

Citation:

Oloruntoba, O. 2015. Resilience and adaptive capacities in Cyclone Larry. In Proceedings of the 5th International Conference on Building Resilience, 15-17 July 2015, Newcastle, NSW

Resilience and Adaptive Capacities in Cyclone Larry

Abstract

The paper presents a theoretical overview of the concept of resilience. The overview comprises current understandings of resilience, and its main components: stress; adaptation; wellbeing; and resources. The paper also analyses the relationship between resources and their dynamic attributes; a network of adaptive capacities; and rapid adaptation after a disruption, — the key attribute of resilient systems. Community resilience is manifested in quick restoration of community functioning and individual welfare, and wellbeing after a disruptive event. The paper also argues that community resilience should be built long before an event from four categorisations of adaptive capacities: (1) wealth and economic development; (2) social networks and social capital; (3) effective information dissemination and communication systems as well as (4) technical knowledge and competence. The paper concludes by describing empirical case examples of some effective resilience strategies in the management of the Cyclone Larry disaster of March 20, 2006.

Introduction

This paper addresses three questions: What is the current theoretical and empirical understanding of resilience? What are the key components of resilience and their relationships? How can we design resilience into contemporary Australian communities to better withstand disasters? The rest of the paper is structured as follows: first, I discuss the current theoretical and empirical understanding of resilience; second, I define a ‘disaster’; and third, I provide an analysis of the most important components of community disaster resilience and adaptive capacities and argue that resilience can and should be built into communities in the preparing for disasters. This section is then followed by a description of some empirical case examples drawn from the preparedness and response phase of the management of Cyclone Larry 2006, because, in general, there is a consensus that Cyclone Larry is an exemplar case from which lessons of resilience may be drawn. In the penultimate section, six recommendations for policy, and practice are discussed, and then the paper concludes with a summary.

The concept of resilience

Resilience is a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance (Norris et al 2008). Resilience is a commonly used concept in disaster management research; and several studies have linked the genesis of resilience to the disciplines of physics and mathematics (e.g. Comfort et al 2010; Norris et al 2008; Paton and Johnston, 2006; Pelling, 2003). Resilience was traditionally used to describe the capacity of a material or system to return to equilibrium after a displacement. In mathematics a resilient item, for instance will bend, and flex and bounce back, rather than break when flexed, or stressed (Bodin and Wiman 2004; Gordon, 1978). Similarly but differently, in physics, resilience is not a matter of how large the initial flex, or displacement

is, but is more about the *speed* of recovery to its initial state i.e., the speed with which homeostasis achieved.

Furthermore, the concept of resilience has often been used to describe biological and ecological systems such as the term ‘ecological resilience’ coined by Holling (1973); and recently, the seminal case study of the role of traditional ecological knowledge to cope with challenges from global environmental change by Gómez-Baggethun et al (2012). Resilience has also been used to describe the capacity of individuals to adapt to difficult situations in the discipline of psychology (e.g. Weine, 2013; Bonanno, 2004, 2005; Richardson, 2002), and child psychology (e.g. Butler et al. 2007).

More recently, the concept of resilience was adapted to fit the context of human communities as used in the term ‘community resilience’ (e.g. Poortinga, 2012; Cutter et al 2008; Sonn and Fisher 1998; Godschalk 2003), and other areas. In summary, the concept of resilience is diverse in application, and may be understood, and addressed at different levels of analysis.

However, notwithstanding the origins of the concept, or the sheer diversity of contexts in which the concept has been studied, and applied; two things are clear: first, most analysis emphasize a capacity for effective *adaptation*, and adaptability rather than *stability* in the face of disturbance, stress, or adversity (e.g. Waller 2001; Handmer and Dovers 1996). Second, resilience is often analysed as an *ability* or a *process* rather than as an outcome (e.g. McManus et al 2008; Pfefferbaum et al. 2005).

In this paper, I focus on the resilience of communities in the face of, and context of disasters.

Community resilience is a process linking a set of networked adaptive capacities to a positive trajectory of functioning and adaptation in constituent community populations after a

disturbance (Norris et al 2008). Such focus is because disasters are a part of life and their incidence is increasing (Oloruntoba, 2005; McEntire, 2002, 1999). Also, the socio-economic impacts of natural disasters are increasing (Centre of Research for the Epidemiology of Disasters, 2009). For example, in 2010, more than 290,000 people were killed, and over 217 million were affected by natural disasters worldwide (Centre of Research for the Epidemiology of Disasters, 2009). Worldwide disaster-related economic damage was estimated at roughly US\$124 billion (Guha-Sapir et al., 2011). In other words, the focus of community resilience is on developing systems of capacities to face disasters, and to reduce vulnerabilities.

