

Overcoming drought vulnerability in rangeland communities: lessons from central-western Queensland

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Abstract. Drought and climate variability are an increasing global problem, especially in rangelands which may lack robust socioeconomic systems. Vulnerability is being applied in drought and climate change policy theory, by describing exposure and sensitivity factors, and adaptive capacity. In this paper we examine these vulnerability factors in central-western Queensland (CWQ), Australia, as a case study to test the idea that vulnerability and resilience must be considered together to build strong and enduring rangeland communities. The region's economy and employment are strongly coupled with rain-fed agriculture. Drought is a key risk to CWQ communities, with 13 extended droughts recorded since 1898. The region has been officially in drought since 2013 following well below-average rainfall, and remains in drought in 2019. The impact has led to reductions in town business turnover of 30–60%, loss of livelihoods and outmigration of 20%. Outmigration corresponds to the recent periods of drought. Social networks have been destabilised, highlighting that the cascading impacts of drought are complex, interrelated and affect the whole community. Regionally led responses have helped to re-build social cohesion, provide mental health support and stimulate economic activity and employment. These actions provide examples of a systemic, whole-of-community approach, that (1) captures place-based advantages; (2) enhances internal and external socioeconomic networks; (3) engages meaningfully through multi-level consultation; and (4) seeks to build sustained financial investment. A common theme of success is partnerships which provide external support for regionally-identified issues and solutions. There has been considerable investment of public, philanthropic and private funds in drought relief and infrastructure programs. This has occurred through a whole-of-community approach, and suggests a move towards policy which aims to build long-term regional resilience. CWQ has linked vulnerability and resilience by asking of both internally and externally led drought relief 'will this action build or undermine community resilience'. This approach could also be applied to the design of drought policies and responses in other rangeland regions.

Additional keywords: adaptation, pastoralist, resilience, regional policy, rural communities, small business.

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Introduction

Drought in rangeland environments can be prolonged and extreme, severely impacting on productivity and livelihoods (Wilhite 2000). A large proportion of the global rangelands are arid and semiarid, with low and variable rainfall which is often coupled with persistently high evaporation (Asadi Zarch *et al.* 2015). Drought is defined in many ways according to meteorological, hydrological, agricultural, industrial and socioeconomic parameters (Botterill and Fisher 2003; Wilhite *et al.* 2014) and there is a lack of international consistency (Botterill 2003; Wilhite *et al.* 2007). In this paper we adopt the definition of drought that has been standardised in Queensland research and extension services since 1991 where: severe drought is the driest 5% of calendar years; and moderate drought is the second driest 5% of calendar years (Clarkson and Owens 1991). This is consistent with the national Australian definition that drought represents the lowest 10% of rainfall years (BoM 2018).

The impact of drought varies across the world. Within nations dominated by subsistence agriculture, the lack of rainfall, water and impacts on agricultural production can be catastrophic – leading to the displacement of large numbers of people, refugee crises, famine, civil unrest and war (UNDP/UNSO 2000; ISDR 2007; CARE International 2017). Where market production agriculture prevails, drought in rangeland regions is more often associated with economic downturn, business closures, reduced labour markets, population outmigration, physical and mental health issues relating to poverty and distress and the erosion of services and human capital as impacts cascade through as socioeconomic drought (Edwards *et al.* 2015, 2009; Fritze *et al.* 2008).

Land degradation events often follow prolonged and severe drought (McKeon *et al.* 2004; Stafford Smith *et al.* 2007), leading to reduced regional agricultural productivity, reduced economic activity and reduced employment opportunities over long time

spans (Olston 2008; Productivity Commission 2017a, 2017b). The resultant loss of rangeland population and settlements is common to many OECD countries (Maru *et al.* 2007; Hospers and Reverda 2014).

Within Australia's rangelands, farm populations are low and dispersed, and most towns are small (Maru and Chewings 2008). These towns tend to have strong, or highly clustered, social networks (McAllister *et al.* 2008) through shared family ties, bonds of friendship and community services that contribute to a region's social capital (Besser 2009). Australia's drought policy moved towards a risk management approach in the early 1990s (Botterill and Wilhite 2005; Stone 2014), with a focus on enhancing farm productivity and farm business preparedness for drought. However, rural socioeconomic systems are also disrupted through drought (Botterill 2003), and yet the towns and communities that provide labour, services and social connectivity to the agricultural industries are generally not included in policy approaches. Australia's Productivity Commission (2017a, p. 113) recommended that, even though 'population decline and the loss of services affects the people remaining in these communities', government should not intervene to prevent the loss of small rural towns. Such policy creates strong tensions with the residents of smaller towns who have financial, intellectual and emotional investment in their local communities (Argent 2008; Sartore *et al.* 2008). It is also at odds with high productivity in many regions representing untapped economic potential (RAI 2017). It may be inevitable that changing circumstances will continue to lead to the concentration of economic activity and population into regional centres, but the residents of smaller towns would argue that this does not have to be at the expense of their own community; many tiny communities (e.g. Ilfracombe, Forrest 2003) have defied economic logic and survived. However, successive droughts inevitably increase the vulnerability of these towns and communities.

