post-disaster recovery and reconstruction to reduce further losses from repeated events. Comprehensive plans can promote public information and education campaigns to increase residents' awareness of potential hazards and sustainable use of natural resources (e.g. water), and educate homeowners and builders about best location and building practices (Srivastava and Laurian 2006). Natural hazards such as floods, wildfires and droughts disrupt communities, their economies and environments, and cost millions every year. The existing literature on hazard mitigation shows that community resilience is best achieved through comprehensive planning. Kumagai, Carroll and Cohn (2004, p.31) point out that community resilience is assisted by preparedness; they state "a community's disaster recovery processes reflect the community's pre-disaster social and physical conditions". Such preparedness is likely to be more effective and strategic if it is based on sound empirical variables.

In most published studies of community resilience to disaster and traumatic events, the research design has taken either a sociological, macro perspective or a psychological, micro perspective. Rarely, have the two been used at the same time to triangulate findings. Given the interconnectedness of individual and community resilience this leaves many questions unanswered. We still need to address many issues including: how levels of preparedness affect the response and recovery phases of individuals and communities and subsequently community resilience; how to increase the resilience of vulnerable groups, including the infirm, the elderly, the young, the indigent; how, when and if, government responses and interventions are necessary to build long term resilience to disasters and climate change; how do different disaster types affect community resilience and what interventions are necessary at individual and community level to support post-disaster functioning and resilience and who decides what should be made resilient to what, for whom resilience is managed, and to what purpose? (Lebel et al. 2006)

Overall then, in assessing community resilience to disaster we need a multi- method, longitudinal approach, that includes baseline pre-disaster, community data. Qualitative data need to be coupled with indicators from several levels within a community, including individuals' ratings; preferably using a model such as Bronfenbrenner's to collate, triangulate and interpret findings and gauge the relative strength of relationships within data.

3. METHODS

3.1 Introduction

As discussed in the literature review, community resilience cannot be assumed from evidence of individuals' resilience alone because within a community the range of levels of resilience is dependent upon individual characteristics influenced by social and economic variables. More sophisticated measures are needed to link community level indicators with individual level indicators of resilience.

It is the aim of this research to:

a) Link individual level resilience variables with community level variables and;

b) Triangulate findings by estimating and evaluating community resilience via comparisons of pre-post disaster measures of community data such as employment rates, numbers of businesses, welfare payments and so on.

The study design was non-experimental, cross-sectional and associative. In order to address the research questions, it was conducted sequentially: a qualitative phase, through focus group interviews, is followed by a quantitative phase to generalise the findings from the qualitative phase. Examination of social perception using traditional, quantitative strategies may produce an incomplete picture. Perception is subject to too many uniquely individual experiences compounding the wider, culture specific experience of the individual. To understand and explore the influences acting upon these cognitive constructs an interpretive approach and qualitative data generation is also required. This way the overlapping ecological systems bearing upon human perception may be distinguished (Bronfenbrenner 1979). A mixed methods approach is deemed appropriate to explore the experience of a natural hazard and isolate the variables that are thought to support community resilience.

Our mixed method research design is shown below:

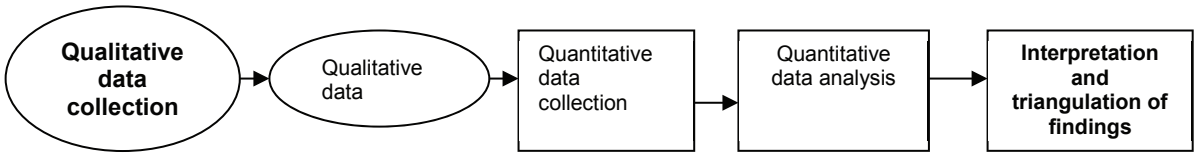

Figure 3.1 Mixed methods research design (Creswell 2003)

Case studies are a multi method approach for gathering data with respect to specific instances of a case and thereby are suited to the project's goals (Stake 1994). To address our research aims we identified and interviewed key local personnel in the four case study sites. Through case studies of communities which have experienced cyclone (Innisfail), flood (Ingham), fire (Beechworth) and drought (Bendigo), a range of variables of community resilience can be documented. Focus group interviews with key stakeholders from the state emergency services, education, health, and local council recovery and response managers, insurance personnel, philanthropic organisation personnel, church ministers, local industry representatives, and residents help to obtain beliefs, behaviours and policies that promote post-disaster resilience, to populate Bronfenbrenner's model of resilience at microsystem, exosystem and macrosystem levels. Empirically derived variables supporting prevention, preparedness, response and recovery are used to describe each community's resilience and inform the construction of survey items for a questionnaire. The questionnaire is applied to a

sample from each community to generalise findings so variables can be measured and modelled. Results from the demographic study, qualitative and quantitative phases are then triangulated.

In-depth qualitative data collected through focus group interviews at each site supplies data on variables which have influenced post disaster recovery, and enables us to gauge community members' perceptions of the local community level of resilience. Focus group interviews are conducted in each case study community, with each group representing different sectors of the community (e.g. community leaders, emergency response personnel, business and management personnel in profit and non-profit areas affected by natural disasters, a cross-section of local citizens, youth). The particular sectors and the identification and recruitment of participants are strategically determined in consultation with local key stakeholders. The questions posed to the focus groups address their understanding of any relationship between climate change and natural disasters, their level of preparedness and sense of efficacy (or despair and hopelessness) in responding to and dealing with natural disasters, the variables that influence such efficacy or lack thereof, and their perceived needs for different kinds of support to respond to natural disasters. The data will be triangulated: both individual case analysis across community sectors and cross-case analysis to identify similarities and differences across communities and the different kinds of disaster experiences are conducted. Further analysis to interpret and explain identified themes follows by drawing on relevant international literature.

Capturing the complexities of human responses to disaster and assessing 'what works' in terms of disaster prevention, warning schemes and support for the recovery of a community to enhance its resilience to a natural hazard, requires a flexible and wide-ranging methodology which embraces both quantitative and qualitative approaches. The methodology adopted in the project comprises four distinct but complementary strands which will be triangulated to address the research aims:

Socio-demographic profiling of the selected disaster impacted communities to generate a community profile before and after the impact of the natural hazard;

Semi-structured interviews with key stakeholders in each community;

Focus group discussions with residents in the four disaster impacted communities and;

Questionnaire survey of households in the four disaster impacted communities.

3.2 Rationale for the research design

"The method must follow the question. Campbell, many decades ago, promoted the concept of triangulation- that every method has its limitations, and multiple methods are usually needed." - Gene V. Glass eulogizing pioneering methodologist Donald T. Campbell, quoted in Tashakkori and Teddlie (1998, p.22).

In seeking to identify any similarities and differences between the four communities with regard to disaster resilience, this study examined social variables and policies and psychological constructs cited by the interviewees. As such, it may be described as developing within a (social) psychology framework. To expand on the perceptions gathered from the interviewees, Bronfenbrenner's bioecological theory was used. In doing this it was hoped that any interactions between social and psychological variables and their influences might be uncovered. Given these aims, the best method to gather such data was considered to be a mixed method approach.

Using a survey to collect attitudes and beliefs (observations) is expedient and commonplace. They are used to gather data for a variety of uses including: to

influence or persuade others, to aid in the design of marketable products or services, and, as in this study, to understand and predict relationships between variables (Fife-Schaw 2000). Surveys can be either cross-sectional, eliciting a snap-shot of a population through the survey of a sample of that population, or longitudinal, where information is collected at different times to examine changes or stability over time in the phenomenon of interest (Fife-Schaw 2000). But like any other data collection instrument surveys are subject to limitations (Fife-Schaw 2000). Surveys are limited by their own usefulness. The very reasons that make them useful (economy of design, restricted categorical choices for responses, the simple language of their construction, the selection of questions and the reduction of complex issues into variables for correlation purposes) also limit the insight they can give to the respondents' life world (Fife-Schaw 2000). There is a need for a qualitative approach alongside the quantitative, to gather empirically the variables cited to be important to community resilience by those who experienced the natural hazard, or disaster, in the context of the experience. Once these variables are gathered then they can be systematically compared and contrasted across the four research sites and survey questions can be extracted that can be applied more generally to each community for generalisation of findings.

The application of a quantitative phase upon the research not only helps to generalise the results, and therefore to eliminate any highly idiosyncratic variables identified, but can also correct for some of the confounding influences that exist between interviewer and participants.

These interactions may in some cases obscure the "truth". Participants may try to respond in a way that they believe is expected of them. This, the response effect (Borg and Gall 1983), is the difference between the answer given by the respondent and the correct answer.

Mixed methods overcome the weakness of the statistical methodology which tends towards "abstract and sometimes vacuous generalizations" (Ragin 1987,p.69) and the case study's main limitation of particularizing. Mixed methods are useful when what is aimed at is to:

a) better understand a research problem by converging numeric trends from quantitative data and specific details from qualitative data;
b) identify variables/constructs that may be measured subsequently through the use of existing instruments or the development of new ones;
c) obtain statistical, quantitative data and results from a sample of a population and use them to identify individuals who may expand on the results through qualitative data and results, and;
d) Convey the needs of individuals or groups of individuals who are marginalized or underrepresented (Hanson, Creswell, Plano Clark, Petska and Creswell 2005).

Given that four communities were compared to identify contextual interactions between community and individuals' variables that give rise to resilience outcomes, the use of mixed methods for the purpose identified in b) above closely matches the project's requirements.

The use of varied types of data concerning the same issue is one example of what has become known as triangulation. The term triangulation is taken from land surveying (Janesick 1994), where three points as in a triangle are used to locate oneself at particular locations, and radio triangulation (Lincoln and Guba 1985), whereby directional antennae set up at two ends of a known baseline are used to identify the

point of origin of a radio transmission. Triangulation was used as early as 1928, when statistics and case studies were used together to verify data to give mutual validation of findings (Erzberger and Kelle 2003, p.459). It took on a slightly different meaning when it was used in psychological testing: empirical results were thought to be validated by measuring the same traits with different instruments (Campbell and Fiske 1959). In developing qualitative research techniques, Denzin (1978) adopted and modified the concept into one of combining methods, whether this means combining a qualitative and a quantitative approach or using several sources or kinds of data. He stated that "the logic of triangulation rests on the premise that no single method ever adequately solves the problem of rival causal variables. Because each method reveals different aspects of empirical reality, multiple methods of observation must be employed" (Denzin 1978, p.28). Studies that use only one method of inquiry are more vulnerable to errors linked to that method than studies that use multiple methods in which different types of data provide cross-data validity checks.

Four types of triangulation have been identified by Denzin (1978):

a) data triangulation, the use of a variety of data sources in a study;
b) investigator triangulation, the use of several different researchers or investigators;
c) theory triangulation, the use of multiple perspectives to study and interpret a set of data, and;
d) Methodological triangulation, the use of multiple methods to study a research question.

In this project data, investigator and methodological triangulation are implemented. During the qualitative phase, investigator triangulation was implemented, by having two or more investigators interpret the responses given in focus interviews. Moreover, data triangulation took place because data examining the same concepts were obtained through surveys and focus interviews. Finally, methodological triangulation was also implemented through the use of Rasch analyses, descriptive and inferential statistical analyses and structural equation modelling methods (SEM) employed to answer the project questions.

3.3 Design and sequencing of research

Mixed methods research has become more extensively studied and refined into typologies, giving this emerging methodology a theoretical basis (Cresswell 2003). The design adopted in this study is the sequential exploratory design, which is characterised by the collection and analysis of qualitative data, followed by the collection and analysis of quantitative data. The two sets of data are integrated during the interpretation phase of the study. Quantitative data are used primarily to augment qualitative data. Data analysis is usually connected, and integration usually occurs at the data interpretation, triangulation stage and in the discussion. These designs are useful for exploring relationships when study variables are not known, refining and testing an emerging theory, and generalizing qualitative findings to a specific population (Hanson, Creswell, Plano Clark, Petska and Creswell 2005).

3.4 Qualitative sequence

The purpose of this sequence is to obtain relevant information and residents' perceptions of the communities' experience of each disaster, as it pertains to preparedness, response and recovery.

The assumptions underlying this rationale were that each community would have unique experiences and policies guiding their response and recovery from the disaster.