The concept of disasters

I adopt the definition of a *disaster* as ‘a potentially traumatic event that is collectively experienced, has an acute onset, and is time delimited; disasters may be attributed to natural, technological, or human causes’ (McFarlane and Norris, 2006, p.4). Thus, a disaster is a *non-routine* event that exceeds the capacity of the affected area to respond to it in such a way as to save lives; to preserve property; and to maintain the social, ecological, economic, and political stability of the affected region.

The definition includes natural events, such as cyclones, or hurricanes as they are referred to in North America. Other examples of disasters include earthquakes, floods, heat waves; large transportation, nuclear, or industrial accidents. The definition excludes chronic environmental hazards, or slow-on set events such as drought and famine, ongoing wars and conflict, political and community violence, and epidemics. These are excluded because how such disasters (or community stressors) latently ‘cook’ often undetected for years, before they erupt are often different. The dynamics of how such disasters unfold over time often differs

enough to warrant boundaries of the potential applicability of theory and research (see Turner, 1976; 1976b for a comprehensive account of slow-onset disasters). Given the multi-disciplinary and inter-disciplinary nature of disaster studies and disaster management, I draw upon existing resilience literature in a range of disciplines with a particular focus on disaster studies and disaster management. I draw on the disciplines of sociology, anthropology, geography, public administration, emergency management, economics, health, organisation studies, technology, and communications.

Components of community disaster resilience

I have summarised the key components of the resilience of communities in the face of disasters into four broad categories: (a) stress and stressors; (b) adaptation and adaptability; (c) community wellbeing; and (d) resources.

(a) Stressors and stress:

A stressor is an aversive circumstance that threatens the well-being, or functioning of the individual, organization, neighbourhood, community, or society (Murray and Zautra, 2012). For example, a disaster such as an earthquake or a sudden volcanic eruption is a stressor of the affected community. The process by which a stressor stresses a community is dependent on factors such as: the features of the stressor (e.g. scale, intensity, duration, surprise); subjective appraisals and evaluations of the stressor (e.g. by public safety officials or members of the community); the response to and impact effects of the stressor (e.g. physical, social, economic, psychological impacts) and a range of factors that influence the network of

relationships between the stressor, stress appraisal, and response to the stress (e.g. by individual members of the community, or public safety officials).

The level of community exposure to the stressor interacts with pre-existing individual and community vulnerabilities. This in turn influences the magnitude and severity of the impact of the stressor on the community, and the individuals within it i.e. the level of stress. Ultimately, the level of stress also determines to a large extent the ability of the individual, and community to respond as well as the nature of individual, and the nature of the community response to the stressor (Paton, 2008; Benight et al 2006; Benight, 2004).

Community stressors arising from the range of impacts of disasters often include: injury to self or family member; life threat; and bereavement. Others include damage to property, neighbourhood, or community destruction, financial and economic loss, and displacement. Disasters are stressful not only for individuals experiencing personal loss but also for the community at large (e.g., Murray and Zautra, 2012; Paton, 2008; Mollica et al 2004; Norris et al 1994; Raphael et al 1986).

The unpredictable nature of the dangers confronting contemporary communities, planners and governments has been comprehensively addressed by several authors (e.g. Comfort, 2010, 2007; Allenby and Fink 2005; Longstaff, 2005; Barnes and Oloruntoba, 2005; Boin and Lagadec, 2000; Mitroff and Alpasian, 2003; Perrow, 1984). The world is increasingly complex, interconnected, with systems in constant flux in reaction to the dynamism of other changing systems, making surprise more common than predictability. Ultimately, community well-being depends in part on the effectiveness of organizational and societal preparedness and responses. However, since it is impossible for communities to be so prepared for all

eventualities that there is a nil chance of a stressor event such as a disaster occurring; the situation thus calls for broad resilience strategies. Ultimately, the purpose of disaster management is to maintain the safety and well-being of the public, and to promptly restore community well-being if it is jeopardised.

