Disaster resilience in a flood-impacted rural Australian town

Helen J. Boon

Abstract This paper reports exploratory research conducted in a flood-impacted rural Australian town to identify the factors which residents perceived as supporting community resilience to disaster. There is a gap in this research area centred in the Australian disaster context. Since Australia is predicted to be highly impacted by the effects of climate change in the form of an increased incidence of flooding, an urgent need exists to examine the factors that confer resilience to disaster-impacted localities to inform suitable disaster mitigation and adaptation policies for the future. Because of the complexity of community resilience and its interrelationship with individual resilience, a multi-method approach was used: a demographic study to assess community stability and functioning before and after the flood disaster, focus group interviews to obtain from community members their views on what supported them and their community resilience and a survey to generalise the interview findings. Our operating hypothesis was that individuals remaining in the town post-flood were likely to be resilient to the flood disaster. The demographic study results pointed to a resilient community after the floods as they reflected stability in population numbers and socio-economic indicators. The interviews and survey showed that individual resilience was promoted by social connectedness and a sense of place, a factor that was also negatively linked to the desire to relocate from the community. The use of structural equation modelling of our results provided verification of prior research findings about the role of sense of place in supporting individuals' resilience. Results are discussed in the context of future climate change adaptation policy.

Keywords Resilience · Disaster · Community · Climate change

1 Introduction

In a global context of increasing incidence of natural disasters, there is widespread interest in understanding patterns of resilience in disaster-affected individuals and communities.

For Australia, climate change risk scenarios for the future (2030) show a high probability of increased average temperatures, sea level rises and water cycle implications, including higher intensity and frequency of floods, storm surges and droughts (Bureau of Meteorology and CSIRO 2012). 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 there is an urgent need to understand how individuals will cope and what will promote community resilience.

The study reported here was conducted to gain an understanding of community resilience after a disaster event, in this case severe flooding. The community selected for the research was Ingham, in Queensland, because it had sustained severe and unprecedented flooding in 2009. In order to obtain from community members their views of what helped community resilience, we adopted a grounded theory approach (Glaser and Strauss 2009) in so far as theory formation and data gathering was concerned. This meant that we undertook the research process in three distinct stages: first, we examined macro-level socio-economic and demographic variables that pertained to community level resilience; second, we conducted interviews with key community informants and resident groups representing demographic groups of the community; third, we constructed a survey from the data obtained during the interview phase in order to apply findings to a community sample and assess their generalisability. The research was underpinned by the assumption that those individuals still resident in the community post-disaster experience a year after the event were presumed to be resilient. The research was initially guided by the resilience literature.

2 Resilience

Norris et al. (2008a) refer to community resilience as the ability of communities to withstand hazards. Community resilience is interwoven with individual resilience (Miller 2012; Boon et al. 2012a; Norris et al. 2008a, b). Norris et al. (2008a, b), however, point out that community resilience is connected to individuals' resilience at population level. To extract the sources and incidence rates of resilience, Norris et al. (2008b) caution that characteristics of populations rather than those of individuals are required. Community resilience can then be assessed, at the macro- and sociological level through proxy indicators, such as institutional change, economic structure and demographic change (Norris et al. 2008b; Boon et al. 2012a).

Individual resilience in the context of disaster has been characterised by some level of distress as a reaction to a natural hazard (Bonanno 2004; Flynn 1994), but the dysfunction is transient, followed by a reasonably rapid return to predisaster levels of functioning. For example, Bonanno et al. (2010) conducted a review of studies in which people exposed to disaster showed various psychological problems. Severe levels of these problems were observed in only 30 % of most adult samples. Frequently, more than half of those exposed experienced only transient distress and maintained a stable trajectory of healthy functioning or resilience. This was the case in the United States, a developed country (Bonanno et al. 2010). In the context of rural and regional Australia, the mental health impacts of climate-change-induced disasters have been documented (Berry et al. 2008); however, less is known about the trajectories of resilience.

Resilience has been variously defined depending on the level of analysis, which may be the individual, community or ecological system. Most definitions incorporate a stressor and the notion of adaptation and a speedy return to prestressor levels of functioning (Norris

et al. 2008a, b). Bonanno et al. (2010) make a distinction between recovery and resilience, defining individual resilience as a person's capacity to maintain overall healthy, stable functioning, a stable equilibrium, following stressful life events; recovery is characterised by a period of post-traumatic stress disorder (PSTD) lasting usually for several months before gradually returning to predisaster levels, up to 2 years after the event.

Individual resilience appears to be partly a trait and partly a dynamic process promoted by two groups of generic factors (Miller 2012; Boon et al. 2012a). First, personal attributes such as social competence, problem-solving, autonomy and sense of purpose contribute to resilience. Second, contextual, environmental influences such as peers, family, work, school and local community also influence individual resilience (Boon et al. 2012a) with social connectedness being a salient factor in promoting resilience (Reich 2006).

In the context of individual disaster resilience, local community factors fall among the latter group of influences. For example, Breton (2001) and Murphy (2007) asserted that resilience was dependent on social connections through which members of a community can be mobilised for action. Landau et al. (2008) cited research confirming that feeling connected with family acts as a protective factor against health threats, supporting resilience. Nelson et al. (2007) cited several case studies linking social community networks to more effective management during, for example, droughts in developing countries. In reviewing the disaster literature, Bonanno et al. (2010) stated that: '… post-disaster social relations are important predictors of coping success and resilience' (p. 2). In earlier research, Reich (2006) was emphatic about the importance of social connectedness, citing several studies and concluding that the loss of human connections impacts both physical and mental health, decreasing the chances of resiliency post-disaster.

3 Sense of place

The literature of individuals' disaster resilience identifies social connectedness as a key influence. Social connectedness overlaps strongly with the concept of a sense of place (Miller 2012). Prewitt Diaz and Dayal (2008, p. 1) argued that 'the most catastrophic impact of natural disasters is an individual feeling of ''loss of place''' and they believe that a re-establishment of a sense of place helps disaster survivors recover from the impacts of the disaster.