3.5 Participant selection

Those selected for focus interview were representatives of key stakeholder groups in each site and groups of individuals representing demographic sections of each community determined by our demographic study to be pertinent to the community. They also represented the mesosystem, exosystem and macrosystem of Bronfenbrenner's model. Selection of the participants for the focus interviews was based on theoretical or purposive sampling. The sample becomes by definition and selection representative of the phenomenon of interest (Cresswell 2003; Patton 2002). This was intended to support the issue of generalisability, which is not without tensions, since the search for particularity competes with the search for generalisability.

Participants for this phase of the project consisted of:

3.5.1 Beechworth

Ten (10) key informant individuals interviewed between November 2010 and January 2011. These ten people were involved with the 2003, 2006 and/or 2009 bushfires in the Beechworth area in the following capacities:

Co-ordinator, Beechworth Neighbourhood Centre, arrived just post 2003 fires and was in this role for 2009 fires;

Owner, Carriage Motor Inn Beechworth, president of the Beechworth Chamber of Commerce for 2009 fires;

Bushfire Youth Development Officer, Indigo Shire (also covering Alpine Shire). Working with children aged 10-25, mostly 10-17years old;

Manager, Emergency Management Planning Committee, Indigo Shire;

Team Leader, Community strengthening project, Indigo Shire;

Former Manager of Community Planning and Municipal Recovery Manager, Indigo Shire. Experienced 2006 and 2009 fires in this position;

Bruarong farmer, Bruarong Hall Committee member, formerly Indigo Shire Home and Community Care worker (2009 fires), active fire fighter;

Stanley resident, Stanley CFA member, researcher;

Orchardist – property lost in 2003 and 2009 fires;

Buckland Gap resident, Beechworth CFA member and coordinator of the Beechworth Health Service's Planned Activity Group (elderly residents living at home);

Exosystem representatives:

Co-ordinator, Beechworth Neighbourhood Centre Owner, Carriage Motor Inn Beechworth, and president of the Beechworth Chamber of Commerce

Bushfire Youth Development Officer, Indigo Shire, also covering Alpine Shire. Manager, Emergency Management Planning Committee, Indigo Shire;

Team Leader, Community Strengthening project, Indigo Shire;

Former Manager of Community Planning, and Municipal Recovery Manager, Indigo Shire.

Thirty (30) participants in focus group interviews held between December 2010 and January 2011 with the following focus groups:

Stanley community (SFG) – 5 women, members the Stanley newcomer women's social group, set up post 2003 fires for mutual support;

Bruarong community (BFG) – 16 members of the Bruarong Hall Committee and the Bruarong community, including farmers, CFA members and businesses directly impacted by the 2009 fires (Eight women, eight men);

Beechworth business community (BBFG)– 5 members of the Beechworth Chamber of Commerce representing tourism and general business and including people whose homes were directly threatened by fires in 2003 and 2009;

Government Support (GFG) – 4 members of the Indigo Shire Community Resilience Committee, representing Indigo Shire Council, Regional Development Victoria, Emergency Management within the Department of Human Services Victoria, and Ovens and King Community Health Service.

Exosystem representatives

Beechworth business community (BBFG)–of the Beechworth Chamber of Commerce- representing tourism and general business and including people whose homes were directly threatened by fires in 2003 and 2009;

Macrosystem representatives

Government Support (GFG) –representing Indigo Shire Council, Regional Development Victoria, Emergency Management within the Department of Human Services Victoria, and Ovens and King Community Health Service.

3.5.2 Bendigo

Ten (10) key informants interviewed between August and December 2010 representing:

The City of Greater Bendigo;

Rural Financial Counselling Services;

Department of Sustainability and Environment;

Department of Human Services;

Department of Planning and Community Development;

Bendigo Welfare Agency Group.

Exosystem representatives

The City of Greater Bendigo, Community Capacity Building Officer.

The City of Greater Bendigo, Drought Response Officer.

Rural Financial Counselling Services, Regional Committee Chair an Regional Officers.

Chair of the Bendigo Welfare Agency Group.

Macrosystem representatives

Department of Sustainability and Environment, Climate Change Adaptation Officer.

Department of Human Services, Manager, Strategic Support.

Department of Planning and Community Development; Community Capacity Building Officer and Co-ordinator of the Rural Women's Network response to Drought and Climate Change.

Nineteen (19) participants took part in focus group interviews:

Business group (4 participants);

Sustainability group (4 participants);

Community health group (4 participants);

"Lifestyler" group (7 participants).

Exosystem representatives

Business group, engaged in agriculture, nursery and water businesses.

Bendigo Sustainability group and Garden Club.

Community health group, involved in women's, youth and health programs

3.5.3 Ingham

Sixteen (16) key informants were interviewed between August 2010 and March 2011: their organisations and roles are:

Queensland Health, Director of Nursing/Facility Manager;

Local Chamber of Commerce, President;

Local Community Support Organisation/ Self-employed – agricultural sector, cane farmer, social workers (3), manager;

Queensland Police Service, police officer – emergency response;

Hinchinbrook Shire Council, Manager corporate and economic support;

Emergency Management Queensland, Managers;

Government, Local Government Member;

Local Aged Care Facility, Senior Nurse and Administrator;

Local Medical Centre, General Practitioner;

Small business, owner.

Exosystem representatives

Local Chamber of Commerce, President;

Local Community Support Organisation- two social workers and a manager;

Hinchinbrook Shire Council, Manager, Corporate and Economic Support;

Local Government Member;

Local Aged Care Facility, Senior Nurse and Administrator;

Local Medical Centre, General Practitioner.

Macrosystem representatives

Queensland Health, Director of Nursing/Facility Manager;

Queensland Police Service, police officer – emergency response;

Emergency Management Queensland, Manager.

Sixty-three (63) participants took place in focus group interviews. They were derived from:

Low Income Focus Group (LIFG) (5 participants);

Sugar Cane Focus Group (SCFG) (9 participants);

Real estate representatives (RE) (2 participants);

Youth Council Focus Group (YCFG) (6 participants);

Disaster Managers Focus Group (DMFG) (8 participants);

Emergency Responders Focus Group (ERFG) (15 participants);

Non-governmental Organisation Focus Group (NGOFG) (2 participants);

Governmental Welfare Providers Focus Group (GWFG) (2 participants);

Local Business Focus Group (LBFG) (6 participants);

Retirees Focus Group (R) (2 participants);

Community Health (incl. Indigenous Health) Focus group (ICFFG) (6 participants).

Exosystem representatives

Real estate representatives;

Youth Council;

Disaster Managers;

Emergency Responders;

Non-governmental Organisations;

Local Business.

Macrosystem representatives

Governmental Welfare Providers;

Community Health (incl. Indigenous Health).

3.5.4 Innisfail

Twenty (20) key informants were interviewed between August 2010 and March 2011: their organisations and roles are:

Queensland Department of Communities, Community Recovery Officer;

Queensland Government, Local Government Member involved in Post-event community support and assistance;

Queensland Department of Health, Mental Health Worker and Health worker;

Queensland Department of Primary Industries, Economic Impact Assessment Chairperson;

Queensland Rural Adjustment Authority, Queensland Regional Client Liaison Officer

Townsville City Council, Waste Services Manager;

Queensland Fire and Rescue Service, Acting Area Director -Innisfail Command;

Telstra, former and current Area General Manager;

Salvation Army, 2 charity workers;

Queensland Department of Communities, Community assistance and support officer;

Cassowary Coast Regional Council, 2 council officers and Disaster Management Coordinator;

Queensland Police Service, police officer;

St Vincent De Paul's, Charity Worker;

Disability Services, Disabilities Support Worker;

Local Community Support Organisation, Manager and Social Worker.

Exosystem representatives

Townsville City Council, Waste Services;

Salvation Army;

Cassowary Coast Regional Council;

St Vincent De Paul's;

Disability Services;

Local Community Support Organisation.

Macrosystem representatives

Queensland Department of Communities;

Queensland Department of Primary Industries;

Queensland Rural Adjustment Authority;

Queensland Fire and Rescue Service;

Queensland Department of Communities;

Queensland Police Service;

Local Government Member.

Eighteen (18) participants took part in focus group interviews. They were derived from:

The agricultural sector (4 participants);

Small business owners (2 participants);

Innisfail Indigenous Australian community (5 participants);

Construction workers (2 participants);

Innisfail Chamber of Commerce (5 participants).

Exosystem representatives

Small business;

Innisfail Chamber of Commerce.

(All of the residents interviewed had lived in the Innisfail community over a long period of time and were significantly impacted by Cyclone Larry in differing but equally important ways).

Table 3.1 Summary of interview participants across the four sites

Location	Key informants	Focus group participants
Beechworth	10	30
Bendigo	10	19
Ingham	16	63
Innisfail	20	18
Total	56	130

3.6 Interviews

The individual key informant interviews involved one interviewer whilst the focus group interviewers had one interviewer and one note taker. At the start of each interview, participants were welcomed and thanked for their time. The study and its aims were briefly introduced and the ethics forms and information sheets were explained. The interviewer asked permission to audio record the interview using a digital recorder. Confidentiality was assured emphasizing that names would not be used in the analysis or reporting, and they could stop the recorder at any stage or withdraw from the interview. Participants were asked if they had any questions. Throughout the interviews, people were encouraged to reflect on their experiences. Different views were encouraged and the group was not expected to come to any consensus on matters relating to the disasters.

Participants responded enthusiastically. For many interviewees, it was the first time they had been asked to talk about their experiences of the disaster and they welcomed the opportunity to discuss the positive and negative aspects of the disaster experience. For some, it brought back raw emotions of loss, anger, fear and gratitude. The interviewers were aware that the interviews may be cathartic for participants. It was important to create a safe, non-threatening atmosphere at the start of the interview so that people felt they could express their feelings in a supported environment.

An interview schedule was employed so that questions were appropriate and ordered correctly. Open ended questions with long introductions to the topic and wording familiar to the participants obtain a higher level of responding than closed standard questions (Borg and Gall 1983). A response guided approach was adopted whereby answers to questions were affirmed by queries designed to create multi-faceted data (Murray Thomas 2003, p.64). Prior to each interview the study and its aims were introduced, encouraging participants to reflect on their experiences; the ethics forms and information sheets were explained at this stage.

The questions used in the interview schedule were designed to bring to light participants' experiences. The list of questions posed to both key informants and local residents consisted of:

Tell me, did you know the event was coming?

How did you find out about the event?

When did you find out the event was coming?

Have you been through similar events in the past?

Tell me what helped you during the event?

Tell me your recollections post the event – how long were you back into your usual routines?

What sort of things helped you recover after the event?

Who do you think were most affected by the event? And why?

How do you think different people/groups coped with the event? And why?

Who do you think coped least during the event? And why?

In your view has the community got better, got worse or remained the same as a result of the event? What sorts of things have made things better or worse?

Do you think you are now better prepared to face future similar events? Why or why not?

Do you think there is a risk of more disasters occurring?

What keeps you living in the community? Have you ever thought of moving from this community?

3.7 Analysis of interview transcripts

All interviews were recorded and transcribed, using both the audiotapes and the detailed notes taken during each interview. Key informant notes and focus group transcripts were analysed using the standard qualitative techniques as described by Patton (2002). Using content analysis, the process involved identifying, coding and categorising the primary patterns in the data as they appeared in response to the interview questions.

Responses from both the key informants and the focus groups were analysed in the same way, with key issues and themes coded and collated. General themes gathered from the analyses were noted, with quotes incorporated into these themes to further elaborate the views expressed by the informants and focus group participants.

The analyses of the transcripts involved the interpretations of two or more researchers, ensuring that investigator triangulation was imposed on the interpretation process across each of the research sites, and then across all four research sites, to derive common themes. These common themes were then tabulated and used to construct the survey questions for the quantitative phase of the project.

More specifically, the analysis process involved two phases.

1. A process was adopted of identifying and categorising the key issues reported and sorting these in to primary themes in the data (Patton 2002). Four main categories emerged as a logical framework for the data analysis; disaster experiences, recovery experiences, reflections on experiences and the future[3]. Participant responses to individual questions were further categorised within one or more of themes (e.g. knowing what to expect before the disaster; community spirit aiding recovery; local knowledge as an important factor in coping). Two researchers were involved in each case study, they analysed the transcripts and agreeing on emergent issues and themes. The research team then compared themes across sites by teleconference, email and face to face meetings to discuss the common and different issues and themes emerging. The data was then written up as four separate reports (see Appendices 3-6).