(b) Adaptation and adaptability:

Stressors such as disasters cause a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected people to cope using only their own resources (Asian Development Bank, 2005; Asian Disaster Reduction Centre, 2005; Quarantelli, 1986). Hence, theoretically speaking, it is always a balancing act between stressors and available resources according to resilience theory and disaster theory; and demands often outweigh resources in disasters and other stressor situations (Rutter, 1987; Quarantelli, 1986). Indeed, the impacts of disasters arise not only from the needs of the community but from the community's inability, or capacity to meet their needs. The ideal outcome after a disaster is resistance — adequate resources effectively blocking the stressor and consequently the absence of any dysfunction whatsoever. Fire resistant buildings are an example of resistant systems. However, resistance strategies are often valuable only for disasters that are likely to occur with some frequency and can be planned in advance. Hence, the path of resistance is unlikely for communities, individuals, and even for emergency systems in the aftermath of disasters. Temporary or transient dysfunction is therefore more likely than resistance.

Disaster theory indicates that, often, the typical pattern is for distress and dysfunction to be nearly universal in the first few weeks after a disaster (e.g. Raphael et al 1986). However, a disaster's adverse impacts slowly dissipate over time, leaving only a relatively small number

of individuals within affected communities chronically impaired. Much of the time, such transient dysfunction is followed by a gradual return to pre-disaster levels of functioning. The process that produces adapted outcomes is resilience; and the more rapid the return to pre-event functioning, the greater the resilience (Norris et al 2008; Bonano, 2004). Thus, the trajectory of resilience, often involves transient perturbations that may last for weeks, but in general, it returns to a stable trajectory of healthy functioning.

Hence, resilience does not preclude dysfunction or distress but dysfunction is transient. However, post-disaster functioning may not be the exact equivalent of pre-disaster functioning as a result of the need to adapt to an altered environment. Such adapted functioning may not necessarily be superior in its effectiveness, nature, character, or level when compared to pre-disaster functioning; it is simply different (Norris et al 2008; Bonano, 2004). Such renewed and adapted functioning becomes the 'new normal' as it has been termed by Redlener and Morse (2006), and the alternative outcome is persistent dysfunction. In other words, the community has adapted and is not in a state of persistent dysfunction. Community functioning and wellbeing, and the wellbeing of individuals in the community is therefore the manifestation of adaptation after a stressor (Norris et al 2008; Bonano, 2004).

(c) Community wellbeing

There is no consensus on how to measure community well-being after a disaster, and measures vary from discipline to discipline (see Forgeard et al.2011; Higgins, 2008; Tiliouine et al. 2006). However, in general, community well-being is often characterised by: minimal impairment of functioning of the community and the individuals within it despite some distress and challenges; rapid recovery from distress and damage, or no distress or damage occurred, or remains at all. At the level of each individual, personal wellbeing seems a viable indicator that adaptation has occurred. It has to do with personal feelings of empowerment,

and resilience as well as healthy patterns of behaviour (Bonano, 2005; Cowen, 2000). Personal wellbeing comprises adequate role functioning at home, school, and/or work; and a high quality of life (Bonano, 2005; Cowen, 2000). Quality of life is how people perceive their lives as a whole in the domains of work, family life, health, leisure, and neighbourhood (Bonano, 2005; Cowen, 2000). Cowen (2000) noted that wellness is a continuum. Individuals and communities show varying degrees of wellness before, and after disasters, and this must be taken into consideration in any post-disaster assessment of adaptation and adaptability.

(d)Resources

Resources determine the process, and ultimately, the outcome of a disaster, whether a community is able to be resilient or not (Hobfoll, 2006). Resources are a range of objects, assets, conditions, characteristics, and energies that people value, and they often provide protection against the consequences of a disaster (Hobfoll, 2006). Resources are dynamic attributes of resilience (Bruneau et al 2003). Several types of resources have been shown, or theorized to influence community resilience (Bruneau et al. 2003). I will go a through a few dynamic attributes of resources which resources must possess in order to be able to engender resilience (Bruneau et al. 2003). The four attributes may be used for monitoring the performance of the organizational, social, technical and economic systems of a community.

(1)Robustness

- Robustness is the ability to withstand stress without suffering degradation. Hence, a resistance strategy is robust if it counteracts a wide variety of dangers. However, it is fragile if it only works in a small number of possible disaster scenarios (Longstaff 2005; Bruneau et al. 2003).

(2) Redundancy

- Redundancy is the extent to which elements are substitutable in the event of disruption or degradation. For instance, industrial and technological systems such as power grids and airplanes have extensive redundancy or duplicates, and triplicates built into them. Individuals that possess larger social networks for example have redundancy. Hence, redundancy is a type of 'resource diversity.' Likewise, a community relying only on a limited or narrow range of resources is less able to cope with change that involves the depletion of that resource (Hobfoll, 2006).

(3) Rapidity

- Rapidity is the ability to achieve goals in a timely manner in order to contain losses, and avoid disruption. It relates to agility, responsiveness, and speed (Hobfoll 2006).