Sense of place as a concept is a composite of perceived community factors, one with a long history in the social sciences. Steele (1981) described sense of place as the attitudes, beliefs, meanings and interpretations that people associate with a particular place. Researchers have deliberated upon a number of related constructs, such as place attachment (e.g. Altman and Low 1992; Hidalgo and Hernandez 2001), community satisfaction (e.g. Bardo and Bardo 1983) and sense of community (e.g. Glynn 1981; Nasar and Julian 1995; Pendola and Gen 2008). Others (for example, Hay 1998) discussed a sense of place by considering the social and geographical context of place bonds and the sensing of places, such as aesthetics and a feeling of dwelling. Insider status and local ancestry are important notions helping develop a sense of place.

There is some contention among theorists as to what precisely constitutes a sense of place. A number of disciplines have explored the concept, and this has led to the use and development of a range of approaches, definitions and methods (Larson et al. 2013). Some academics argue that the diversity of approaches has resulted in an inconsistent literature with incoherent concepts (Stedman 2003) that 'resists any precise definition or consensus on what the concept should contain, how it should be constructed, or measured'

(Kaltenborn 1998, p. 172). Social anthropology, environmental and social psychology, and human geography represent three of the most divergent disciplines addressing sense of place (Graham et al. 2009). Notwithstanding differences among theorists, a sense of place has consistently been thought to emanate from the experiences and perceptions of individual residents, as Billig (2005) found through an Israeli study.

> In residential environments the sense of place is established mainly by the residents themselves and is formed at the inter-subjective level, connecting between the behaviour of the individual and that of the other residents. The sense of place of the residential environment will thus be affected by perceptions of its physical characteristics, by the feeling and behaviour of its residents, and by the interactions between them (p. 118).

Another study, a Canadian empirical quantitative study (Williams et al. 2008), resulted in a composite measure of sense of place based on four variables: (1) feeling part of the neighbourhood; (2) comfort in participating in neighbourhood projects; (3) calling on neighbours in a crisis and (4) volunteering for organisations (Williams et al. 2008, p. 17). Important factors that influenced a sense of place included residential longevity (i.e. 10 years or more), participation in volunteer activities and neighbourhood friendliness.

Sense of place has been investigated within the context of disasters, although few studies have examined sense of place within the Australian flood disaster context. In the United States, Chamlee-Wright and Storr (2009) looked at a sense of place in examining the return of residents to an impoverished neighbourhood of New Orleans following Hurricane Katrina. According to Chamlee-Wright and Storr (2009), a sense of place was composed of place attachment, place identity and place dependence. They argued that it was the residents' sense of place that was the central theme in their return to New Orleans. Others have identified a sense of place as being supportive of community resilience in rural Queensland, Australia (Hegney et al. 2007, through a qualitative study), community cohesion in the United Kingdom (Chang 2010), social capital and fire preparedness measures in the United States (Bihari and Ryan 2012), which also support disaster resilience.

4 Research aims

The research reported here was part of a larger project examining rural community resilience to a range of disaster types. Ingham, a rural Queensland Australian town of population 12,201, was selected because while it is vulnerable to seasonal flooding, it was affected by severe flooding in 2009 which was highly irregular and unpredicted and which was considered to herald the future in terms of climate change weather impacts. Therefore, reflections of residents and community responses as a whole could potentially serve as an exemplar to guide future policy for rural Australians' adaptation to predicted climate change impacts. Before the research was conducted, ethical clearance was obtained from James Cook University. The 2009 flood experience of Ingham (Fig. 1) was unique in a town regularly subjected to seasonal flooding. Two consecutive floods occurred in 2009, both predominantly riverine and exacerbated by prolonged rainfall periods (Bureau of Meteorology 2009). Many residents were trapped in their homes for over a week. It was estimated that 65 % of the shire or around 2,900 residences and businesses were affected by the floodwaters. Initial estimates of infrastructure damage were $120 million; the main industry of the region, sugar cane cultivation and milling, was severely damaged as the

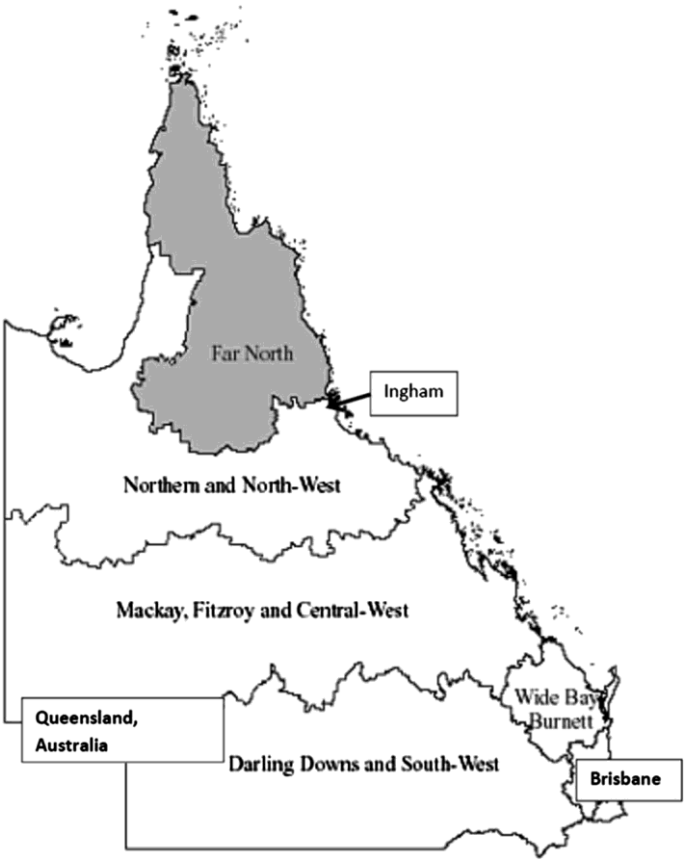

Fig. 1 *Ingham, Queensland, Australia*

floodwaters destroyed the sugar cane crop, resulting in significant economic losses to the town.