2. These findings were then analysed further by all researchers, those responsible for the Queensland sites and those responsible for the Victorian sites, and categorised according which level of Bronfenbrenner's model they were most congruent with, whilst looking for indicators of perceptions of individual and community resilience at these levels (e.g. prior experience at all levels, communications at all levels, and social networks at exosystem level). (Chapter 5 includes all qualitative results; in addition they were reported in conference papers of the Australian and New Zealand Emergency and Disaster Management Conference 2012 (see Appendix 9).

[3] NVIVO software was deemed inappropriate for this analysis due to the complexities of cross case study analysis.

3.8 Quantitative sequence

3.8.1 Pilot survey and instrumentation

Since our project used a design and theoretical framework not previously applied in this area of research, no existing survey instruments fully matched our research aims. Therefore we piloted a survey constructed for the purpose to ensure the main survey would measure the themes identified through the qualitative phase in a manner consistent with, and appropriate for, analysis.

We proceeded with the following steps: First we constructed a pilot survey and applied the survey to a sample other than the samples of interest, but nonetheless similar in that they had also experienced a natural disaster. Then we Rasch analysed the pilot survey responses to eliminate any inappropriate items from the main survey. Second, we applied the survey to the samples of interest, and again Rasch analysed the results to ensure that the subscales measuring the variables or constructs of interest (for example, preparedness, microsystem support and the like) were informed by the correct items of the survey. Third we performed a principle components analysis of the residuals to extract any latent traits within the proposed subscales that we had not anticipated, a process corresponding to the construction of congeneric factors as approached by structural equation modelling (Byrne 2001). An overview of the analytic process followed is summarised in Figure 3.2.

Before further description of the analytic process is undertaken, a note rationalising the use of self-report measures to assess resilience and other constructs in this study is warranted. The use of self-report measures to assess quality of life attitudes and beliefs is widespread in the psychological literature. Moreover, where attempts have been made to examine the validity of self-report instruments compared to other measures these have resulted in very positive evaluations of the self-report measures compared to other more “objective” measures. For example, when Meyer et al. (2001) summarized evidence and issues associated with psychological assessment, using data from more than 125 meta-analyses on test validity and 800 samples examining multi-method assessment, they concluded that psychological test validity was strong and compelling and comparable to medical test validity. In an earlier example, (Petersen, Crockett, Richards and Boxer 1988) used multi-methods in a longitudinal study of 335 adolescents over three years to assess adolescent pubertal changes. They concluded that the self-report data were valid when compared to the other measures employed in the study. Lastly, and pertinent for this research, a study examining resilience was conducted that validates our choice of self-report measures for individual resilience. The study was based on the theory that resilient individuals "bounce back" from stressful experiences quickly and effectively and to understanding psychological resilience. The authors (Tugade and Fredrickson 2004) used a multi-method approach in three studies to confirm that resilient people used positive emotions to rebound from, and find positive meaning in, stressful encounters. Results of mediational analyses revealed that positive emotions contributed, in part, to participants' abilities to achieve efficient emotion regulation, demonstrated by accelerated cardiovascular recovery from negative emotional arousal (Studies 1 and 2) and by finding positive meaning in negative circumstances (Study 3), overall supporting their resilience. These findings show that more objective measures such as physiological assessments are accompanied by emotional and cognitive internal references which can only be assessed through self-report surveys. Since resilience is an individual’s assessment of their abilities to respond to stressful situations, self-report is a very logical method of exploring it. Moreover, since in this study it is a retrospective assessment, individuals who did not manage very well, or required assistance to cope, would be able to reflect on this more objectively post the disaster

experience. In all, we believe that self-report is an appropriate way to measure resilience in this context.

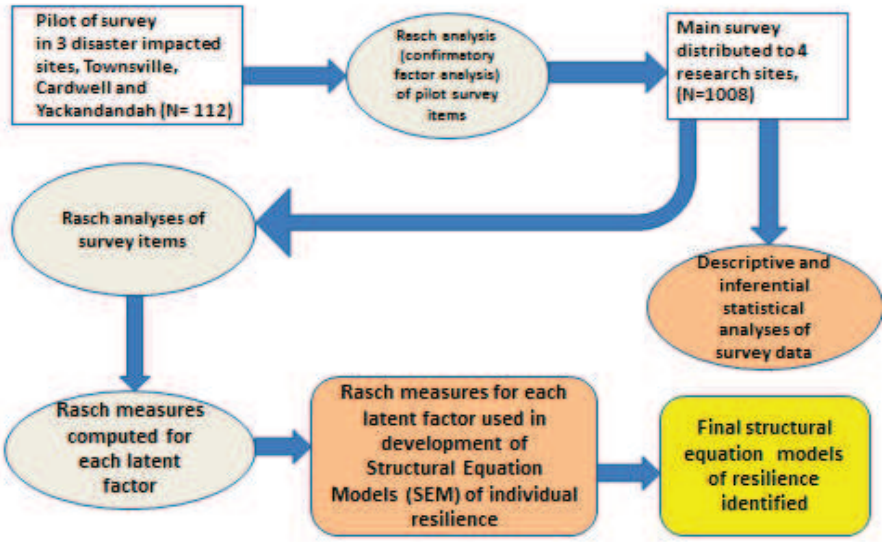

Figure 3.2 Overview of analytic process employed for the survey data

The pilot survey consisted of items testing the themes derived from the qualitative analyses and issues pertinent to each level of Bronfenbrenner's model which informed our theoretical and analytical framework. In addition, the relevant disaster and resilience literature provided additional items to augment and inform our survey items.

The literature provided us with the following groups of items for the pilot survey:

Climate change attitudes: Items used are obtained from Reser et al. (2011).

These items have a self-report Likert scale, response scale coded from 1 (definitely disagree) to 4 (definitely agree) with Don't Know coded 0.

They are:

I trust what scientists say about the environment

I am concerned about climate change (global warming)

I trust what the government says about the environment

I trust what the media says about the environment

I think climate change is caused by human activities

I think climate change is a serious problem right now

Resilience items: obtained from the resilience scale developed by Connor and Davidson (2003) because this scale was suitably tested in the general population, as well as in clinical samples, demonstrating sound psychometric properties, including good internal consistency and test–retest reliability. The scale demonstrated validity in relation to other measures of stress and hardiness, and reflected different levels of resilience in populations thought to be differentiated, among other ways, by their

degree of resilience (e.g. general population compared with patients with anxiety disorders).

These items also have a self-report Likert scale, response scale coded from 1 (definitely disagree) to 4(definitely agree) with Don't Know coded 0.

They are:

I have been able to adapt to change

I feel I can deal with whatever comes

I know where to turn for help

I focus and think clearly under pressure

I think of myself as a strong person

I know that when things look hopeless, I don't give up

As a result of the event my health and wellbeing remains stable

I was prepared to deal with the emotional impact of the event

With an added item we designed to be specific to disaster resilience namely:

I feel I can deal with natural disasters

As to date there has been no published survey to assess disaster resilience *per se* in individuals, the indicators chosen for the resilience scale are broadly commensurate with the underlying characteristics that have been found to be important when defining a person as resilient. These characteristics include traits which Polk (1997) clustered into four patterns: dispositional, relational, situational and philosophical. They include good health, intelligence, easy-going temperament, sociability, self-efficacy, confidence, optimism, hope, social support, problem-solving ability, an internal locus of control, appraisal skills, flexibility in goal setting and the ability to mobilize available resources. Masten and Obradovic (2006) further analysed a range of studies published since 1990 pertaining to adult resilience and concluded that they identified a remarkably consistent set of findings about the elements of resilience. These included longevity, positive physical and mental health status and career success.

Rutter (2007), one of the foremost authorities on human resilience, argued that resilience is not a personality trait. He stressed that people can only become resilient in the presence of adversity and that this dynamic process can vary in different contexts. Rutter's theory has been further strengthened by a recent concept analysis study of resilience by Gillespie, Chaboyer and Wallis (2007), which argued that resilience is the process of struggle against hardship which can be learned at any age. This presents the notion of the concept as an acquired skill, or process refined over time, as we have argued in Chapter 2. Masten and Obradovic (2006, p. 22) caution that many attributes are involved in the development of resilience, which they stress argue is not a single trait or process, but a 'complex family of concepts'.

In choosing the items for the measurement of resilience, we had to balance the length of the survey and the ethical requirements imposed on us by the ethics committee with the kinds of questions we could hope to have respondents answer. Some aspects of resilience, such as social support, we believe were answered via questions which were grouped under the set of questions designed to examine microsystem support, for example: During the event my family/ friends/neighbours helped me. Given the premise

that resilience development is complex and said to arise from processes of interaction across multiple levels of functioning, e.g. from genes to neural systems to relationships to individual-media interaction (Masten and Obradovic 2007) our overall model was designed to capture the influences arising from several systems defined by Bronfenbrenner (with the exception of the natural, environmental ecosystem).

It has to be acknowledged that for a much more accurate depiction of resilience researchers need to access multiple sources of information, from medical records to employment records, over the life-span of individuals. Only in this way can we be certain that a person is resilient, and in particular resilient to disaster experiences. Nonetheless, measures based on confidential, self-report surveys are routinely used across the social and medical sciences in connection with mental health and resilience issues with a high degree of confidence that they represent an accurate level of typical individuals' internal states. These can be said to be broadly analogous to the anonymous survey used in this study.

Sense of place (SOP) and effects of the disaster (exosystem or macrosystem influences by our definition) were measured with some items developed by Chang (2010), using a self-report Likert scale, response scale coded from 1 (definitely disagree) to 4 (definitely agree) with Don't Know coded 0.

They are:

I think my neighbourhood is a good place for me to live (SOP)

I can recognize most of the people who live in my community (SOP)

I have closer relationships with my neighbours (SOP)

I know the names of my closest neighbours (SOP)

And: As a result of the event I experienced…

Problems with gas supply? (exosystem)

Water problems? (exosystem)

Delays of insurance payment? (exosystem)

Difficulty in finding alternative accommodation (exosystem)

Shortages of food? (macrosystem)

The disruption of postal delivery? (macrosystem)

In addition we developed some items from the results of the qualitative interviews:

As a result of the event I experienced lengthy disruption of transport (or economic loss in the case of Bendigo) (macrosystem)

As a result of the event I had internet and mobile phone problems (or livestock / crop problems in the case of Bendigo) (exosystem)

Council and community functioning evaluations were measured with some items developed by Benight (2004) in the context of disaster resilience.

These items also have a self-report Likert scale, response scale coded from 1 (definitely disagree) to 4 (definitely agree) with (Don't Know) coded 0.

They are:

> My town/community/council is now able to:
>
> ....identify and respond to individuals in greatest need.
>
> ...to recognize the need for outside support.
>
> ...to successfully respond to a future disaster.
>
> ...to identify appropriate individuals within the community to lead recovery efforts.
>
> ...to deal with emotional responses that are part of a disaster,

Plus an item we designed to measure community functioning by way of people's perceptions of the recovery of their community:

> My community has recovered from the event's negative impact.

Items measuring communications, a critical factor in promoting disaster preparedness, were designed by our team in response to the qualitative interview findings. Similarly, since the concept of community connectedness was theorised to be important (Chapter 2, Norris et al. 2008) we designed three items to measure connectedness:

> I asked my neighbours if they needed help
>
> We found we had to look after ourselves at all times
>
> I feel able to work effectively with others in the community

All items used had a self-report Likert scale, response scale coded from 1 (definitely disagree) to 4 (definitely agree) with (Don't Know) coded 0.