(4) Resourcefulness

- Resourcefulness is the capacity to identify problems, and mobilize resources when conditions threaten the system. These four are attributes of resources rather than characteristics of systems. Hence, in summary, resilience-resources often possess four dynamic properties: *robustness*, *redundancy*, *rapidity*, and *resourcefulness*. A resource need have only one of these attributes to engender resilience (Hobfoll, 2006). However, resilience may fail when resilience-resources are themselves severely disrupted, or damaged by a stressor such as a disaster. This demonstrates the importance of robustness as an essential quality of resilience-resources. Disasters often result in simultaneous resource deterioration, and resource mobilization, with the hope that newly mobilised resources are sufficient to protect, or replenish vulnerable resources, however, this not always the case.

Stress often occur when resources are lost, or threatened (Hobfall, 2006). Stress often is the result, when individuals fail to gain resources following a significant investment of other resources. Individuals often invest resources in order to protect against resource loss, recover from losses, and gain resources. Hence, individuals, communities and systems with greater resources are less vulnerable to resource loss and more capable of resource gain; and as a result are more resilient. Disasters threaten a range of resources such as: housing; personal resources (e.g. sense of well-being, optimism, and safety); social resources (e.g. companionship); and energies (money, free time). Thus, an event in which resources are themselves harmed by the stressors they are supposed to buffer significantly limits the protection resources available. In short, resource loss has highly correlated with the severity of disasters and stressors in several studies (e.g. Norris et al. 2002).

Adaptive capacities

Adaptive capacity is the property of an ecosystem that describes changes in stability landscapes and resilience (Link et al. 2013; Berman et al.2012; Smith and Wandel, 2006; Woods and Cooks, 2006). It comprises the pre-existing features of communities that influence their ability to identify, mobilize, and address social problems and other problems that relate to the public such as disasters, or other stressors. Adaptive capacity often comprises the pre-disaster cultivation and post-disaster use of transferable skills, knowledge, resources, technology, and systems that affect individual and community-level changes consistent with goals and objectives relating public wellbeing. Such capacities may be seen as adaptive capacities when they are *redundant*, *rapidly accessible* and *robust*, and therefore able to offset a sudden disaster or stressor.

Categories of adaptive capacities that enable community resilience include (1) wealth and economic development; (2) social networks and social capital; (3) information dissemination

and communication systems; and (4) technical knowledge and competence. In the following section, I illustrate the key antecedents and indicators of community resilience in the Cyclone Larry response.

Antecedents and indicators in Cyclone Larry

First, I discuss why and how cyclone Larry was selected as an example to demonstrate antecedents and indicators of community resilience in the aftermath of a major stressor. Second, I describe Cyclone Larry in terms of its geographical area of impact, and its physical, social, and economic characteristics. Third, I draw out some examples of antecedents and indicators of community resilience in Cyclone Larry. The analysis in this paper focuses mostly on the immediate emergency response phase. However, the analysis draws on relevant background mitigation, preparedness and planning activities that appear to have contributed to the resilience of cyclone impacted communities.

The rationale for Cyclone Larry

Prior evaluations of the perceptions of disaster preparedness and management of cyclones revealed that relative to other cyclones, Cyclone Larry was the biggest and best prepared and managed disaster in Australian history (see Dufty, 2014; Turton, 2008; Cyclone Summit, 2006). Commonly evaluated factors align with factors that contribute to the community's ability to adapt, and return to functioning and wellbeing. Respondents are often asked to rank aspects of disaster preparedness, response, recovery, and management such as relief, gender and children care, agriculture, education, logistics, food aid, public health and epidemiology, water and sanitation and emergency shelter. Questions often rated quality and speed of: (1) coordination and logistics amongst responding organisations; (2) food and water delivery; (3) restoration of houses, schools and buildings; (4) infrastructure restoration; (5) restoration of

health/hygiene; (6) provision of emergency shelter; and (7) non-food relief items. The preparedness, response and management of Cyclone Larry was often ranked as most exhibiting indicators of resilience when compared to Cyclones Ted (1976), Winifred (1986), Aivu (1989), and Steve (2000). Thus, there seems to be a consensus that Cyclone Larry is an exemplar case from which lessons could be learnt (see also Oloruntoba, 2010; Queensland State Disaster Management Group, 2009).