5 Methods

A sequential mixed-method approach was employed in the study (Tashakkori and Teddlie 2003). We aimed to examine community resilience at the macro- and population level using socio-economic and demographic data to ascertain changes to the community after the floods and interview and survey data to explore individual resilience. Our study was based on the hypothesis that persons remaining in the disaster-impacted community post-disaster were likely to be resilient to disaster; otherwise, they would have relocated. The research process involved distinct phases:

1. Collection of socio-economic and demographic data to profile the community, determine representativeness of samples and to compare pre- and post-disaster impact upon the community.
2. Focus interviews to identify factors that residents believed supported their disaster resilience. Data were collected through a series of semi-structured interviews

conducted throughout the second half of 2010. A team of researchers participated in the process which included team meetings, triangulation of researcher coding and debriefings. Participants, key informant and local resident groups, were all asked the same set of questions in the same sequence. They were as follows:

1. Tell me what helped you during the event?
2. What sort of things helped you recover after the event?
3. Who do you think were most affected by the event? And why?
4. How do you think different people/groups coped with the event? And why?
5. Who do you think coped least during the event? And why?
6. 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?
7. What keeps you living in the community? Have you ever thought of moving from this community?[1]:

A total of 81 people participated in a series of key informant interviews and nine focus group interviews. These interviews generated themes identified by participants as being supportive of disaster resilience, and they guided the construction of survey items. The themes identified by the participants included social connectedness and a connectedness and love for Ingham, a collective belief that in times of trouble residents banded together to help restore functionality to the community and to help neighbours and friends, and a belief in their own capacity to cope through disasters such as floods. In addition, a factor that residents identified as impeding resilience was related to health impacts. Our literature review of the resilience and sense of place research studies assisted with the interpretation of emergent themes and guided the use of survey items. Social connectedness and love of the community were interpreted as sense of place and measured with some items developed by Chang (2010), which reflected interview data, using a self-report Likert scale, response scale coded from 1 (definitely disagree) to 4 (definitely agree) with do not know coded 0. Resilience items suitable for use in the context of disaster resilience were selected from the resilience scale developed by Connor and Davidson (2003), as they reflected the comments that residents made during the focus interviews.

3. A pilot survey was generated and sent to a sample of 112 residents in similar disaster-affected areas (areas that were cyclone affected in Queensland rural areas) to validate the items and proposed constructs. The pilot survey data were subjected to Rasch modelling for construct validity; misfitting items were removed from the survey, based on fit indices' results.[2] Rasch modelling was used to ensure that survey items did not behave differently for particular subgroups of the sample. After the preliminary item and person statistics were estimated for each construct, a principal component analysis of standardised Rasch residuals was carried out to ensure that each subscale could be considered as yielding a single measurement dimension, i.e. unidimensionality was confirmed by principal component factor analysis of the Rasch item/person residuals (Bond and Fox 2007).

The validated items for each construct were as follows:
Sense of place:

a. I can now recognise most of the people who live in my local area;
b. I know the names of my close neighbours;

[1] Only those interview questions pertaining to findings reported in this paper are listed.

[2] All analyses and fit indices pertaining to the construction of the survey are reported in Boon et al. 2012b.

c. I have closer relationships with my neighbours;
d. I feel able to work effectively with others in the community;
e. I think my neighbourhood is still a good place for me to live.

Resilience:

a. I focus and think clearly under pressure;
b. I think of myself as a strong person;
c. I know that when things look hopeless, I do not give up.

We also acknowledged that personal experience with flood impacts beyond damage to property was likely to have important effects upon one's coping reserves and resilience, as this was mentioned by our key informants, the medical and health professionals, those who took care of the aged and infirm and the emergency managers. We therefore included three items to assess respondents' exposure to health and injury impacts upon their immediate social connections, family and friends. The health items that were constructed for the purpose and validated via Rasch analyses were as follows:

a. As a result of the floods, I had to deal with the injury of a close family member or close friend;
b. As a result of the floods, I had to deal with the death of a family member or close friend;
c. As a result of the floods, a member of my family experienced health problems.

Although our interview participants and survey sample continued to reside in the community after the floods, it was possible that they were unable to leave the community but would have preferred to relocate if they had the means. We therefore included survey items to assess this. The three items that were validated by Rasch analyses as belonging to the 'Relocating' construct are as follows:

a. I seriously considered the option of leaving my home/property for good;
b. Ideally, I would like to move away from this community;
c. As a result of the event, I had difficulty finding alternative accommodation.

4. Final surveys were completed by a sample of 287 Ingham residents identified through geographical cluster sampling using grid points on a map. Surveys were hand-delivered to randomly selected households and picked up by arrangement a few days later. Response rate was 92 %. Rasch analyses (Bond and Fox 2007) were used to quantify each participant's score for each construct, by transforming their ordinal response data to log-odds ratios, or *logits*. The interval measures obtained thus for each participant on each construct were then modelled using AMOS structural equation modelling (SEM) software to estimate the influence of sense of place upon resilience and leaving. Our interview data and the resilience literature also pointed to the effects of length of residence upon resilience and relocation intentions. Therefore, in order to account for the influence of length of residence, length of residence as measured variable was included in the model.

6 Results

6.1 Demographics

Our demographic study indicated that the population had remained relatively stable since 2006 (Australian Bureau of Statistics (ABS) 2012a), (Table 1). The relatively stable population after

the floods was broadly indicative of community resilience that is resilience at the macro-level rather than individual level. In fact, the population had increased slightly (about 1 %) and the unemployment decreased (by 1.2 %) post-flood disaster, indicating a stable community economy. The medians and averages in the table are a summary of primary socio-economic indicators, useful for evaluating community resilience. The number of persons per bedroom is a useful indicator of levels of overcrowding in communities in Australia, showing relative stability over time in this case. 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; the unemployment is a strong indicator of socio-economic vulnerability; thus, these low rates indicate low vulnerability and stability after the floods. In all the community appeared to have absorbed the physical and economic impact of the floods, despite being in an economically weaker state because of the global financial crisis (GFC) of 2008 which led to higher mortgage repayments and rental repayments.