The remaining survey items were designed by our team and were comprised of items of relevance to Bronfenbrenner's model. Since it was our intent to measure what people thought about their preparedness, their community's preparedness and the macrosystem's preparedness we designed items to measure these issues. These items and the constructs they to load on to are listed in Table 3.1. Some demographic questions were also inserted in the survey, including questions about prior disaster experiences or traumatic experiences, because prior experience of disasters has been found to support individuals' disaster response and preparedness in subsequent disasters (e.g. Marchand 2008). Examples of the full survey are reproduced in **Appendix 1.**

3.8.2 Rasch analyses: discussion

Rasch modelling or latent trait analysis (LTA), has the advantage of not requiring assumptions about a normal distribution to be met. It overcomes the dependence of factor analysis upon the nature of the sample, which often leads to lack of factorial invariance of the set of identified variables, a perennial problem of factor analysis, and it is able to compute item and person scalar measures from survey items even when there are some missing data (Wright, 1996). In addition, Rasch modelling was used in place of confirmatory factor analysis because data collected using scales based upon traditional test theory are ordinal in nature, and therefore only non-parametric statistical tests are appropriate analysis tools (Hambleton, Swaminathan and Rogers 1991; Wright and Stone 1979; Zhu 1996). Even if data are interval data, which surveys based on Likert scales are not, highly skewed distributions should be reported using the

median and the interquartile range rather than the mean (Peterson and Wilson 1992). In applying the Rasch model, we checked the degree to which a variable with fundamental measurement had been created (Andrich 1988). Moreover, since when the data-model fit is good, the observed results are independent of the sample of persons and of the particular items (Wright and Stone 1979), we obtained item/variable results that are based on person free calibrations and item-free person measurements for particular variables such as household preparedness. As a result, it was possible to assess the properties of the scale in question, independently of the distribution of the person parameters, and, importantly, measurements were on an interval level scale, rather than an ordinal level scale as is commonly obtained and reported in the literature. This permitted us to more easily compare individuals and the respondents from the four different sites, on a particular attribute (Wright and Stone 1979). Moreover, the interval level measurements obtained were more easily used in Structural Equation Modelling (SEM) to test for relationships between the various identified variables or constructs.

Rasch analysis uses a logistic transformation of fitting item data to produce interval level scale measurements (rather than ordinal level statistics) from each sub-scale score. By this means we are able to determine not only that, for example, people at Site x report more Connectedness than those at Site y, but by how much as well. The survey response categories: Strongly Disagree; Disagree; Agree and Strongly Agree are often analysed by ascribing numerical values 1, 2, 3 and 4 and then treating those values (e.g. finding means) as if they were interval data. But, the raw data from the response categories are merely ordered: Strongly Disagree< Disagree< Agree< Strongly Agree, so they should be treated as ordinal data. The way in which Rasch analysis revealed how the response categories were actually used in the connectedness sub-scale provides good evidence about the samples' perceptions of the distances between the response options. The actual gaps shown in Figure 3.3 below are quite different from the 'unit=1' presumption:

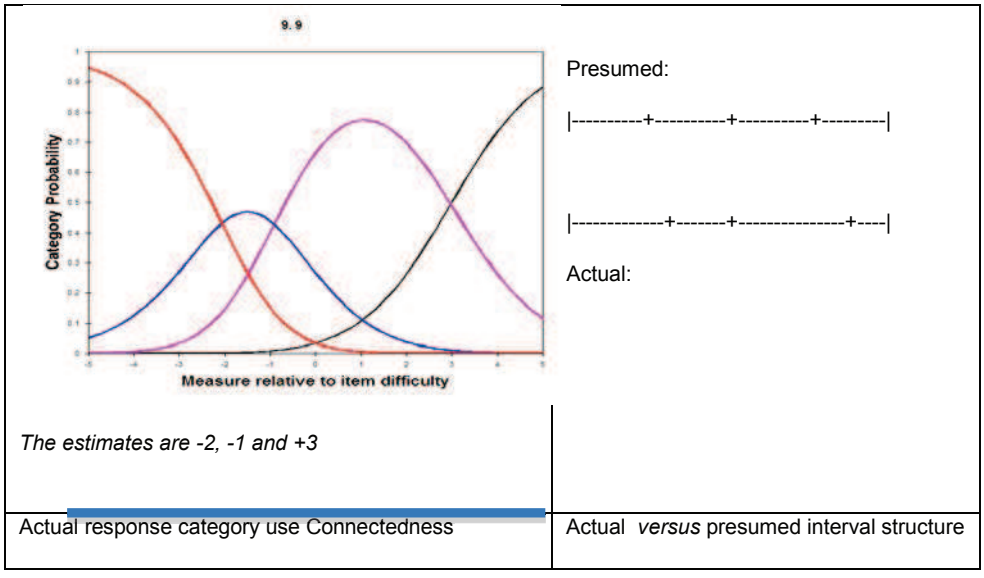

Figure 3.3 Measurement estimate: actual compared to presumed measurement

In sum, Rasch measurement converts each group of survey counts into a measure located on a straight line. Consequently, respondents, sites and items can be located along that line. Each sub-scale summary can also be considered a measure for that same reason. The combination of two

Rasch measurement properties, unidimensionality and interval scaling, provides two unique benefits: it allows for both the meaningful comparisons as made in the following sections of this report, and the quality control of data used as input for the structure equation modelling reported in chapter 6.

3.8.3 Trial survey analysis

Rasch modelling was used to ensure that the survey items and hypothesized factors or variables worked together in the way that they were intended to work across all sites. Survey items should not behave differently for particular subgroups of any sample. If an item does not perform consistently (i.e. it does not fit the Rasch model's requirements), that item reduces the validity of the measure for that construct, for example, household preparedness. Rasch analysis is particularly appropriate for the analysis of these data in which many components are theorized as having possible effects In particular, two Rasch model[4] properties are of foremost importance and utility for this purpose: unidimensionality and interval scale measurement. Unidimensionality requires that those items which are combined together as indicators of any particular attribute should measure that attribute and no other attribute; i.e. attributes should be measured one at a time. The requirements of the Rasch model, unidimensionality (i.e. whether the items fit together to form a unitary latent trait) and local independence (i.e. the likelihood of the person correctly responding to an item is relatively independent from the other items in the survey) had to be met. Survey items constructed to represent traits such as resilience or preparedness or various aspects of Bronfenbrenner's theory, were first theoretically grouped into content-related groups. Rasch model fit statistics and principal components factor analysis of the item-person residuals were then used to control the quality of the sub-scale measures derived from the theory-based groupings of items.

The survey trial data set was analysed during September 2011, to investigate, *inter alia,* the extent to which groups of items could be combined together to construct meaningful subscales to produce *measures* of some underlying attributes of those exposed to natural disasters. One consideration that always is a pre-condition to building such subscales concerns the manner in which the respondents actually used the response category options that were provided for them.

Residents in Townsville and Cardwell after their experience of Cyclone Yasi and in the town of Yackandandah post the 2003 bushfires completed the pilot survey returning 112 useable surveys. The purpose served by the pilot survey and its Rasch analyses was to ensure that the items of the main survey were interpreted by each person in a way that was consistent with the presumed underlying ability, characteristic or trait, that was required to answer the item. The results of the Rasch analyses of the pilot survey permitted the construction of the final, main survey to be made with few changes.

Data comprising the trial survey responses of 112 persons to a total of 78 items were drawn for exploratory Rasch analysis in the program Winsteps. Separate analyses were conducted for each individual cluster of items grouped into sub-scales, i.e.:

Preparedness at individual and microsystem scale

[4] For an introduction to the features, please consult: Bond, T.G. and Fox, C. M. (2007). *Applying the Rasch model: Fundamental measurement in the human sciences.* (2nd ed.) Mahwah, N.J.: Erlbaum.

Communications
Microsystem positive influences
Microsystem negative influences
Macrosystem negative influences
Exosystem influences
Connectedness
Sense of place (Q58 replaced by Q57)
Resilience
Assistance from Macro-system
Evaluation of community
Climate change attitudes

While most items performed in accordance of the requirements of the Rasch model, there are a few items which misfit their respective scales, each of which is indicated below by * (marginal misfit) or ** (substantial misfit). These items were seen as in need of reconsideration for rewriting for / dropping from the Main Survey as they might tend to yield low quality data in the main survey. Subsequently Boon and Bond conducted that review / revision of the following items:

Q10*; Q11**; Q20**; Q12_6*; Q17*; Q52*; Q30**; Q58**; Q37_2**; Q44**; Q66*
The section “Assistance from Macro-system did not function well (as a survey sub-scale) at all as 3 out of 4 items in this construct received 99% of responses in the option "0". While that is the case, the information provided by those data was nonetheless posited to be crucial to the interpretation of resilience and those items were retained as they were.

3.8.4 Main survey items and methods employed

After the preliminary item and person statistics were estimated for each proposed sub-scale, a Principal Component Analysis of standardized Rasch residuals was carried out. After the removal of misfitting items, the results indicated that each subscale could be considered as yielding a single measurement dimension.

The survey provided 4 substantive response options and a N/A or Don’t Know option:

Strongly disagree	Disagree	Agree	Strongly Agree	N/A* / Don’t know

These responses were coded 1,2,3,4 respectively so that a higher code in the data set always indicated stronger agreement. N/A was coded as 0. The final survey items that were used are listed in Table 3.2.

Table 3.2 Final survey items and the variable each item loads to

Trait	Survey section	Description of question	Item number
Financial capacity (preparedness)	A1	I had financial resources to deal with the impact of the event	1
Financial capacity (preparedness)	A2	I had adequate insurance to deal with the impact of the event	2
Preparedness (individual and microsystem levels)	A3	I had a fire action plan/household emergency plan/water saving plan to follow	3

Preparedness (individual and microsystem levels)	A4	I had an emergency kit/water saving plan to use in event	4
Preparedness (individual and microsystem levels)	A5	I prepared/ secured my home/property well	5
Preparedness (individual and microsystem levels)	A6	I was prepared to deal with the physical impact of the event	6
Resilience (individual)	A7	I was prepared to deal with the emotional impact of the event	7
Preparedness (individual and microsystem levels)	A8	I was aware of evacuation routes and centres for my area/ I was aware of support groups in my area	8
Connectedness	A9	I asked my neighbours if they needed help	9
Preparedness (individual and microsystem levels)	A10	I received the first/enough warning in time to prepare for the event	10
Preparedness (individual and microsystem levels)	A11	I felt I knew enough about how to best prepare myself and my property for the floods	11
Communications	B1a	I got critical information at regular intervals during the event from: neighbours or people in my local community	12
Communications	B1b	I got critical information at regular intervals during the event from: friends or family	13
Communications	B1c	I got critical information at regular intervals during the event from: my local council	14
Communications	B1d	I got critical information at regular intervals during the event from: the CFA/SES/Victoria farmers' federation	15
Communications	B1e	I got critical information at regular intervals during the event from: state government agencies	16
Communications	B1f	I got critical information at regular intervals during the event from: my mobile phone	17
Communications	B1g	I got critical information at regular intervals during the event from: internet web sites	18
Communications	B1h	I got critical information at regular intervals during the event from: the radio and television	19
Microsystem positive influences	B2	During the event my friends helped me	20
Microsystem positive influences	B3	During the event my neighbours helped me	21
Microsystem positive influences	B4	During the event my family helped me	22
Exosystem influences	B5	During the event I received help from local community groups	23
Exosystem influences	B6	Our community was well served by the formal rescue or support services	24
Connectedness	B7	We found we had to look after ourselves at all times	25
Evaluation of council functioning and community recovery	B8	The council's responses to the emergency were effective	26
Preparedness (individual and microsystem levels)	B9	I evacuated dependent family members/ I lost animals due to the drought	27
Leaving	B10	I seriously considered the option of leaving my home/property for good	28
Exosystem influences	C1	As a result of the event I had problems with gas supply/soil erosion	29
Exosystem influences	C2	As a result of the event I had water supply/water quality problems	30
Microsystem negative influences	C3	As a result of the event I had financial costs not covered by insurance/ financial costs	31
Exosystem influences	C4	As a result of the event I had electricity supply problems/ weed problems	32
Exosystem influences	C5	As a result of the event I had internet and mobile phone service problems/ live stock or crop problems	33
Microsystem negative influences	C6	As a result of the event I had damage to my residence/property	34
Microsystem negative influences	C7	As a result of the event I had to deal with the injury of a close family member/close friend	35
Microsystem negative influences	C8	As a result of the event I had to deal with the death of a family member or close friend	36