Low and declining populations contribute to rangeland communities being vulnerable to droughts, yet strong social capital and community networks help sustain these remote regions (Maru *et al.* 2014). Responses to drought are often 'crisis-driven', so fail to account for local socioeconomic characteristics, and result in short-term responses undermining long-term resilience, often in ways that may be apparent only to local residents. Focusing on short-term fixes without considering long-term effects leads to ineffective and inefficient investment of the public, private and charity funds mobilised to address the immediate issue.

A vulnerability framework (Kasperson *et al.* 2005; Adger 2006; Fussel 2007) has been proposed as a way of mitigating climate risks (IPCC 2014). Vulnerability is being used to assess the risks in drought-exposed regions around the world (Wilhite *et al.* 2007; Wilhite *et al.* 2014), such as north-eastern Brazil (de Assis de Souza Filho *et al.* 2016). This approach is emerging as a useful guide for governments and non-government aid organisations to prioritise investment.

Maru *et al.* (2014, p. 337) presented a linked vulnerability and resilience approach, recognising that 'people in remote regions demonstrate significant resilience to climate. . . variability' while paradoxically being 'chronically disadvantaged and therefore. . . among the most vulnerable to climate change impacts'.

They hypothesised that focusing on short-term responses risks leading to greater longer-term vulnerability (Maru *et al.* 2014).

In this paper we aim to build on this theme by exploring the idea that vulnerability and resilience must be considered together to build strong and enduring rangeland communities. A case study in central-western Queensland (CWQ) tests the utility of a regional vulnerability framework (Kasperson *et al.* 2005; Adger 2006; Fussel 2007) and to consider the implications of short-term drought relief actions on longer-term resilience. Evidence is provided through a lens of lived experience using quantitative and qualitative social research, drawing on regionally-relevant reports and media articles, and theory from peer reviewed articles relevant to regional vulnerability and resilience.

Defining vulnerability and resilience

Vulnerability and resilience are often seen as opposites, rather than complementary concepts in a systemic framework, as highlighted by Maru and colleagues (2014). Responses to address vulnerabilities are generally shorter-term, while building towards resilience tends to take a longer-term perspective. An integrated and coordinated approach is required to both overcome vulnerability factors and build resilience.

Vulnerability

Although a rich multidisciplinary literature on vulnerability of people to hazards has existed since the 1980s (Cutter *et al.* 2009), vulnerability is a relatively new concept in the climate change and drought literature. A framework to assess vulnerability of any kind can be applied at a regional level, where communities, towns, and local government areas (LGAs) share similar issues and constraints. The scale of profiling should accommodate both local and regional vulnerabilities, as identified by their communities.

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as 'the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity' (McCarthy *et al.* 2001, p. 995), which is pertinent to drought as one key attribute of a changing climate. This framework helps to profile their exposure and sensitivity to drought, and the adaptive capacity to build resilience.

The key elements of IPCC (2014) defined vulnerability are:

- (1) exposure factors – the extent to which the population and socioeconomic systems are exposed to external risks which cannot be controlled, such as the frequency and duration of drought, or volatile overseas markets;
- (2) sensitivity factors – the internal elements within a region which it can influence through adaptive actions. Sensitivity factors can mediate or exacerbate the impact of drought on the socioeconomic system. Sensitivity is characterised by technology and regional activities, such as a narrow regional economic base strongly dependent on rainfall, limited and poor planning around water security or economic contingencies, lack of alternative incomes, or marginalised populations. Sensitivity can vary according to

the magnitude, frequency, duration and extent of the hazard; and

- (3) adaptive capacity – the capacity of human capital and governance systems to maintain livelihoods, services and basic human rights during drought. Adaptation is the ability of socioeconomic systems to evolve in order to accommodate environmental hazards or policy change and to expand the range of variability with which it can cope. Adaptive capacity is strongly influenced by the build-up or erosion of the elements of social-ecological resilience (McCarthy *et al.* 2001; Adger 2006; Bhattacharya and Das 2007).