Cyclone Larry

Cyclone Larry was first tracked on 16 March 2006 (Bureau of Meteorology, 2006) (BOM). On 18 March 2006 it was classified as a Category 5 cyclone as it approached the Queensland coast. At 4:45 a.m. on 20 March 2006 and with winds over 260 km/h it made landfall near Innisfail and wreaked havoc on the northern coast of Queensland (ABC, 2006). Innisfail, a town of 8000 people, about 1700 km north of Brisbane suffered the brunt of the cyclone. Wind gusts were estimated to have been up to 240 km/h (Category 4) in the area of Innisfail and up to 290 km/h in other areas (category 5) (BOM, 2007). Cyclone Larry travelled almost 450 km inland to around Croydon before being downgraded to a rain depression, however, there was severe flooding (ABC, 2006). Cyclone Larry devastated communities in an area over a 17,000 km². Over 25,000 people lost their homes and/or farms, and personal properties and many others experienced damage (Cyclone summit, 2006). More than 140,000 people lost their electricity while 30,000 lost their telephone services for days. Approximately 280,000 people were affected, 30,000 people in the worst affected area (BOM, 2006). Affected areas suffered extensive damage to infrastructure and crops with the total estimated loss of over \$A1.5 billion (ABC, 2006). Dozens of towns and villages that rely on income generated by tourism and the tropical fruit plantations e.g. sugar cane, avocados and banana farms were wiped out with attendant consequences on the regional economy (ABC, 2006).

Also, water supply systems, schools, farms, hospitals, and basic sanitary infrastructure were destroyed or damaged. Major roads were made impassable as fallen trees and debris blocked access (ABC, 2006). Floods and strong winds destroyed or damaged fishing equipment in the affected areas (ABC, 2006). In addition, since agriculture, tourism and fishing are the main sources of income in the region; the most-affected households faced an aggravated income shortage as well as a decrease in food reserves because routine commercial/retail supply chains were out of action. Cyclone Larry sparked Australia's biggest ever relief effort (Queensland Government, 2009). Although, Cyclone Larry caused extensive damage to the environment, infrastructure and property (Turton, 2008), there were minimal injuries and no loss of life resulting from its direct or indirect effects (BOM, 2006). Within two weeks of Cyclone Larry, and the emergency response life rapidly returned to 'normal', the 'new normal' before long term recovery and rebuilding activities commenced.

Examples of Indicators of Adaptive Capacities in Cyclone Larry

As earlier discussed, resources are dynamic attributes of resilience, and several types of resources influence community resilience (Bruneau et al 2003). However, resources themselves must possess the *dynamic attributes* of robustness, redundancy, and rapidity in order to be able to engender resilience (Bruneau et al. 2003). The four basic categorisations of adaptive capacities are: (1) wealth and economic development; (2) social networks and social capital; (3) effective information dissemination and communication systems as well as (4) technical knowledge and competence.

The discussion is structured into two consecutive parts: (1) examples, factors, antecedents and indicators (of resilience) in the cyclone preparedness and planning phase — including activities undertaken and resources made available before the cyclone that are core to the adaptive capacity, hence resilience of the affected community, and (2) factors and issues

emerging during the cyclone itself and its immediate aftermath that contributed to adaptation and resilience.

Wealth and economic development

[A] Pre-disaster

The far north of Queensland is known for its tropical fruits plantation industries, mining, as well as its tourism and offshore economies. Hence, the region can be said to be relatively prosperous and experiencing economic growth and stability of livelihoods. Furthermore, being a regional area far from densely populated urban south east Queensland, the cost of living is more affordable than in any Australian capital city. Also, the distribution of income and assets within populations is more equitable compared to capital cities like Sydney. Land and housing is more affordable and accessible. Furthermore, because of the agricultural base of the region (e.g. cattle, dairy farming, bananas, and assorted tropical fruits) there were sufficient employment opportunities. Sometimes transient farm labour from overseas and other parts of Australia are hired to harvest crops. Overall, such an economic landscape seems to have been an essential part of the resource base of the community before the cyclone struck.

[B] Post-disaster

However, there are extensive interdependencies at the regional, state and national macroeconomic level as the resilience of the regional economy and livelihoods is dependent on both the capacities of individual businesses and the capacities of all the entities that depend on them and on which they depend. For example, resources were sent rapidly from Canberra and Brisbane to prop up the devastated agricultural industries.