Resilience (individual)	C9	As a result of the event my health and wellbeing remains stable	37
Exosystem influences	C10	As a result of the event I had delays of insurance payments	38
Microsystem negative influences	C11	As a result of the event I had delays in repairing my damaged property	39
Microsystem negative influences	C12	As a result of the event I had difficulty in finding alternative accommodation/funding children's education	40
Macrosystem negative influences	C13	As a result of the event I had issues of prolonged shortages of food	41
Macrosystem negative influences	C14	As a result of the event I had the experience of lengthy disruption of transport/ economic loss	42
Macrosystem negative influences	C15	As a result of the event I had the experience of lengthy disruption of postal deliveries	43
Microsystem negative influences	C16	As a result of the event members of my family experienced health problems	44
Macrosystem positive influences	D1a	I received assistance from council	45
Macrosystem positive influences	D1b	I received assistance from charity groups/welfare groups	46
Macrosystem positive influences	D2	I received financial assistance from state or federal government	47
Preparedness (individual and microsystem levels)	E1	My household is well prepared for future events	48
Exosystem preparedness	E2	Our neighbourhood is well prepared for future events	49
Exosystem preparedness	E3	Our council is well prepared for future events	50
Macrosystem preparedness	E4	State government - emergency services etc. are well prepared for future events affecting our community	51
Macrosystem preparedness	E5	Commonwealth government - emergency management, health, social security etc. are well prepared for future events affecting our community	52
Evaluation of council functioning and community recovery	E6	My community has recovered from the event's negative impact	53
Evaluation of council functioning and community recovery	E7	The council is now able to identify and respond to individuals in greatest need	54
Connectedness	E8	I feel able to work effectively with others in the community	55
Evaluation of council functioning and community recovery	E9	Our town is now able to deal with emotional responses that are part of a disaster	56
Evaluation of council functioning and community recovery	E10	The council is now able to recognise the need for outside support	57
Evaluation of council functioning and community recovery	E11	The council is now able to identify appropriate individuals within the community to lead recovery efforts	58
Sense of place	E12	I think my neighbourhood is still a good place for me to live	59
Sense of place	E13	I can now recognise most of the people who live in my local area	60
Leaving	E14	Ideally I would like to move away from this community	61
Sense of place	E15	I know the names of my close neighbours	62
Resilience (individual)	E16	I have been able to adapt to change	63
Resilience (individual)	E17	I feel I can deal with whatever comes	64
Sense of place	E18	I have closer relationships with my neighbours	65
Resilience (individual)	E19	I feel I can deal with natural disasters	66
Resilience (individual)	E20	I know where to turn for help	67
Resilience (individual)	E21	I focus and think clearly under pressure	68
Resilience (individual)	E22	I think of myself as a strong person	69
Resilience (individual)	E23	I know that when things look hopeless, I don't give up	70
Climate change attitudes	E24	I trust what scientists say about the environment	71
Climate change attitudes	E25	I am concerned about climate change (global warming)	72
Climate change attitudes	E26	I trust what the government says about the environment	73
Climate change attitudes	E27	I feel I know a lot about climate change (global warming)	74
Climate change	E28	I trust what the media says about the environment	75

attitudes			
Climate change attitudes	E29	I think climate change is caused by human activities	76
Climate change attitudes	E30	I think climate change is a serious problem right now	77
Prior experiences	Dem1	I have lived through a disaster event prior to the event	78
Prior experiences	Dem2	I have experienced traumas prior to the event	79
Prior experiences	Dem3	I have experienced major financial difficulties prior to the event	80
Demographics	Dem4	I identify as a Torres strait islander	81
Demographics	Dem5	I identify as an aboriginal	82
Demographics	Dem6	Gender	83
Demographics	Dem7	Age	84
Demographics	Dem8a	Please list how many adults live in your household	85
Demographics	Dem8b	Please list how many children under 18 live in your household	86
Demographics	Dem9	How long have you lived in your community	87
Demographics	Dem10a	Did the event cause you to move out	88
Demographics	Dem10b	When did you move back - I moved back after x days	89
Demographics	Dem11a	In case of a future disaster do you have building insurance cover	90
Demographics	Dem11b	In case of a future disaster do you have contents insurance cover	91
Demographics	Dem11c	In case of a future disaster do you have farm insurance cover	92
Demographics	Dem12a	Are you currently employed	93
Demographics	Dem12b	Or studying full time	94
Demographics	Dem13	If you are employed please indicate the area of your employment by ticking the appropriate box	95
Demographics	Dem14a	Employed full time	96
Demographics	Dem14b	Employed part time	97
Demographics	Dem14c	Not in paid employment	98
Demographics	Dem14d	In casual employment	99
Demographics	Dem15	What is your highest educational qualification	100
Demographics	Dem16a	My residence is	101
Demographics	Dem16b	Other – specify	102
Additional information	Dem17	Free response	103

Groups of items for each proposed subscale (e.g. *Resilience* items; *Preparedness* items etc.) were subject to Rasch analysis using the Rasch Rating Scale Model. Misfitting items were removed, one at a time, as necessary, until all remaining items in each subscale showed adequate fit to the Rasch model's requirements for measurement[5]. Unidimensionality was confirmed by Principal Components Factor Analysis of the Rasch item/person residuals. The Category Characteristic Curves showed that the four response options were used as intended, and in each separate sub-scale analysis results revealed satisfactory response category performance.

3.8.5 Outcomes for each subscale - main survey

The information below provides summary data concerning the performance of the *items* and response *categories* for each group of items.

The report format contains:

a) Item information outputs that show the items which work together to form each of the proposed subscales;

b) The estimates for the response category thresholds; and

c) A note of any item(s) which did not fit that subscale.

[5] A small number of items were retained in the final survey (Item 55 and 14) despite less than optimal fit indices because, on balance, these items were deemed to be essential for the integrity of the scale at this first analytical stage.

The following outputs were used to inform decisions about the suitability of items for measuring each of the subscales determined *a priori*. For detailed explanations of the statistics reported in each Winsteps output file, and the rationale for the procedure please refer to the Winsteps User Manual (Linacre, 2009).

Preparedness at microsystem level

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
3	1561	819	-.92	.07	.90	-1.9	.90	-1.7	.73	.72	73.5	70.0	1.91	3
4	1457	814	-.52	.06	1.02	.5	1.04	.7	.75	.73	70.5	67.9	1.79	4
5	1732	840	-1.51	.07	.71	-5.5	.68	-5.8	.79	.71	78.7	72.4	2.06	5
6	1503	836	-.50	.06	1.01	.2	1.01	.1	.73	.73	70.0	68.0	1.80	6
10	1574	825	-.88	.07	1.35	5.6	1.30	4.4	.66	.72	69.5	70.0	1.91	10
11	1701	850	-1.28	.07	.80	-3.7	.77	-4.0	.77	.72	76.0	71.2	2.00	11
48	1781	864	-1.50	.07	1.15	2.5	1.19	2.9	.64	.72	72.8	72.4	2.06	48
MEAN	1615.6	835.4	-1.02	.07	.99	-.3	.98	-.5			73.0	70.3		
S.D.	113.9	16.4	.39	.00	.20	3.5	.20	3.4			3.2	1.7		

Items removed: 1,2 ,8, 27.

Communications

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
12	1299	743	-.49	.06	.82	-3.5	.82	-3.5	.74	.70	67.5	61.1	1.75	12
13	1397	752	-.81	.06	.89	-2.0	.87	-2.3	.72	.70	68.3	62.6	1.86	13
14	1038	726	.33	.06	.69	-6.8	.70	-6.2	.77	.70	70.6	57.2	1.43	14
15	1064	678	-.10	.06	1.01	.3	1.02	.4	.71	.70	62.8	57.9	1.57	15
16	885	658	.45	.06	.84	-3.2	.98	-.3	.72	.69	66.9	56.8	1.34	16
17	810	656	.74	.06	1.12	2.3	1.19	3.1	.68	.70	63.9	56.1	1.23	17
18	1079	683	-.09	.06	1.29	4.8	1.28	4.6	.69	.71	56.5	58.0	1.58	18
19	1738	842	-1.30	.06	1.30	5.2	1.27	4.5	.60	.69	64.4	63.8	2.06	19
MEAN	1163.8	717.3	-.16	.06	1.00	-.4	1.02	.0			65.1	59.2		
S.D.	282.5	58.6	.64	.00	.21	4.0	.20	3.7			4.0	2.7		

Items removed: nil

Microsystem positive influences

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
20	1305	701	-1.10	.10	.99	-.1	.79	-1.3	.92	.93	86.0	85.1	1.86	20
21	1246	688	-.67	.10	.99	-.1	.80	-1.2	.94	.93	85.8	84.8	1.81	21
MEAN	1275.5	694.5	-.89	.10	.99	-.1	.79	-1.3			85.9	85.0		
S.D.	29.5	6.5	.22	.00	.00	.0	.00	.0			.1	.1		

Items removed: 22

Microsystem negative influences

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
31	1074	654	-.59	.06	.96	-.8	1.03	.6	.72	.73	59.4	51.5	1.64	31
34	1156	685	-.80	.06	.99	-.1	1.09	1.6	.74	.73	48.2	49.4	1.69	34
35	365	485	1.37	.08	.83	-2.6	.79	-2.9	.66	.63	72.9	62.6	.75	35
36	311	475	1.70	.08	1.12	1.6	1.19	2.2	.56	.60	74.0	61.8	.65	36
39	692	451	-.17	.07	.96	-.6	1.01	.2	.72	.68	60.0	52.7	1.53	39
40	303	270	.62	.10	1.04	.5	1.00	.0	.70	.69	71.3	60.1	1.12	40
44	588	544	.72	.07	1.03	.5	1.06	.9	.67	.68	61.5	60.4	1.08	44
MEAN	641.3	509.1	.41	.07	.99	-.2	1.02	.4			63.9	56.9		
S.D.	328.9	128.4	.89	.01	.08	1.2	.11	1.5			8.7	5.1		

Items removed: nil

Macrosystem positive influences

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
45	147	827	1.19	.10	.95	-.7	.91	-.6	.69	.68	84.1	83.0	.18	45
46	124	836	1.64	.11	.96	-.6	.85	-.7	.66	.65	84.9	84.9	.15	46
47	478	851	-2.17	.13	1.03	.2	3.18	3.6	.80	.81	93.6	93.5	.56	47
MEAN	249.7	838.0	.22	.11	.98	-.3	1.65	.8			87.5	87.1		
S.D.	161.7	9.9	1.70	.02	.04	.4	1.09	2.0			4.3	4.6		

Items removed: nil

Macrosystem negative influences

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
41	640	579	1.01	.08	1.32	4.2	1.24	2.9	.80	.85	79.0	73.4	1.11	41
42	832	589	-.30	.08	.88	-1.8	.85	-2.1	.89	.88	78.4	71.4	1.41	42
43	847	618	-.14	.08	.77	-3.6	.73	-3.9	.91	.88	78.4	72.9	1.37	43
MEAN	773.0	595.3	.19	.08	.99	-.4	.94	-1.0			78.6	72.6		
S.D.	94.2	16.5	.59	.00	.24	3.3	.22	2.9			.3	.9		

Items removed: nil

Exosystem influences

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
23	629	576	.72	.06	.98	-.3	.99	-.1	.52	.55	56.4	49.3	1.09	23
24	1512	763	-.80	.05	.99	-.1	1.02	.3	.51	.55	58.5	49.7	1.98	24
26	1200	747	-.14	.05	1.02	.4	1.12	2.4	.41	.57	54.5	48.0	1.61	26
29	432	416	.69	.07	.92	-1.2	.93	-1.1	.52	.52	59.1	49.6	1.04	29
30	1149	719	-.17	.05	.96	-.8	.95	-1.1	.62	.56	55.2	47.9	1.60	30
32	1668	786	-1.13	.05	.99	-.1	.95	-1.1	.61	.55	53.8	51.4	2.12	32
33	1308	679	-.76	.05	.95	-.9	.93	-1.3	.66	.56	49.2	49.5	1.93	33
38	565	415	.33	.06	1.23	3.4	1.20	3.0	.51	.54	47.2	48.1	1.36	38
MEAN	1057.9	627.6	-.16	.05	1.01	.0	1.01	.1			54.2	49.2		
S.D.	431.3	141.6	.66	.01	.09	1.4	.09	1.6			3.9	1.1		

Items removed: nil

Connectedness

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
9	1551	790	-.82	.06	1.03	.5	1.00	.0	.68	.61	66.8	66.5	1.96	9
25	1313	756	-.17	.05	1.20	3.5	1.21	3.4	.67	.65	60.6	59.5	1.74	25
55	1585	783	-.95	.06	.70	-5.6	.69	-5.7	.53	.62	80.1	69.0	2.02	55
MEAN	1483.0	776.3	-.65	.06	.97	-.6	.97	-.8			69.2	65.0		
S.D.	121.0	14.7	.34	.00	.21	3.8	.22	3.8			8.1	4.0		