6.2 Interview results

The focus interviews provided us with an in-depth set of reflections from the residents of the town, about what they believed sustained them through the floods and what supported their resilience. A common theme that arose from interviews revolved around a sense of 'pride' within the community. Locals felt that what helped them most *during* the event was a strong 'community spirit', helping the community 'band together' during and after the flood.

> You can't rely on the government or the council to look after you, if you're living in a street and you hear your neighbours, well you look after each other (Retired Businessman).

Participants felt strong family and community links were all critical factors in helping them 'get through' the event. They also stated that the community's strong social networks

Table 1 Ingham socio-economic indicators before and after the 2009 floods

Socio-economic and demographic indicators	2006 Census			2011 Census		
	Male	Female	Total	Male	Female	Total
Total persons	6,150	5,921	12,071	6,319	5,882	12,201
Aged 20–24 years	197	186	383	283	183	466
Aged 25–34 years	501	513	1,014	511	478	989
Aged 35–44 years	751	814	1,565	698	644	1,342
Aged 45–54 years	869	808	1,677	909	868	1,777
Aged 55–64 years	868	880	1,748	963	904	1,867
Median total personal income ($/weekly)			384			477
Median total family income ($/weekly)			1,015			1,187
Median mortgage repayment ($/monthly)			804			1,200
Median rent ($/weekly)			100			160
Average number of persons per bedroom			1.1			1.1
Average household size			2.4			2.4
Couple family with no children			1,463			1,512
Couple family with children			1,309			1,275
Unemployment rate (%)			5.4			4.2

and community spirit made the recovery a lot easier to deal with. Residents frequently spoke of a help-thy-neighbour attitude to deal with the physical, as well as the financial impacts of the flood and the overarching and enduring financial crisis of 2008.

> The image of Ingham was positive. Everyone got in and worked, sometimes it's the way to bring communities together is to go through some adversity. It was a fantastic story in that people were helping each other and those sort of things... (Disaster Manager)
>
> [I think it is the] size of the community itself... there is still pretty good communication mechanisms in place, neighbours know neighbours, and they haven't become insular like in bigger cities. So neighbours are willing to help and those neighbours realised that help was there, so they didn't feel completely hopeless like they might in a big city (Cane Farmer).
>
> In flood times pubs do a roaring trade. Where I live at Longpocket the pub was the hub point of the community, it is where everyone came, they make their own entertainment you know? And what I know from Longpocket, people were then helping each other because the hotel was the community centre so if I had a dozen spare eggs because my chooks were laying still I went there, or if I had lots of toilet paper or whatever I had surplus of and I would just say ''take whatever you need'', ...like in my street, everybody helped one another and they come together to clean up to (Emergency volunteer).

Interviewees were unsure whether community recovery was complete almost 2 years after the floods because of the conflating influences of the GFC. At individual levels however, they felt that they had recovered, with only two of the 81 participants, both female health workers, stating that they would leave the community if they had the financial means. The economic recovery of the town was delayed because of the impacts of the flood to the sugar cane industry.

> The 2009 crop in Ingham was very substantially affected, it was reduced in the amount of tonnes available to the industry during the crushing season which meant we had a smaller than normal crop so the sugar industry was very substantially affected (Government Welfare Officer).
>
> Some of those farmers have gotten extended credit so they would be suffering and would be really stressed out by this... (Disaster Manager)

Despite the economic adversity, the lifestyle the residents had chosen, a lifestyle noted for being close-knit, family centred and highly networked, was precisely what they believed helped the community cope, recover and adapt.

> I think this town recovered well in a very short space of time and directly after the flooding people get in and help each other. I don't think anyone was left to their own devices, if that makes any sense? And all they had to do was ask neighbours and they were quite happy to help and clean up the mess that was left afterwards. The authorities too came into participate in an effort to clean up (Retiree/Local Businessman).

As one Ingham interviewee summed up, you have to be stoical in the face natural disaster:

> It doesn't matter where you live there is a potential for natural disaster. If you live in Sydney - the hail storms ...you know you live along the beach there's a potential for

tsunamis or tornadoes, you know. I think there's that potential and OK it happens but the positives of living [here in this community] have to outweigh that or you will go. And you know I did some reading many years ago and it is probably quite antiquated research but the long term psychological benefits of someone staying who has gone through an event like this is better than someone who leaves straight after. If you stay you get the positive stuff that reminds you why you are there and you don't end up hanging onto all the bad things that happened if you leave straight after the event that is what is fresh in your mind, and I think there is a lot of good things about living in this community there is certainly that sense of a neighbourhood and your people next door and you get phone calls at six in the morning, ''Hey there's a flood coming you better get up"…(Council Worker)

6.3 Survey results

The characteristics of the sample are displayed in Table 2 below. It is evident that the majority of householders were long-standing members of the community, aged 41 or over who lived in their own home with one or more children. A fifth of the sample comprised of graduates, while three quarters were employed full time in a wide range of fields. Those who were unemployed consisted mainly of people over 55 years old (76.6 %), 56 % of whom who had lived in their community for at least 21 years. To determine whether our sample was representative of the Ingham demographics, responders' demographic characteristics were checked against those of Ingham as detailed in the census documents available.[3] Our sample represented Ingham demographics appropriately because their proportions corresponded with the proportions of the categories reflected in the census of Ingham. For example, the majority of respondents were long-standing members of the community, in two-person households, educated up to high school level, echoing trends recorded in the census. The main difference in our sample and the representative demographics of Ingham was the number of females, which in our sample was greater than the proportion of females in Ingham.

The survey results indicated that the majority of respondents (59 %) either strongly agreed or agreed that the community had recovered from the flood's negative impact (Table 3).

Further, most respondents reported a positive sense of place (Table 4), which corroborated the views and comments made by interview participants. For example, most either agreed or strongly agreed that their neighbourhood was still a good place for them to live (96.1 %) and that they could now recognise most of the people who lived in their local area (85.8 %). Similarly, the majority agreed they knew the names of their close neighbours (94.3 %) and agreed they had closer relationships with their neighbours (73.7 %). Finally, 87.3 % agreed or strongly agreed they felt able to work effectively with others in the community.