The Queensland and Commonwealth government made special pre-planned disaster relief provisions for affected economic segments of the region. The first stage was to ensure that immediate aid, and assistance packages are provided to businesses and industry. Afterwards, other short and longer term disaster assistance such as job and support programmes such as ‘work for the dole’ type arrangements. These economic assistance and livelihood packages ensured that people could be employed under those arrangements with a fractional often negligible financial top-up from the companies or the farms that were receiving relief. These include banana, avocado and sugar cane growers, as well as vessel owners and operators in the tourism sector. Owners of commercial, recreational and other vessels in the ports and harbours from Cairns, just north of the eye of the Cyclone, to Cardwell in the south were able to repair their assets or procure new assets. Likewise, owners of tourism aircrafts and vessel owners operating in the World Heritage listed Great Barrier Reef (a key attraction for rich Japanese tourists). The then State Premier and then Prime Minister visited umbrella associations of the industry and economic groups in the region and announced various immediate special grants, and longer term soft loans often with 0% interest for the various groups. Under the NDRAA relief scheme, primary producers and businesses were given concessional loans of up to \$500,000.

In addition, hundreds of emergency electricity generators were distributed free of charge to the dairy and aquaculture industries to maintain animal welfare. Portable cow milking machines were air-freighted to scores of north Queensland dairy farms including trucks and trailers for six weeks in order to kick-start the milking of cows and economic output. Without the Queensland and Commonwealth governments concurrently providing such financial and economic resources to the regional economy, the outcome would have been different. The economy of the region was given as much attention as individual recovery, thus contributing

to economic resilience and ultimately community resilience. Thus, the case for a link between economic resources, livelihoods, and jobs and individual post-disaster wellness and wellbeing is clear. Hence, poor communities are not only at greater risk of death and severe damage, but they are often less successful in mobilizing support after disasters.

Social networks and social capital

[A]Pre-disaster

The basic idea of social capital is that individuals invest, access, and use resources embedded in social networks to gain returns (Fullilove and Saul 2006; Comfort 2005; Lin, 2001; Goodman et al.1998). An aspect of community capacity is the use of inter organizational networks that are characterized by reciprocal links, and supportive interactions that overlap with other networks. Social capital also includes the ability to form new associations, and cooperative decision-making processes as well as efforts to broaden the scope of actors, agents, and knowledge that can be mobilised.

The AUSASSIST plan describes how Australian civil and military assets might be jointly deployed in response to a natural disaster. The plan was developed long before the Cyclone Larry disaster, and has been used in various disaster assistance scenarios around the world. For instance, in the Asian tsunami disaster of 2004, the crisis in Timor-Leste and in the Solomon Islands. The plan paves the way for smooth implementation of disaster response aided by the placement of liaison officers for the initial stages of a disaster response. The liaison officers are the first point of contact (POC) with the civil authorities. Only the State Premier can request military assistance from the Attorney-General in Canberra, who then makes a case to the Minister of Defence and the Prime Minister.

[B]Post-disaster

The joint military-civil response strategies were smooth, flexible and highly collaborative with other civil government agencies and non-government organisations (NGOs). This seem may be explained by the social capital and goodwill cultivated before the cyclone, and enjoyed by all responding parties that managed the disaster relief and recovery. This is because of the pre-existing good camaraderie, inter-personal, and inter-organisational relationships (social capital) cultivated and maintained over the years. Moreover regular practice among government actors and agencies synchronised with the regular nature of cyclones in the region seemed to have helped the various actors know each other relatively well. Hence, there was a unity of direction amongst responding government agencies and top officials of the various tiers of government:

“...the Prime Minister has spoken with the Queensland Premier offering every assistance in the face of the cyclone. The ADF stands ready to help our fellow Australians in their time of need and will provide whatever assistance it can to help those affected by Cyclone Larry”—
Minister of Defence (Media release 029/06, 20 March, 2006).

The larger Australian national community also recognised the social legitimacy of the affected peoples of Queensland. Funds were raised across the country and sent to help the affected region in addition to government disaster response. This demonstrated that the larger community including the government and the Australian Defence Force (ADF) cared about the needs and well-being of affected members of the Australian community. This is tantamount to self-help, mutual support, and national cohesion. It also highlights the social relationships and bonds that exists (social embeddedness), and the benefits that ‘legitimate’ members receive from their social ties. Furthermore, social capital comprises relationships between individuals and their larger neighbourhoods and communities as demonstrated in

this analysis; and such social ties are critical to community capacity, and ultimately, community resilience.

Information dissemination & communication systems

[A]Pre-disaster

Information dissemination and communication systems are arguably the key resource in technical and organizational systems that enable adaptive performance. There seemed to be two categories of information dissemination and communication systems: (a) public cyclone education and awareness information, and early warning; and (b) inter organisational information and communications flow during the response.