Items removed: nil

Sense of place

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
59	2055	878	-3.05	.08	1.14	2.5	1.10	1.3	.69	.71	80.7	77.6	2.34	59
60	1656	849	-1.00	.07	.93	-1.3	.94	-.9	.78	.75	76.6	73.6	1.95	60
62	1924	879	-2.22	.07	.97	-.5	.87	-1.9	.77	.74	80.9	77.3	2.19	62
65	1476	825	-.38	.07	.94	-1.2	1.08	1.4	.72	.76	75.5	68.8	1.79	65
MEAN	1777.8	857.8	-1.66	.07	.99	-.1	1.00	-.1			78.4	74.3		
S.D.	225.9	22.4	1.04	.00	.09	1.5	.10	1.4			2.4	3.6		

Items removed: 28, 61

Resilience of individuals

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
63	1743	829	-2.10	.09	1.10	1.4	.95	-.4	.71	.76	85.2	83.7	2.10	63
64	1622	810	-1.34	.09	.97	-.4	.78	-2.2	.80	.77	81.3	81.5	2.00	64
66	1547	794	-.98	.09	.92	-1.1	.87	-1.2	.80	.77	82.3	80.6	1.95	66
67	1590	821	-.96	.09	1.43	5.6	1.27	2.5	.68	.76	76.6	80.4	1.94	67
68	1659	840	-1.19	.09	.85	-2.3	.69	-3.3	.81	.77	83.4	80.5	1.98	68
69	1764	862	-1.65	.09	.74	-4.0	.56	-5.1	.81	.76	87.0	82.7	2.05	69
70	1792	848	-2.15	.09	.82	-2.5	.61	-4.5	.75	.76	88.7	83.8	2.11	70
MEAN	1673.9	829.1	-1.48	.09	.98	-.5	.82	-2.0			83.5	81.9		
S.D.	86.9	21.5	.46	.00	.21	2.9	.22	2.4			3.7	1.4		

Items removed: 7, 37

Preparedness evaluations of the exosystem

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
49	1374	733	-1.40	.09	.96	-.5	.74	-2.1	.87	.87	86.9	85.7	1.87	49
50	1134	674	-.31	.09	.99	-.2	.79	-1.6	.89	.89	85.6	84.5	1.68	50
MEAN	1254.0	703.5	-.86	.09	.97	-.3	.76	-1.9			86.2	85.1		
S.D.	120.0	29.5	.55	.00	.01	.2	.03	.2			.6	.6		

Items removed: nil

Preparedness evaluations of the macrosystem

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
51	1289	711	-1.72	.10	.98	-.2	.89	-.3	.93	.92	88.7	88.3	1.81	51
52	1116	650	-.92	.10	.98	-.3	.95	-.1	.90	.91	87.9	87.4	1.72	52
MEAN	1202.5	680.5	-1.32	.10	.98	-.2	.92	-.2			88.3	87.9		
S.D.	86.5	30.5	.40	.00	.00	.1	.03	.1			.4	.5		

Items removed: nil

Evaluation of community

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
53	1408	791	-.91	.08	1.32	4.7	1.09	.9	.78	.80	72.2	79.0	1.78	53
54	932	586	-.28	.09	.81	-2.9	.67	-3.6	.84	.81	82.9	76.7	1.59	54
56	1176	673	-.79	.09	.97	-.4	.79	-2.1	.79	.80	80.7	78.4	1.75	56
57	1157	645	-1.18	.09	.85	-2.4	.71	-3.1	.79	.79	84.1	78.2	1.79	57
58	1069	607	-.97	.09	.93	-1.0	.83	-1.6	.80	.79	82.7	78.1	1.76	58
MEAN	1148.4	660.4	-.83	.09	.98	-.4	.82	-1.9			80.5	78.1		
S.D.	155.8	71.9	.30	.00	.18	2.7	.15	1.6			4.3	.8		

Items removed: nil

Climate change attitudes

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	P-VALUE	item
71	1071	757	.00	.06	.85	-3.0	.89	-2.2	.83	.80	69.8	63.8	1.41	71
72	1395	806	-1.00	.06	.87	-2.8	.86	-2.7	.84	.81	73.6	63.2	1.73	72
73	748	748	1.34	.07	1.02	.4	.96	-.7	.75	.75	69.9	65.4	1.00	73
75	692	776	1.78	.07	1.34	5.9	1.51	6.4	.63	.73	58.6	66.2	.89	75
76	1191	738	-.65	.07	.96	-.7	.98	-.4	.82	.81	72.0	63.4	1.61	76
77	1356	777	-1.04	.06	.90	-2.0	.93	-1.4	.83	.82	72.4	63.3	1.75	77
MEAN	1075.5	767.0	.07	.07	.99	-.4	1.02	-.2			69.4	64.2		
S.D.	273.4	22.4	1.11	.00	.17	3.0	.22	3.1			5.0	1.2		

Items removed: 74

Fourteen (14) measurement subscales were constructed, each with sufficient fit to the Rasch model that the summary scores could be used as subscale measures. Ten (10) items were not included in those subscales. Response categories were used as

expected by respondents in each of the subscales. The 14 identified subscales were then used to make comparisons across the four sites for the project (Chapter 6).

Next, since this survey as a whole had not been used before, further Rasch analyses were conducted to reveal the possible existence of any smaller subscales (based upon examination of the residuals). This yielded some underlying possible measures derived from the main subscales; for example, "resilience" was composed of two smaller variables, resilience and adaptability, each informed by three items. These items were then analysed as separate sub-scales and the consequent item and person measures were then used to develop the values of the subscales shown in Table 6.24. Unidimensionality was assessed using fit statistics, which report the extent to which the pattern of observed answers fit their Rasch modelled expectations. The subscale scores thus obtained were used in the Structural Equation Models. The results of this set of Rasch analyses (the principal components analyses of the residuals) are to be found in Appendix 7.

3.8.6 Descriptive and inferential data analyses

Descriptive statistics were employed to compare the four communities. To assess significant differences between the four groups, analyses of variance (ANOVA) and, in some cases, regressions analyses were used to answer particular research questions. The statistical program IBM SPSS was employed to perform the statistical computations.

3.8.7 Structural equation modelling analyses

To test the relationships between constructs and traits and construct a model of resilience across the four sites, SEM was employed. SEM requires that that researcher theories are made explicit prior to the testing of the models proposed (Fife-Schaw 2000). The advantage of SEM techniques over traditional multivariate regression models are:

a) SEM allows the researcher to explore relationships amongst dependent variables, e.g. resilience and preparedness;
b) SEM allows the researcher to estimate latent constructs such as preparedness by separating the measurement error and contribution of each indicator variable to the latent construct. For example, resilience, a latent construct, may be more dependent upon coping with disaster than knowing where to get help. SEM shows the degree to which each indicator variable contributes to the latent variable.

Since SEM can estimate relationships between variables with the measurement errors removed, group difference testing can be accomplished. Thus, a test of the difference in scores on a latent variable is possible, even though only data on the indicator variables pertaining to that latent variable are available. This is important when, for example, a group difference is detected using a t-test or ANOVA, but the t-test or ANOVA does not discriminate whether the difference is a "true" difference in the latent construct or a difference in measurement errors (Byrne 2001).

The person scores (transformed to be interval level scale measurements) from each of the variables computed by the Rasch model were used via AMOS, the structural equation modelling program, to obtain relationships between the various variables via a structural equation model.

3.8.8 Quantitative sampling strategies for the main survey

We used a method of systematic cluster sampling for each community to gather responses from people who lived in different parts of the four selected communities. To do this we overlayed a grid on the whole map of each community site, then selected alternate grid squares, but had to move the location to clusters of residential houses. We then obtained the latitude and longitude to position each marker for the collection of surveys from the houses on those points. Thus, geographically diverse parts of each community have an equal chance of being sampled. A project assistant or emergency services volunteer spoke with each householder and offered the survey to those who were present through the disaster and afterwards. Surveys were hand-delivered to households and they were then collected by arrangement with the householders a few days later. A total of 1008 correctly filled, useable surveys were collected from the four sites of interest. The survey distribution and collection took place between October 2011 and February 2012.

3.9 Ethical considerations

Ethical codes relating to psychological research stress that researchers must consider the welfare of the participants and must protect them from being either physically or mentally harmed by the research process (Breakwell and Rose 2000). In this project, there were no physical or psychological risks for the participants over and above those that the participants would encounter during the course of their normal lifestyle.

The taped interviews will be locked in a filing cabinet to which there will be no access to any person other than the principal researcher. After five years the tapes will be destroyed.

James Cook University Ethics Committee granted ethics clearance for the project in April 2010 approval number H3844 and the informed consent sheet is attached in Appendix 2.

4. DEMOGRAPHIC PROFILES

4.1 Introduction

Each of the four case studies lies within a larger shire for which demographic data are tabulated. The exception is Bendigo, where ABS data were tabulated for Greater Bendigo, which consists of the city and surrounding peri urban communities. In the cases of Beechworth and Innisfail, each town is one of a small number of towns and rural communities in, respectively, Indigo and Cassowary Coast Shires. Ingham is the only significant town in Hinchinbrook Shire, but all three of these smaller case study profiles are presented as shire profiles. The ABS presents profiles of suburbs within Ingham and Innisfail, but each would need to be aggregated to identify the town and, in doing so, would exclude peri urban communities. The time involved in such an analysis precludes its use (once data packs are available later in 2012 communities within towns are easily identified and full data sets will be available).

Non census data, such as economic and social statistics, are not available at small community levels, but are sometimes available at Shire level. Much data, like crime and health statistics, are not readily available at shire levels. Therefore these profiles have extracted data where available. Only the first release of 2011 census data is available in mid-2012. These data are the primary profile statistics presented here as they usefully include time series data of the same geographical unit for 2001 and 2006 as well as 2011. Cassowary Shire is a new amalgamated unit post 2006, but the profile for each of the censuses has aggregated all into the same unit for comparison.

These profiles serve two primary purposes:

1. They provide a summary profile of each community's population and socio-economic characteristics;
2. They indicate changes and trends over a ten year period.

The disasters that have been a focus of this research project occurred within the ten year inter-censual period from 2001 to 2011. Some of the socio-demographic changes identified by the census data may be attributable in part to the impact of the specific disaster on each community. However, it is not possible to disentangle disaster impact from all of the other processes of social and economic change that have occurred during the same inter-censual periods. The 2001 census took place just before 9/11, which indirectly triggered significant increases in petroleum prices and transport costs that have resulted in much higher costs of living and housing in the small communities that are the focus of this study. For extended periods of the last decade, Victoria experienced drought, but at the same time agricultural commodity prices declined in real terms in all four locations. The global economic recession from 2009 onwards compounded the economic problems of agriculture and small businesses generally. Further complexity of natural disasters took place in 2011, before the census, with extensive floods throughout Queensland and Victoria, and another category four cyclone that impacted on Ingham and Innisfail, and particularly devastated the southern part of Cassowary Coast Shire.

4.2 Hinchinbrook Shire Community Profile

Hinchinbrook Shire (Ingham is a town within the region) was one of the only regional councils not changed during the 2008 amalgamations. It is located in ABS Northern division (Australian Bureau of Statistics 2006) and is accessed as ABS Statistical Local Area: Hinchinbrook (ABS 2006).

4.2.1 Brief history of Ingham

Ingham was named in 1879 and originally called Slygo and did not appear in the official records until 1882. Ingham is located 110km north of Townsville, 245km south of Cairns and adjacent to the Hinchinbrook channel and island. Other small townships in the Hinchinbrook Shire are Halifax, Lucinda, Taylors Beach and Forrest Beach (Hinchinbrook - the natural place to be 2010b).

The Hinchinbrook Shire is 2,600 square kilometres (Hinchinbrook - the natural place to be 2010b). The climate is tropical with the wet season from November through to April (Hinchinbrook - the natural place to be, 2010b). Local tourism attractions include: Wallaman Falls, Hinchinbrook Island, Tyto Wetlands, Broadwater State Forest, scenic beaches and fishing in the Hinchinbrook Channel (Hinchinbrook - the natural place to be 2010b).

4.2.2 Ingham's role

The main industries of the region are sugar cane cultivation and milling, tourism, cattle raising and aquaculture (Hinchinbrook - the natural place to be 2010b). The region has been multicultural from the time of its settlement, with a history in particular of Italian migrants to establish and cultivate the sugar industry (Hinchinbrook - the natural place to be 2010a, Douglass 1995).

4.2.3 The event – 2009 Ingham Floods

Two consecutive floods occurred in Ingham in 2009 which were both predominantly riverine exacerbated by the prolonged rainfall periods (Bureau of Meteorology 2009). The Bureau of Meteorology produced a report titled "Herbert River Floods: January and February 2009", which provides the meteorological and hydrological assessments of the 2009 floods in Ingham.