Results presented in Table 5 provide further support for our contention based on the demographic study that most respondents remained in Ingham by choice and were therefore likely to be resilient. The majority of respondents either disagreed or strongly disagreed with the statements *I seriously considered the option of leaving my home/ property for good* (68.5 %) and *Ideally I would like to move away from this community* (85.7 %). The item looking at relocation as a result of the flood suggested that only 4 % of the sample had difficulties finding alternative accommodation.

[3] For more details of the sample and Ingham demographics, please refer to Boon et al. 2012b.

Table 2 Characteristics of the sample ($N = 287$)

Demographic questions	*N* (%)
Gender	
Male	34.6
Female	65.4
Age group	
18–25	8.9
26–40	15.6
41–55	41.1
55?	34.4
Number of adults in household	
One person	13
Two people	65.4
Three people	12.3
Four people	7.8
Five and over	1.5
Length of residence in community	
2–5 years	10.2
5.5–10 years	9.8
11–20 years	14.9
21–44 years	34.5
45 years ?	30.5
Moved out of home because of the floods	6.6
Highest educational qualification attained	
Primary school	4.3
High school	42.2
TAFE/trade certificate	31.4
University bachelor degree	17.7
Post-graduate (e.g. masters or Ph.D.)	4.3
Residence ownership	
Rented	18.7
Own home	78.4
Other	2.9

Table 3 Community evaluations

	N (%)
My community has recovered from the event's negative impact	
Do not know	8.6
Strongly disagree	4.0
Disagree	28.4
Agree	51.4
Strongly agree	7.6

When respondents were asked to rate various items of individual resilience, the overwhelming response was positive (Table 6). For example, most respondents either agreed or strongly agreed that they focus and think clearly under pressure (84.9 %); think of

Table 4 Sense of place responses

Sense of place indicator	*N* (%)
I think my neighbourhood is still a good place for me to live	
Do not know	
Strongly disagree	
Disagree	
Agree	
Strongly agree	
I can now recognise most of the people who live in my local area	
Do not know	2.2
Strongly disagree	1.5
Disagree	10.5
Agree	59.6
Strongly agree	26.2
I know the names of my close neighbours	
Do not know	1.1
Strongly disagree	1.4
Disagree	3.2
Agree	57.7
Strongly agree	36.6
I have closer relationships with my neighbours	
Do not know	2.9
Strongly disagree	1.8
Disagree	21.5
Agree	60.9
Strongly agree	12.8
I feel able to work effectively with others in the community	
Do not know	6.9
Strongly disagree	0.7
Disagree	5.1
Agree	73.9
Strongly agree	13.4

themselves as a strong person (91.1 %); and do not give up when things look hopeless (93.8 %).

To examine the links between the constructs' sense of place, negative health factors, relocation and resilience, SEM was employed (Fig. 2). The insertion of the number of years of residence in the model was included to assess whether longevity in the community infl enced sense of place (Williams et al. 2008) resilience, or the desire to relocate.

Results of the modelling showed that the length of time spent in this community was not linked to sense of place or relocation attitudes. However, a sense of place was a strong predictor of resilience (regression weight, standardised $b = 0.41$) and was negatively linked to a desire to relocate resilience (regression weight, standardised $b = -0.23$) as might have been predicted from prior research findings (e.g. Chamlee-Wright and Storr 2009; Hegney et al. 2007). A stronger sense of place appears to be linked to less negative

Table 5 Relocation attitude responses

Relocation attitudes	*N* (%)
I seriously considered the option of leaving my home/property for good	
N/A	21.1
Strongly disagree	40.9
Disagree	27.6
Agree	5.7
Strongly agree	4.7
Ideally I would like to move away from this community	
N/A	4.4
Strongly disagree	47.4
Disagree	38.3
Agree	6.9
Strongly agree	2.9
As a result of the flood, I had difficulty finding alternative accommodation	
N/A	70.2
Strongly disagree	5.8
Disagree	20.0
Agree	2.2
Strongly agree	1.8

Table 6 Disaster resilience responses

	N	*N* (%)
I focus and think clearly under pressure		
Do not know	13	4.7
Strongly disagree	3	1.1
Disagree	26	9.4
Agree	182	65.5
Strongly agree	54	19.4
I think of myself as a strong person		
Do not know	7	2.5
Strongly disagree	2	0.7
Disagree	16	5.7
Agree	196	70.3
Strongly agree	58	20.8
I know that when things look hopeless, I do not give up		
Do not know	8	2.9
Strongly disagree	2	0.7
Disagree	7	2.5
Agree	197	71.6
Strongly agree	61	22.2

health experiences in family and friends, supporting prior researchers' contentions (Landau et al. 2008; Miller 2012; Reich 2006). Moreover, an experience of health impacts in social connections seems to lead to a greater want to relocate from the town (regression weight,

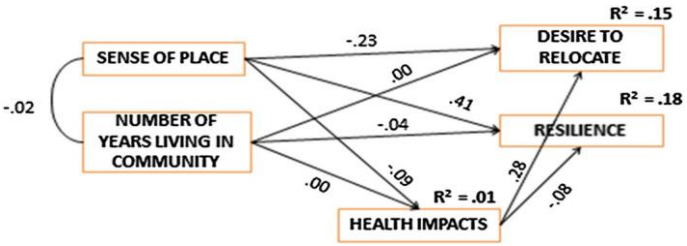

Fig. 2 Model of links between *sense of place, number of years living in the community, health impacts, resilience and desire to relocate* ($N = 287$)

standardised b = 0.28). This model accounted for 18 % of the variance (R^2)[4] in resilience and 15 % of the variance in relocating attitudes. All regressions (standardised regression beta weights) (b) are significant to p ₩ .005, except those arising from length of residence to other factors which are not significant at p ₩ 0.05. The currently acceptable test for assessing goodness of fit of proposed structural equation models is the chi-square test (Heene et al. 2012). The chi-square test (v^2) tests the hypothesis that an unconstrained model (no direct arrows; variables related randomly) fits the covariance/correlation matrix as well as the given model. The chi-square p value should not be significant if there is a good model fit (Kline 2005). The model fit index for the proposed model above is excellent, $v^2/df = 0.41$, p ₩ 0.53.