Cyclone education and awareness

Queensland in northern Australia is the most disaster and cyclone prone region of Australia (Queensland State Counter Disaster Organisation, 2001). Over the decades the people and government have undertaken routine cyclone awareness and education campaigns in order to maintain an adequate level of preparedness amongst at risk communities. Seasonal media campaigns have always taken place amongst the residents of north Queensland because of the cyclical cyclone season from November through April. Cyclone awareness and education campaigns to the public and community at large consisted of non-specific cyclone preparation advice that is issued at the beginning of each cyclone season in November and reiterated throughout the season to reduce vulnerability (Cyclone summit, 2006). As a result, much of the population knew what to expect and what to do to prepare, and be safe. Despite routine cyclone education and awareness campaign and the expected high level of awareness among the affected communities, disaster managers kept the campaigns going.

As regards early warning, the Bureau of Meteorology (BOM) routinely provides weather, hydrological, climatic, and oceanographic forecasts and information in the context of mitigating disasters. BOM also issued early warnings to the Australian government of gales, storms and other weather conditions likely to endanger property or life (BOM website, 2009). A part of such warning information dissemination and communication system is the Tropical Cyclone Warning System (TCWS). The TCWS comprises BOM receiving high-resolution satellite imagery every hour from the Japanese geostationary meteorological satellite MTSAT-1R. The imagery was then processed by BOM to determine the precise intensity, direction and area of landfall of Cyclone Larry on 16th March, 2006, 4 days before the cyclone made landfall. Weather forecasters undertook several specific radio and television campaigns as well as live interviews and discussions during the cyclone's life at sea up to 96 hours before it made landfall. They issued explicit and specific cyclone watch and cyclone warning advice.

The BOM regularly updated the council, state, and commonwealth governments on the level of threat, including the State Premier who put the ADF on stand-by, and the Prime Minister. BOM also updated disaster managers, the community, and other emergency professionals. The local populace was instructed to bunker down, self-evacuate, or be forcibly evacuated in areas prone to storm surges under the State Government's Declaration of Disaster Situation announced on the 18th of March two days before cyclone Larry made landfall. Based on these warnings persons who were not directly in the path of the cyclone were asked to bunker down by sealing off windows of their homes with boards. Those unsure self-evacuated to friends and family in safer communities (EMQ, 2006).

Specific cyclone early warnings were repeatedly broadcast to the public just before the cyclone made landfall at the predicted impact areas. The specific cyclone warnings

intensified throughout Sunday 19th March until the cyclone made landfall. The standard emergency warning signal (SEWS) was used in the delivery of public warnings and messages on TV and radio. SEWS was used as an alert signal played on public media to draw listeners' attention to a following emergency warning. As part of the specific warnings, it appeared that the public in areas that were prone to storm surges were either compulsorily evacuated by the Police, or simply told to move on (ABC, 2006) under the state declaration of disaster; residents of low lying communities could be forcibly evacuated by the Police. Overall, the residents, the authorities, and the ADF were reasonably expecting the cyclone, and were well prepared for its arrival.

[B] Post-disaster

As regards, the effectiveness of inter organisational information and communication flows, a trusted source of information is the most important resilience asset that any individual or group can have (Longstaff 2005). The appointment of a well-known and trusted General by the Prime Minister to head a special recovery taskforce at a high strategic and coordinative level ensured that accurate information was available to the myriad of responding organisations. Furthermore, the taskforce set up a 'one-stop shop' where representatives of all local, state and commonwealth governments were represented to provide accurate information to affected members of the community on any issues ranging from insurance to rebuilding houses.

The hub also had representatives of the banks, insurance companies, trades people and so forth. Hence, there was no need to search for information. Each day the taskforce relayed updated response-related information to the response and recovery organisations as well as the members of the community. The taskforce used radio, flyers, billboards and personal

visits to inform the community of positive developments on the response on a daily basis and also collected information on what is yet undone, which they relayed to builders for action.

Technical knowledge and competence

Technical knowledge and competence are the knowledge and capabilities to perform specialized tasks related to a specific field. Disaster managers using a range of other professionals such as social workers, doctors and builders often need to have technical skills in order to communicate effectively with line workers and coordinate efforts. Individual professionals such as nurses and builders have their own specialised skills which they contribute to the disaster response effort.

The first responders (the ADF and the Queensland State Disaster Management teams) were highly skilled. Emergency Management Queensland was quite professional in the way the cyclone was managed from the moment it became public knowledge that a cyclone was approaching to the moment the last responder flew back home. For example, responders targeted the restoration of specific services in a certain order for those affected by the cyclone. The phased restoration of public services appears to be another element of strategic planning and competency. The responders had prior guidelines on what their priorities were. Although, search and rescue, food, water and medical services were the priority, quick restoration of the environment was of paramount importance (EMQ, 2007). These services or tasks had to be undertaken first before other tasks could be undertaken.