The initial flood in Ingham was between 12-13 January and the second between 29 January and 8 February 2009 (BOM 2009). The peak of the floods was on Tuesday 3rd February 2009 following heavy rainfall into the Herbert River catchment associated with category 1 Tropical Cyclone Ellie crossing the coast at Mission Beach, north of Ingham as depicted in Figure 4.1 (BOM 2009). The rainfall continued with a weak low which developed on the monsoon trough to the east of Cairns on the 4 February then drifted northwards with the monsoon trough, producing heavy rainfall on Friday 6 and Saturday 7th February in the Herbert River catchment (BOM 2009).

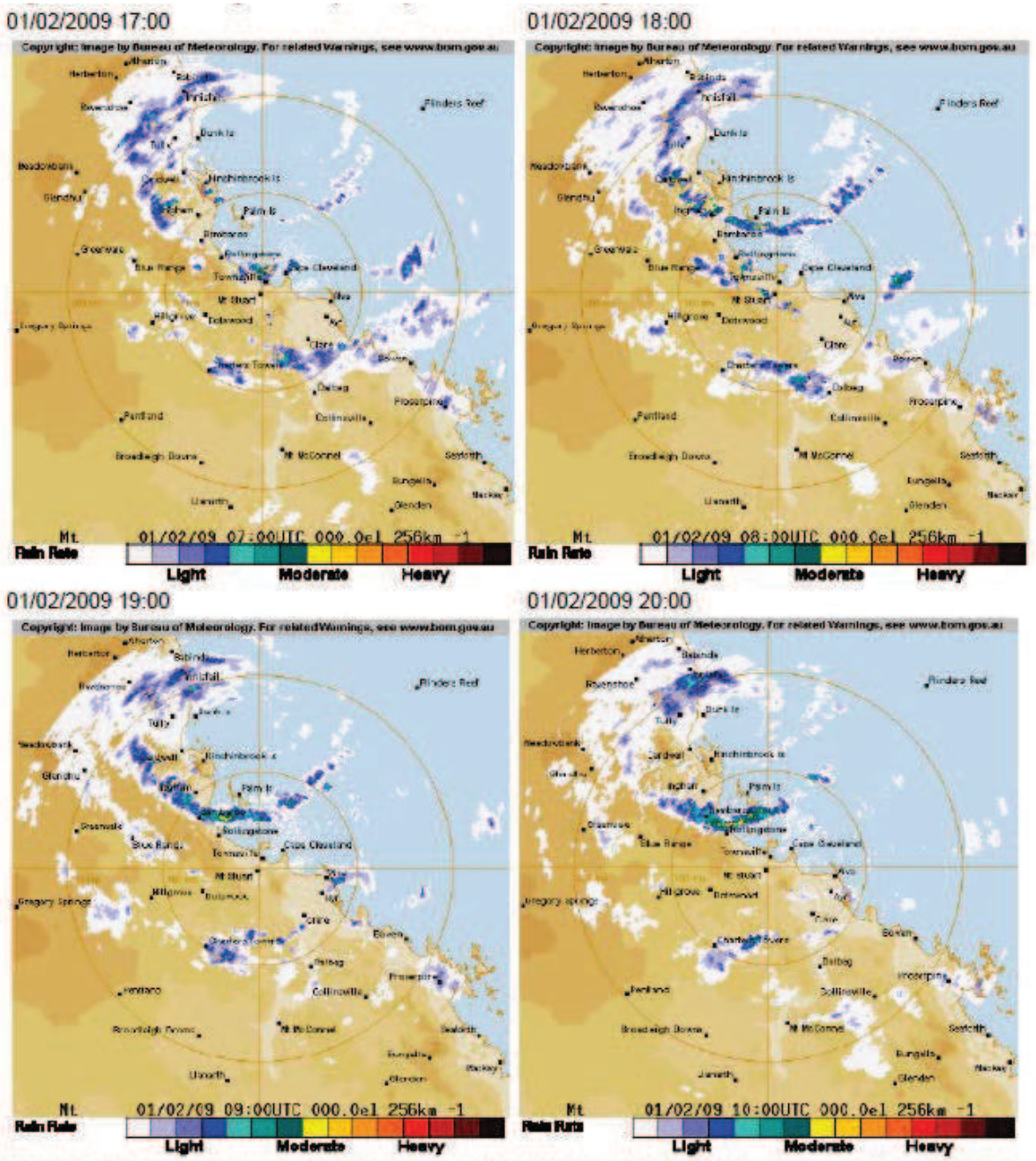

Figure 3.1.2 shows radar images of the low pressure system crossing the coast. The images from 17:00 to 20:00 on 01/02/2009 show heavier rainfall echoes over the Ingham and the Gairloch area, which is reflected in the totals shown at these stations in Figure 3.1.4.

Figure 4.1 Radar imagery of the category 1 Tropical Cyclone Ellie crossing the coast and associated rainfall into the Herbert River catchment which resulted in flooding Ingham in 2009 (BOM 2009)

The bank collapsed at the gauging station in Ingham (Ingham Pump Station AI) during the 2009 floods so rainfall data was taken from the BOM gauge at Gairloch to estimate the rainfall during the flood. The Herbert River reached 12.25m at the Gairloch bridge on 3 February 2009, which is classed as a major flood and remained this high until 7 February 2009 (BOM 2009). Whilst these were major flood recordings, they are not uncommon at the Ingham Pump station and Gairloch bridge, with at least one major flood event recorded every 10 years since records commenced in the 1900s (Figures 4.2 and 4.3 (Bureau of Meteorology (2010a)).

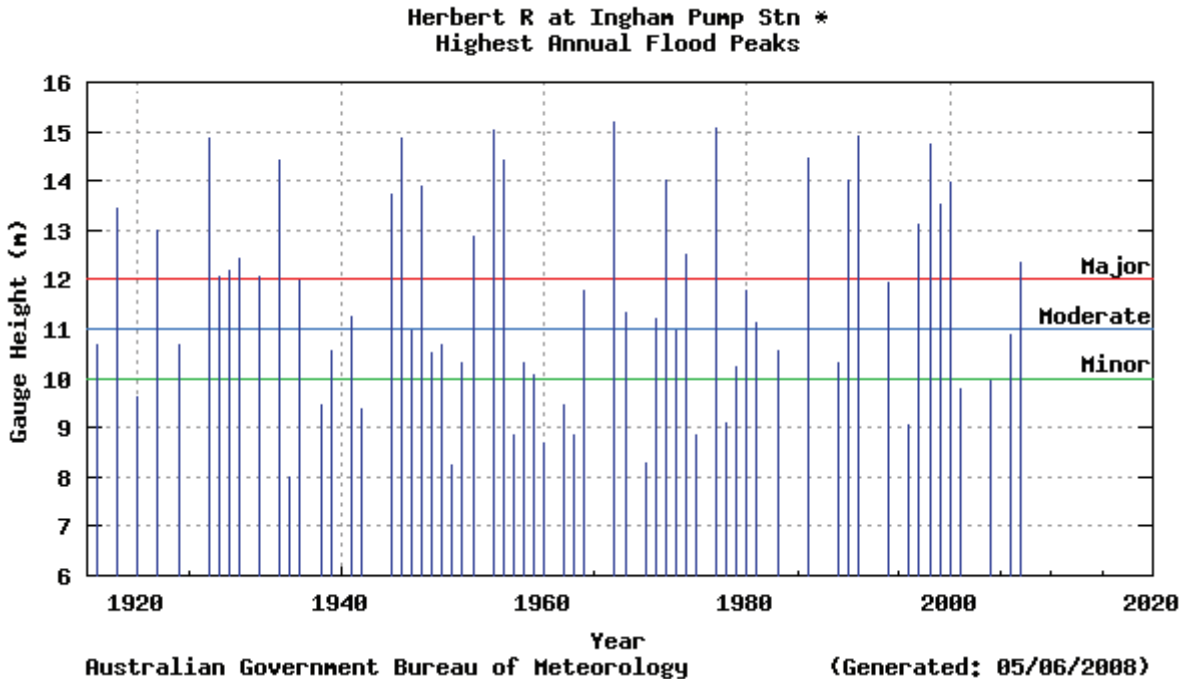

Figure 4.2 Ingham Pump Station (BOM 2010a)

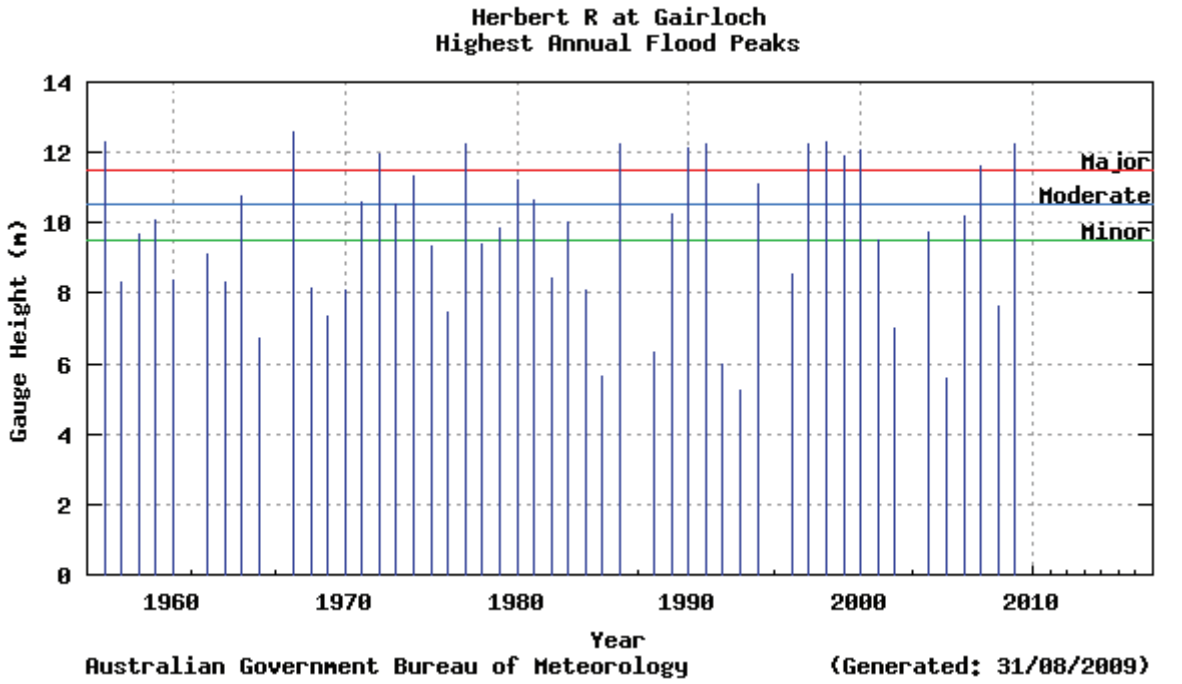

Figure 4.3 Gairloch Pump Station (BOM 2010a)

Flood levels were recorded as the third highest in Ingham's history (Queensland Government 2009).

4.2.4 Impacts/severity of the event

The town of Ingham is located on the Herbert River floodplain as illustrated in figure 4.4 and there are a number of natural watercourses that distribute floodwaters through the town during major flood events (BOM 2009). This geomorphology resulted in most of the town being subject to inundation during the 2009 floods (BOM 2009).

Figure 4.4 Herbert River catchment (BOM 2009)

Helicopters were used to bring supplies to remote areas in the Hinchinbrook Shire (Department of Emergency Services 2009). Forty people were evacuated from their homes to an emergency centre established at the Ingham High School (Department of Emergency Services 2009). Many residents were isolated by floodwaters causing them to be trapped in their homes for a week. Emergency Management Queensland estimated that 65% of the Hinchinbrook Shire or around 2,900 residences and businesses were affected by the February 2009 floodwaters, with 50 homes experiencing inundation specifically in living areas (BOM 2009). Initial estimates of infrastructure damage by the Queensland Premier were $120 million (ABC News 2010).