7 Discussion

This study used multiple methods to assess community resilience to an event of severe flooding, classified as a national disaster by the Australian Federal Government in 2009 (Queensland Government 2009). By using a multi-method approach and triangulation of findings, more confidence can be conferred upon findings regarding community resilience.

The demographic study examining pre- and post-flooding community indicators suggested that the population of the community as a whole was stable post-flooding and functioning at preflooding levels. Relocation as a result of natural disaster can lead to severe consequences for the vulnerability of communities dependent on local ecosystem services, such as fishing and farming (IPCC 2012), and therefore, in terms of community resilience, this stable population is a strong indicator of Ingham's resilience at community level. The survey results, which confirmed that the majority of respondents (59 %) thought that the community had recovered from the flood's negative impact (Table 3), supported our conclusions from the socio-economic and demographic results that the community at macro-level was resilient. The survey item looking at the possibility of relocation as a result of the flood showed that only 4 % of the sample had difficulties finding alternative accommodation. One of these respondents, a female aged 21–40 with 3 children, explained in an extended response section of the survey why she wanted to move from her rented accommodation: '... my rented house is still not fixed'. So it was not to leave the community all together but rather to move within

[4] There is one R squared (R^2) or squared multiple correlation (smc) for each dependent variable in the model. It is the percentage variance explained in that variable. An $R^2 = 0.4$ may be interpreted as follows: Approximately forty per cent of the variation in the response variable can be explained by the explanatory variables. The remaining sixty per cent can be explained by unknown variables or inherent variability (Norusis 2003.

the community. Another older female participant stated that if another flood came, she would stay with family outside the region. Furthermore, she had thought of moving house due to the susceptibility of her house to flooding, but she had not considered leaving Ingham. A further respondent, a female aged over 55 years, employed in the field of medicine, explained why she considered relocating (within Ingham):

> People don't always know how much damage they have for a long time after the flood and so miss funding grants and are frightened to apply. Damage is not noticeable for months later and then you can't claim. Shoddy repairers also cause problems.

Despite such difficulties, very few respondents indicated a desire to relocate from the community (Table 5).

Both interview and survey results highlighted the importance of a sense of place in building individual resilience and, by extension, community resilience. Survey data corroborated interview findings; most respondents reported a positive sense of place (Table 4). It was interesting to consider that a sense of place remained strong for Ingham residents despite the experience of an unusual and significant flooding event albeit in a geographical area regularly subject to floods and tropical cyclones. Repeated experiences of flood and other natural hazards did not appear to have eroded the community as a whole or to have increased residents' inclination to relocate. This was not surprising given the contention that those remaining behind after a disaster were likely to be resilient to the disaster. However, a limitation of the research was that we had no access to those who left the community as a result of the disaster and therefore cannot speculate as to why they might have relocated. Nonetheless, given the stable numbers of the community as indicated by the census data, it is unlikely that many residents left Ingham after the floods.

Another limitation was no access to medical records to ascertain whether those individuals who reported being resilient had in fact no significant PTSD symptoms, at the time of the survey or in previous months. Further, we had no access to hospital medical records or doctors' records at a community-wide level. Our health data arose from three focus interviews with healthcare workers, the manager of Ingham hospital and a medical practitioner. They reported that during the flooding, they had more calls from, and a greater workload, in response to the most vulnerable in the community, the elderly living alone, those with mental health needs and those with disabilities.

> ...there was a lot of harm done to older people who were isolated in their homes for an extended period of time and when the toilets stopped working a lot of older people were injured from fall injuries, by trying to go to toilet in buckets and things like that. So I think that is something that we really need to keep lobbying for... Blue Care and Community Health [they] were talking about a lot of older people, frail aged people who were stuck in their houses, who were used to Meals on Wheels coming, who were used to someone coming in and cleaning rooms or changing sheets and coming on certain days, but when they were trapped in their homes for a couple of weeks that didn't happen so it was the social isolation as well...(Health Care Worker)

Results of the model showed how the variables interacted and predicted resilience or relocating from Ingham. A sense of place was the strongest predictor of resilience and was negatively linked to a desire to relocate as might have been predicted from prior research findings (e.g. Chamlee-Wright and Storr 2009; Hegney et al. 2007). People who have a sense of place have strong social connections within a place, emotional ties and often a history anchored in the place. A stronger sense of place was likely to be protective against

negative family health experiences, supporting prior researchers' contentions (Landau et al. 2008; Miller 2012; Reich 2006). Moreover, negative health experiences predicted the desire to leave the community and were negatively associated with resilience. Presumably, the mechanism for this is based on the strain that such health impacts place on social relationships and a concomitant erosion of sense of place which is a product of, among other factors, social interactions and their quality (Reich 2006). This model accounted for 18 % of the variance (R^2) in resilience and 15 % of the variance in relocating attitudes. Resilience has been shown to be the result of many factors, including intrapersonal ones such as intelligence, positive coping strategies, optimism, prior experiences and personal financial capacity as well as external ones such as community facilities and services. Our survey data accounted for approximately one-fifth of individual resilience as captured by the items of the survey, an important finding based on the influence of sense of place on resilience. Moreover, the model explained 15 % of the variance in the desire to relocate, a factor likely to be based on financial, structural, social, personal and health considerations. Results show that health effects and place connection or sense of place form a significant part in any deliberations about whether to relocate from a flood-impacted community. The length of time spent in the community was not associated with a sense of place or relocation attitudes, a somewhat unexpected finding. For example, it might have been expected that a person who had been a long-standing member of the community would not consider leaving. It was also noted, however, that length in the community did not covary with sense of place, the covariance being -.02. This suggests that length of residence in the Ingham community did not necessarily imply a subjective sense of place. As some interviewees indicated, Ingham was an economic place to retire to, and therefore, it could be that while the community provided affordable accommodation, some people living there might not feel as connected to the community as others. Health impacts were unrelated to the number of years resident in the community, an expected result since the flood could affect any individual located in the flood-prone areas, regardless of length of residence. A sense of place rendered some protection against experienced health impacts presumably via the supportive effects of social connectedness; more social connectedness probably led to greater sharing of care of health-impacted individuals. Alternatively, a heightened reporting of family health impacts might be linked with a subjective negative view of sense of place. More research needs to be conducted to refine these particular links in the data.