The highest priority tasks included: the quick restoration of public radio broadcasting to reassure communities that help had arrived; the clean-up process to ensure the safety, and the free movement of vehicles through the clearing of blocked roads (foliage and felled trees) and the neutralisation of live electricity cables. Clearing the roads first is crucial to securing

access to disaster sites by other complementary teams of responders such as ADF chain saw crews who were promptly sent out to clear fallen trees which provided access. In turn access means the ability to assess requirements of those affected and to meet their needs. Thus, these early “services” were not targeted directly to those affected but to the quick restoration of the disaster site to bring it rapidly to a semblance of normality through the restoration of critical infrastructure such as water, electricity, communications, roads and public broadcasting (EMQ, 2007).

Implications and recommendations for policy and practice

Community resilience and the adaptive capacities to secure it as discussed provide a practical guide for designing and enhancing resilience to disasters in communities. I now describe **five** policy recommendations that are most probably necessary for building community resilience to natural disasters.

Access to economic resources

- Governments, the private sector together with communities must develop economic resources, reduce resource inequities, and address social vulnerability within the community. Unleashing an overwhelming amount of organised and coordinated resources very early and very quickly in a post-disaster relief response in a strategic fashion is important for resilience. However, merely pouring in resources after a disaster is inadequate. Pre-disaster mitigation activities should be undertaken concurrently with activities related to the equitable distribution of resources, social justice, and regional and community economic development in order to be resilient. Diversification of economic resources will increase the probability of community resilience to disasters and other stressors.

Access to social capital

- Social capital is one of the key resources of any community. Participatory and inclusive approaches to disaster planning, prevention, and other mitigations activities is pivotal to building community resilience and local people must be engaged in every step of the mitigation process. Communities, governments, and public safety officials must together identify and address their own vulnerabilities to hazards. Communities must identify and invest in their own networks of assistance and information, empower themselves, and enhance their own capacities to solve problems and to take charge of the direction of change. Governments must together with communities identify community strengths and capabilities, mobilise them to help the community to become self-sufficient, and also integrate them into the disaster response plan. Networks of assistance and empowering communities will increase the probability of community resilience to disasters and other stressors.

Relationships and networks

- Governments, the private sector together with communities must cultivate and develop pre-existing coalitions, organizational networks, cooperative agreements, and relationships long before a crisis or disaster occurs. Organizational plans should be explicit on how key constituencies will be involved. Relationships are crucial to the rapid mobilization of emergency disaster response and long term recovery, rebuilding, and provision of other ongoing support services for disaster survivors. Hence, developing effective relationships and networks will increase the probability of community resilience to disasters and other stressors.

Effective information and communication resources

- Governments, the private sector together with communities must cultivate and develop timely and trusted sources of information for fast decision-making such as early warning systems for risk communication with the community. Also, such information systems will be most valuable for coordinating multi-organisational response to disasters, and will thus increase the probability of community resilience to disasters and other stressors.

A coordinated public sector response

- A decentralised but strongly coordinated public sector response with a visible and strong leadership should contribute to community resilience. For instance, with the ADF, the State Premier of Queensland, and the Prime Minister of Australia governed by a single, comprehensive framework in domestic natural disasters (Aussasist), the response was well coordinated; and as a result increasing the probability of community resilience to disasters and other stressors.

Technical knowledge and competence

- Technical knowledge and competence are the knowledge and capabilities to perform specialized tasks related to a specific field. Technical knowledge and competency was for instance demonstrated by the “whole of care approach”. This was supplemented by the prioritised delivery of restoration and relief services, where the environmental, infrastructural, informational, emotional, financial, psychological, medical and nutritional needs of those affected were provided.

Summary and Conclusion

Resilience is a process that results in adaptation to a disturbance, or a stressor such as a disaster not stability, and definitely not an outcome. Stressors will probably result in short term periods of dysfunction before adaptation to an altered environment – a ‘new normal.’ Community resilience and wellness often emerge from a range of adaptive capacities such as resources with dynamic attributes such as robustness, redundancy, and rapidity. The networks of adaptive capacities such as resources often recombine, strengthen, weaken, evolve, and rebound. Hence, adaptive capacities are not a fixed condition that can be easily measured, captured or monitored because they possess dynamic attributes and relationships. They are also governed by political and economic factors. Networks of adaptive capacities can and should be designed into our communities by governments and planners to enable more resilient societies that can better withstand disasters as discussed in the paper.

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