The Community Recovery Centres housed up to 108 people and operated for ten days with an average of 54 people per night (Australian Red Cross 2009). The Australian

Red Cross assisted people at Community Recovery Centres and door knocked 2,660 homes in and around Ingham to check on people's health and wellbeing (Australian Red Cross 2009). The Australian Red Cross was active for a month involving 110 staff and volunteers (Australian Red Cross 2009). Loss to agriculture was largely a result of floodwaters cutting off transport routes down the Bruce Highway to markets (ABC News 2009). In the recovery phase there were issues with insurance agencies such as debate over whether floodwaters were incoming or escaping from residences.

4.2.5 Disaster management system - Ingham

The Herbert River Improvement Trust was constituted under the River Improvement Trust Act 1940-1985 and was constituted by Order-in-Council dated 8th May, 1942 (Hinchinbrook Shire Council 2010a). The function of the Herbert River Improvement Trust is to provide for the protection, repair and improvement of the river beds and banks to prevent flooding (Hinchinbrook Shire Council 2010a). The benefited area is the whole of the Shire of Hinchinbrook, with the main focus on the floodplain of the Herbert River which includes the main town of Ingham (Hinchinbrook Shire Council 2010a).

The Hinchinbrook Shire Local Disaster Management Group (LDMG) manages the response to a disaster at a local level and the committee is chaired by the Mayor of the Hinchinbrook Shire Council (Hinchinbrook Shire Council 2010b). The Executive Officer of the LDMG committee is the Local Government Chief Executive Officer of the of the Hinchinbrook Shire Council (Hinchinbrook Shire Council 2010b). Local Government Counter Disaster Committees develop and maintain Local Disaster Management Plans for the Hinchinbrook Shire (Hinchinbrook Shire Council 2010b).

During the response phase of a disaster, the Hinchinbrook Shire LDMG operates a Disaster Information Service on the Hinchinbrook Shire website, to provide more detailed information to both locals and interested parties outside of the Hinchinbrook Shire (Hinchinbrook Shire Council 2010b). The Hinchinbrook LDMG is also assisted by Area Wardens for each community within the Hinchinbrook Shire (Hinchinbrook Shire Council 2010b). The wardens provide information to the LDMG from these local communities during disaster events to assist them in the decision making processes (Hinchinbrook Shire Council 2010b).

4.2.6 Population levels, birthplace and trends

The population in Hinchinbrook decreased gradually until 2006 with a slight increase to 2011 but not to 2001 levels. Overall population declined by 2.5%, with the greatest decline being amongst infant and child populations: 0-4 year olds declined by 24% from 2001 to 2011 but only by 2.5% from 2006 to 2011; 5-14 year olds declined by 4% from 2001 to 2006 but decreased by 16% between 2006 and 2011. Patterns of decline are evident in all age cohorts until all age groups from age 45 years and above. Even the over 85 year olds are steadily increasing. People aged 0-44 years comprised 50% of the population in 2006 but only 47% by 2011. The ageing population is also very identifiable in the 20-24 year age category which has significantly fewer members than any other cohort. It also indicates an absence of young women. This relates to the uptake of tertiary education opportunities, which begins in the 15-19 year group. While young people are generally leaving Ingham, there is a greater exodus of females, which correlates with the high female uptake of university places (JCU undergraduates are approximately 2 females to every male).

Table 4.1 Selected Population Characteristics of Hinchinbrook Shire (Australian Bureau of Statistics 2012a)

Selected Characteristics	2001 Census			2006 Census			2011 Census		
	Male	Female	Person	Male	Female	Person	Male	Female	Person
Total persons(a)	6,448	6,065	12,513	6,150	5,921	12,071	6,319	5,882	12,201
Age group(a):									
0-4 years	384	361	745	291	324	615	299	301	600
5-14 years	1,003	835	1,838	950	811	1,761	800	722	1,522
15-19 years	506	307	813	452	305	757	485	325	810
20-24 years	269	243	512	197	186	383	283	183	466
25-34 years	663	628	1,291	501	513	1,014	511	478	989
35-44 years	902	894	1,796	751	814	1,565	698	644	1,342
45-54 years	835	826	1,661	869	808	1,677	909	868	1,777
55-64 years	772	815	1,587	868	880	1,748	963	904	1,867
65-74 years	699	646	1,345	768	679	1,447	782	762	1,544
75-84 years	347	389	736	415	477	892	480	494	974
85 years and over	68	121	189	88	126	214	109	201	310
Overseas visitors	30	51	81	22	34	56	33	25	58
Indigenous persons:									
Aboriginal	278	221	499	281	251	532	310	249	559
Torres Strait Islander	60	10	70	111	35	146	95	22	117
Both Aboriginal and Torres Strait Islander(b)	23	23	46	45	30	75	44	23	67
Total	361	254	615	437	316	753	449	294	743
Birthplace:									
Australia	5,441	5,090	10,531	5,190	4,993	10,183	5,322	4,936	10,258
Elsewhere(c)	714	709	1,423	660	668	1,328	635	664	1,299
Language spoken at home:									
English only	5,475	5,202	10,677	5,327	5,139	10,466	5,457	5,118	10,575
Other language(d)	769	673	1,442	648	602	1,250	584	566	1,150
Australian citizen	6,137	5,748	11,885	5,789	5,547	11,336	5,841	5,500	11,341

This table is based on place of enumeration.

(a) Includes overseas visitors.
(b) Applicable to persons who are of both Aboriginal and Torres Strait Islander origin.
(c) Includes 'Australian External Territories', 'Inadequately described', and 'At sea'.
(d) Includes 'Inadequately described' and 'Non-verbal, so described'.

There are very few overseas visitors (mostly tourists) and the numbers declined to 2006 and thence have been low and stable. Indigenous Australians were 4.9% of the population in 2001, 6.2% in 2006 and 6.1% in 2011 although total numbers had declined from 2006 to 2011. This decline is also mainly among younger age groups.

Only 11% of the population was born overseas and 9.4% speak a language other than English at home. Both of these proportions were similar in 2001. Italy is the major

overseas birthplace, but the numbers have declined considerably from 2001 to 2011, by 53%. People born in New Zealand have been growing and those born in UK have remained much the same. Ingham's image as an 'Italian' sugar town is based more on ancestry which is indicated in table 4.3.

Table 4.2 Main country of birth of Hinchinbrook population (ABS 2012a)

Country of Birth	2001 Census			2006 Census			2011 Census		
	M	F	Persons	M	F	Persons	M	F	Persons
Australia	5,441	5,090	10,531	5,191	4,994	10,185	5,322	4,937	10,259
Italy	356	347	703	292	290	582	219	240	459
New Zealand	43	49	92	63	54	117	69	58	127
United Kingdom (d)	113	109	222	117	101	218	118	111	229
Overseas visitors	30	51	81	23	33	56	34	24	58
Total	**6,447**	**6,068**	**12,515**	**6,149**	**5,922**	**12,071**	**6,319**	**5,882**	**12,201**

Only main countries of birth have been selected in this table.

This table is based on place of enumeration.

(c) Includes persons who stated their country of birth as Yugoslavia.
(d) Comprises 'United Kingdom, Channel Islands and Isle of Man, nfd', 'England', 'Isle of Man', 'Northern Ireland', 'Scotland', 'Wales', 'Guernsey' and 'Jersey'.

Table 4.3 Ancestry of Hinchinbrook population (ABS 2012a)

Main Country of Ancestry 2001	Both parents born overseas	Father only born overseas	Mother only born overseas	Both parents born in Australia	Birthplace not stated (b)	Total responses (c)
Australian	77	284	193	3,784	116	4,454
Australian Aboriginal	3	0	3	33	5	44
English	366	270	186	2,835	93	3,750
German	63	31	17	322	7	440
Irish	75	83	50	1,062	32	1,302
Italian	1,535	431	192	1,406	58	3,622
Total responses(c)	**2,742**	**1,235**	**762**	**10,257**	**546**	**15,542**
Total persons(c)	**2,564**	**933**	**522**	**7,917**	**496**	**12,432**
2006						
Australian	75	337	208	3,893	138	4,649
Australian Aboriginal	0	0	0	89	9	99
English	375	271	154	2,634	104	3,535
German	78	32	19	338	13	476
Irish	65	58	29	963	26	1,142
Italian	1,357	415	152	1,478	79	3,476
Scottish	81	70	37	591	11	795
Total responses(c)	**2,590**	**1,325**	**712**	**10,689**	**722**	**16,030**
Total persons(c)	**2,321**	**905**	**470**	**7,693**	**630**	**12,019**
2011						
Australian	61	317	202	3,680	100	4,360
Australian Aboriginal	0	0	3	122	3	128
English	406	269	158	3,037	79	3,949
German	64	28	16	410	4	522
Irish	76	64	34	1,021	32	1,227
Italian	1,165	403	163	1,485	62	3,278
Scottish	91	71	40	693	7	902
Total responses(c)	**2,488**	**1,315**	**773**	**11,145**	**745**	**16,466**
Total persons(c)	**2,225**	**897**	**511**	**7,848**	**665**	**12,146**

(b) Includes birthplace for either or both parents not stated.
(c) This table is a multi-response table, and therefore the total response count will not necessarily equal the total persons count.
(d) If two responses from one person are categorised in the 'Other' category only one response is counted. Includes ancestries not identified individually and 'Inadequately described'.

Italian ancestry declines from 23% of responses in 2001 to 22% in 2006, and 20% in 2011, which follows the pattern of Italian birthplace. Although Ingham stresses its Italian heritage, the largest ancestry is Anglo-Celtic with 37%, then Australian at 26% (ABS 2012a).

The medians and averages in table 4.4 is a summary of primary socio-economic indicators. The table below is reproduced as presented by the ABS. The number of persons per bedroom is a useful indicator of levels of overcrowding in a small number of communities in Australia, but contributes nothing significant here. Of the income levels, the most useful is the household income as this is the most appropriate measure of financial capacity, and it relates more directly to rental and mortgage levels.

Table 4.4 Medians and averages of Hinchinbrook population (ABS 2012a)

Medians and Averages	2001	2006	2011		2001	2006	2011
Median age of persons	40	44	47	Median mortgage repayment ($/monthly)	650	804	1,200
Median total personal income ($/weekly)	291	384	477	Median rent ($/weekly)	90	100	160
Median total family income ($/weekly)	707	1,015	1,187	Average number of persons per bedroom	1.1	1.1	1.1
Median total household income ($/weekly)	587	752	908	Average household size	2.5	2.4	2.4

Median age of persons excludes overseas visitors.

Median total personal income is applicable to persons aged 15 years and over.

Median total family income is applicable to families in family households. It excludes families where at least one family member aged 15 years and over did not state an income, and families where at least one member aged 15 years and over was temporarily absent on Census Night.

Median total household income is applicable to occupied private dwellings. It excludes households where at least one member aged 15 years and over did not state an income and households where at least one member aged 15 years and over was temporarily absent on Census Night. It excludes 'Other non-classifiable' households.

Median mortgage repayment is applicable to occupied private dwellings being purchased and includes dwellings being purchased under a rent/buy scheme. It excludes 'Visitors only' and 'Other non-classifiable' households.

Median rent is applicable to occupied private dwellings being rented. It excludes 'Other non-classifiable' households.

Average number of persons per bedroom is applicable to occupied private dwellings. It excludes 'Visitors only' and 'Other non-classifiable' households.

Average household size is applicable to number of persons usually resident in occupied private dwellings. Includes partners, children, and co-tenants (in group households) who were temporarily absent on Census Night. A maximum of three temporary absentees can be counted in each household. It excludes 'Visitors only' and 'Other non-classifiable' households.

The ageing of the population is clearly evident in table 4.4. The other medians chart the accompanying decline in the community. The sub table below summarises the decline in standard of living.

Table 4.5 Standard of living medians: rates of change (ABS 2012a)

% Increase	2001 - 2006	2006 - 2011
Median total household income ($/weekly)	28%	21%
Median mortgage repayment ($/monthly)	24%	49%
Median rent ($/weekly)	11%	60%

The big jump in rents and mortgage repayments came in the latter part of the decade.

A shortage of housing will have exacerbated this trend and flood damage probably contributed, but these stark statistics show a community where housing costs have risen much faster than income. The declining population of the first half of the decade probably kept rents and house prices lower, and the slight increase in population subsequently will have put pressure on the housing stock, but the boom years up to 2009 followed by the global recession are probably the main factors driving these changes.

4.2.7 Education and qualifications

Only limited data on educational institution being attended are available for the 2011 census and time series. Table 4.6 indicates these data.

Table 4.6 Educational institution of attendance in Hinchinbrook (ABS 2012a)

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