8 Conclusion and implications

Results echoed previous research on residents returning to New Orleans following Hurricane Katrina (Chamlee-Wright and Storr 2009). Perhaps repeated exposure to natural disasters renders people more resilient and facilitates the social connectedness that enhances a sense of place. Furthermore, the exposure might enable individuals and communities to view those natural disasters as surmountable and, to some extent, as expected aspects of life, as one of interviewees stated. If an individual has come through prior disasters, having coped reasonably well, this prior experience confers knowledge, realistic expectations and a measure of confidence which can be transmitted to others if the person is well connected in their community, as Ingham residents generally appeared to be.

> People that had suffered previous flooding coped better because they are used to the floods... They knew what was going to happen, they knew where to go, they knew where to put their car... they put their car out in time. Neighbours... they had lived

with their neighbours for some time, and they helped each other out. Probably people who suffer every year are newcomers, people in town, the people who have maybe moved in from a low flooding area to a flooding area and just don't realise... (Department of Communities Administrator)

It would be worthwhile conducting further research to explore this contention and to determine the influences upon sense of place in an Australian context, particularly with respect to different types of natural disasters which may vary in gravity, and the differences in metropolitan and regional centres. Other factors that may be considered as facilitators of sense of place might include individual characteristics such as gender, age, socio-economic status and personality traits such as trait anxiety and coping styles.

A person's need for social connectedness is great in times of disaster, as interviewees highlighted when they emphasised how the community banded together in response to the floods. Things got done, and goals were achieved when they were able to bond and to work together. Policies and initiatives must recognise the importance of social connectedness in building community resilience, by fostering stronger connections between neighbours to increase people's sense of place though local community programs. Volunteer organisations and informal networks need to be encouraged to develop long before a disaster occurs; when it does, the social network in which each person is embedded becomes a source of confidence and comfort developing the person's resilience which is now recognised to be more of a process than just a set of distinct traits (Boon et al. 2012a; Miller 2012). It is this very sense of belonging and support that underscores a sense of place in individuals, building ties within a community and reducing the desire to relocate.

On the other hand, floods cause enormous damage and loss of life worldwide. In the years between 1975 and 2002, inland floods (river floods, flash floods and drainage floods) caused 175,000 fatalities and affected more than 2.2 billion people (Jonkman 2005). Since climate change is predicted to precipitate an ever-increasing number of flood events, also said to be more severe in the not too distant future (IPCC 2012), from a policy perspective, the finding that sense of place remained strong despite the experience of a significant natural disaster might prove to be a stumbling block to long-term adaptation and mitigation strategies like migration in the wake of climate change (IPCC 2012). This will be particularly problematic should urban planners wish to encourage residents to relocate from sites which are prone to natural hazards.

The disasters the world is facing are associated with significant costs to private enterprises such as insurance companies as well as governments (Guha-Sapir et al. 2004). It is not unforeseeable that these costs may be exacerbated by the tendency for populations and the built environment to continue to develop in hazard-prone areas across Australia (Natural Disasters in Australia 2004). Consequently, this research raises questions about how and whether governments should influence individuals' choices of where they reside in the context of future urban planning. It might be more socially acceptable and cost-effective in the long term to address potentially vulnerable areas by providing infrastructure that can withstand the assaults of floods since relocation can introduce new pressures in areas of relocation (IPCC 2012). An example of such an intervention, infrastructure that was finally put in place to withstand encroaching floodwaters and protect a preschool in Ingham, was noted by a female interviewee during the community health/indigenous health group focus interview:

I think it was the third time in 5 years that the local preschool had been flooded so people were determined at long last that work would be done... engineering work to stop that happening again ... (Indigenous Health Worker).

Improvements to health care and surveillance and organisational infrastructure, water supply, sanitation and drainage systems; climate-proofing of infrastructure; development and enforcement of building codes and better education and awareness across all levels of the education system including professional bodies can all help to reduce vulnerability to disasters without eroding the social fabric of communities which appears to be such an important factor in building community and individual resilience.

Acknowledgments This work was carried out with financial support from the Australian Government (Department of Climate Change and Energy Efficiency) and the National Climate Change Adaptation Research Facility.

References

Altman I, Low S (1992) Human behavior and environments: advances in theory and research. Volume 12. Place attachment. Plenum Press, New York

Australian Bureau of Statistics (ABS) (2012) Socio-economic Indexes for Areas (SEIFA), 2033.0.55.001. Commonwealth of Australia, Canberra

Bardo JW, Bardo DJ (1983) A re-examination of subjective components of community satisfaction in a British new town. J Soc Psychol 120:34–43

Berry HL, Kelly BJ, Hanigan IC et al (2008) Rural mental health impacts of climate change. Commissioned report for the Garnaut climate change review. The Australian National University, Canberra

Bihari M, Ryan R (2012) Influence of social capital on community preparedness for Wildfires. Landsc Urban Plan 106(3):253–261

Billig M (2005) Sense of place in the neighborhood, in locations of urban revitalization. GeoJournal 64:117–130

Bonanno GA (2004) Loss, trauma, and human resilience: have we underestimated the human capacity to thrive after extremely aversive events? Am Psychol 59:20–28

Bonanno GA, Brewin CR, Kaniasty K, La Greca AM (2010) Weighing the costs of disaster: consequences, risks, and resilience in individuals, families, and communities. Psychol Sci Public Interest 11(1):1–49

Bond TG, Fox CM (2007) Applying the Rasch model: fundamental measurement in the human sciences, 2nd edn. Erlbaum, Mahwah

Boon HJ, Cottrell A, King D, Stevenson RB, Millar J (2012a) Bronfenbrenner's bioecological theory for modelling community resilience to natural disasters. Nat Hazards 60(2):381–408

Boon HJ, Millar J, Lake D, Cottrell A, King D (2012b) Recovery from disaster: resilience, adaptability and perceptions of climate change. National Climate Change Adaptation Research Facility, Gold Coast, p 467

Breton M (2001) Neighbourhood resiliency. J Community Pract 12:21–36

Bureau of Meteorology (2009) Herbert river floods: January and February 2009. Bureau of Meteorology, Canberra

Bureau of Meteorology and CSIRO (2012) State of the climate 2012. Bureau of Meteorology, Melbourne

Chamlee-Wright E, Storr VH (2009) There's no place like New Orleans': sense of place and community recovery in the Ninth Ward after Hurricane Katrina. J Urban Aff 30:615–634

Chang K (2010) Community cohesion after a natural disaster: insights from a Carlisle flood. Disasters 34(2):289–302

Connor K, Davidson J (2003) Development of a new resilience scale: the Connor Davidson Resilience Scale (CD-RISC). Depress Anxiety 18:76–82

Flynn B (1994) Mental health services in large scale disasters: an overview of the crisis counseling program. NCP Clin Q 4:1–4

Glaser BG, Strauss AL (2009) The discovery of grounded theory: strategies for qualitative research. Transaction Books, New Jersey

Glynn TJ (1981) Psychological sense of community: measurement and application. Hum Relat 34:789–818

Graham H, Mason R, Newman A (2009) Literature review: historic environment, sense of place, and social capital. English Heritage, UK, p 44

Guha-Sapir D, Hargitt D, Hoyois P (2004) Thirty years of natural disasters 1974–2003: the numbers. Centre for Research on the Epidemiology of Disasters, Presses Universitaires de Louvain, Leuven

Hay R (1998) Sense of place in developmental context. J Environ Psychol 18:5–29

Heene M, Hilbert S, Harald Freudenthaler H, Bhner M (2012) Sensitivity of SEM Fit Indexes with respect to violations of uncorrelated errors. Struct Equ Modeling 19(1):36–50. doi:10(1080/10705511),2012, 634710

Hegney DG, Buikstra E, Baker P, Rogers-Clark C, Pearce S, Ross H, King C, Watson-Luke A (2007) Individual resilience in rural people: a Queensland study, Australia. Rural Remote Health 7(4):620. (Online). Available from http://www.rrh.org.au

Hidalgo M, Hernandez B (2001) Place attachment: conceptual and empirical questions. J Environ Psychol 21:273–281

IPCC (2012) Managing the risks of extreme events and disasters to advance climate change adaptation. A special report of Working Groups I and II of the Intergovernmental Panel on Climate Change. In: Field CB, Barros V, Stocker TF, Qin D, Dokken DJ, Ebi KL, Mastrandrea MD, Mach KJ, Plattner G-K, Allen SK, Tignor M, Midgley PM (eds) Cambridge University Press, Cambridge, UK, p 582

Jonkman SN (2005) Global perspectives of loss of human life caused by floods. Nat Hazards 34:151–175

Kaltenborn BP (1998) Effects of sense of place on responses to environmental impacts. Appl Geogr 18(2):169–189

Kline RB (2005) Principles and practice of structural equation modelling, 2nd edn. The Guilford Press, New York

Landau J, Mittal M, Wieling E (2008) Linking human systems: strengthening individuals, families and communities in the wake of mass trauma. J Marital Fam Ther 34(2):193–209

Larson S, De Freitas DM, Hicks CC (2013) Sense of place as a determinant of people's attitudes towards the environment: implications for natural resources management and planning in the Great Barrier Reef, Australia. J Environ Manage 117:226–234

Miller JL (2012) Psychological capacity building in response to disasters. Columbia University Press, New York, ISBN:978023151962

Murphy BL (2007) Locating social capital in resilient community-level emergency management. Nat Hazards 41(2):297–315

Nasar JL, Julian DA (1995) The psychological sense of community in the neighbourhood. J Am Plan As 61:178–184

Natural Disasters in Australia (2004) Reforming mitigation, relief and recovery arrangements. A report to the Council of Australian Governments by a high level officials group, Canberra

Nelson DR, Adger WN, Brown K (2007) Adaptation to environmental change: contributions of a resilience framework. Annu Rev Environ Resour 32:395–419

Norris FH, Sherrieb K, Galea S, Pfefferbaum B (2008a) Capacities that promote community resilience: can we assess them?. Paper presented at the 2nd annual Department of Homeland Security University Network Summit, Washington, DC. www.orau.gov/dhsresummit08/presentations/Mar20/Norris.pdf. Accessed 22 July 2012

Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL (2008b) Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. Am J Community Psychol 41:127–150

Norusis MJ (2003) SPSS 12.0 statistical procedures companion. Prentice Hall, New Jersey

Pendola R, Gen S (2008) Does ''Main Street'' promote sense of community? A comparison of San Francisco neighborhoods. Environ Behav 40:545–574

Prewitt Diaz JO, Dayal A (2008) Sense of place: a model for community based psychological support programs. Australas J Disaster Trauma Stud 2008:1. Available from http://www.massey.ac.nz/ *trauma/issues/2008-1/prewitt_diaz.htm.

Queensland Government (2009) Emergency Services Minister visits Flooded North West, Queensland Government. http://statements.cabinet.qld.gov.au/MMS/StatementDisplaySingle. Accessed 7 Sept 2010

Reich JW (2006) Three psychological principles of resilience in natural disasters. Disaster Prev Manag 15(5):793–798

Stedman RC (2003) Is it really just a social construction? The contribution of the physical environment to sense of place. Soc Nat Resour 16:671–685

Steele F (1981) The sense of place. CBI Publishing, Boston

Steffen W (2009) Climate change 2009 faster change & more serious risks. Commonwealth of Australia 2009, ISBN: 978-1-921298-58-5

Tashakkori A, Teddlie C (eds) (2003) Handbook of mixed methods in social and behavioral research. Sage Publications Inc., Thousand Oaks

Williams A, Kitchen P, Randall J, Muhajarine N (2008) Changes in quality of life perceptions in Saskatoon, Saskatchewan: comparing survey results from 2001 and 2004. Soc Indic Res 85(1):5–21