Identification of the exposure and sensitivity factors and the proposed adaptations need to be developed in consultation with local communities (Kasperson *et al.* 2005; Adger 2006). As such, this framework provides a systematic approach for local or regional governance groups to develop drought plans which account for the key elements necessary to overcome vulnerabilities and build resilience.

Resilience

Resilience is the ‘capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation’ (IPCC 2014, p. 5). We apply this definition in this paper to include the ambitions of a community to adapt and transform, progressing towards socially desired goals and values, similar to Maru *et al.*'s (2014) interpretation. Such a definition is appropriate in CWQ where the community has indicated a strong desire for improvement and adaptation rather than returning to the same pre-drought socioeconomic system (Kelly and Phelps 2019). In practice, resilience converges with vulnerability theory through on-ground actions. Vulnerability is often overcome with short-term actions, whereas resilience requires longer-term strategies, and these need to be complementary.

Linking vulnerability and resilience

In this we paper present a conceptual flowchart (Fig. 1) with a lack of rainfall initiating drought, with cascading effects through the three vulnerability theory elements of exposure factors, sensitivity factors, and adaptive capacity (IPCC 2014) – with a feedback loop of actions that reduce or increase longer-term resilience.

Regional exposure factors are ultimately expressed as socioeconomic impacts such as the loss of livelihoods and outmigration (Kelly and Phelps 2019). The severity of these impacts are moderated or intensified by the current sensitivity factors. The initial adaptive capacity of the region, which is embedded in the vulnerability elements of social capital, governance and livelihoods, then defines the drought response. A region with strong adaptive capacity may be more likely to choose and direct short-term actions to overcome vulnerability which also build resilience. A region with weak adaptive capacity may accept drought assistance regardless of the longer-term implications. This is represented as a feedback loop which reduces or exacerbates the region's sensitivity factors, further

moderates or intensifies the socioeconomic impact and ultimately builds or erodes resilience. This feedback loop has a strong corollary with the linked pathway of Maru *et al.* (2014), where vulnerability leads to reduced adaptive capacity and resilience builds adaptive capacity. Our conceptual pathway differs in being embedded within a vulnerability framework aligned with the global IPCC (2014) approach, and specifically applied to drought.

Adaptation to drought, degradation or other environmental challenges is most successful when locally identified solutions are supported by external actions implemented through strong partnerships. This is the most crucial step in the survival or collapse of civilisations at the global scale (Diamond 2005). This paper draws inspiration from this global view in exploring how both local/internal and external actions during drought can contribute to – or detract from – sensitivity factors and the resultant socioeconomic impacts. This is represented as the feedback loop within Fig. 1, and stimulates the simple question: ‘will this drought relief action undermine or build resilience in the locality and region where it is delivered?’

Critically, this question highlights the incompatibility of some short-term strategies to overcome vulnerability with long-term strategies to build resilience, for example, providing externally-donated goods for free, rather than purchasing locally for distribution. We explore how actions which focus solely on the short-term and address the current drought event in isolation are unlikely to improve resilience for future droughts, whereas those that focus on both the immediate needs as well as reducing sensitivity – such as through technological advancement to build resilience of current industries or to improve people's livelihoods – are much more likely to enhance regional resilience.

Profiling vulnerability in CWQ

As an example of the information useful to a regional vulnerability profile, the geography, current and historic socioeconomic activities and climate of CWQ are described. Then the vulnerability factors of exposure, sensitivity and adaptive capacity are described and linked to drought. Together, these provide a potential template to develop regional vulnerability profiles in other areas.

Background and European settlement

The case study region of CWQ straddles the Tropic of Capricorn in northern Australia. It starts 450 km inland from Queensland's coast and stretches 900 km further west until it reaches the Northern Territory border (Fig. 3). CWQ is within a semiarid to arid zone. Native vegetation ranges from tree and shrub-lands to open grassland which support extensive livestock grazing (Burrows *et al.* 1998) on family and (some) corporate farms. Pastoralism is the dominant land use, and land tenure is classed as leasehold (where crown land is leased on a long-term basis for commercial pastoral activities). The region is sparsely populated and classified as very remote (Kelly 2018). The largest town and regional centre is Longreach with a current population of 3000 residents (QGSO 2018a). The region includes the LGAs of Boulia, Winton, Longreach, Barcaldine, Tambo-Blackall and Barcoo, which coordinate service delivery and regional

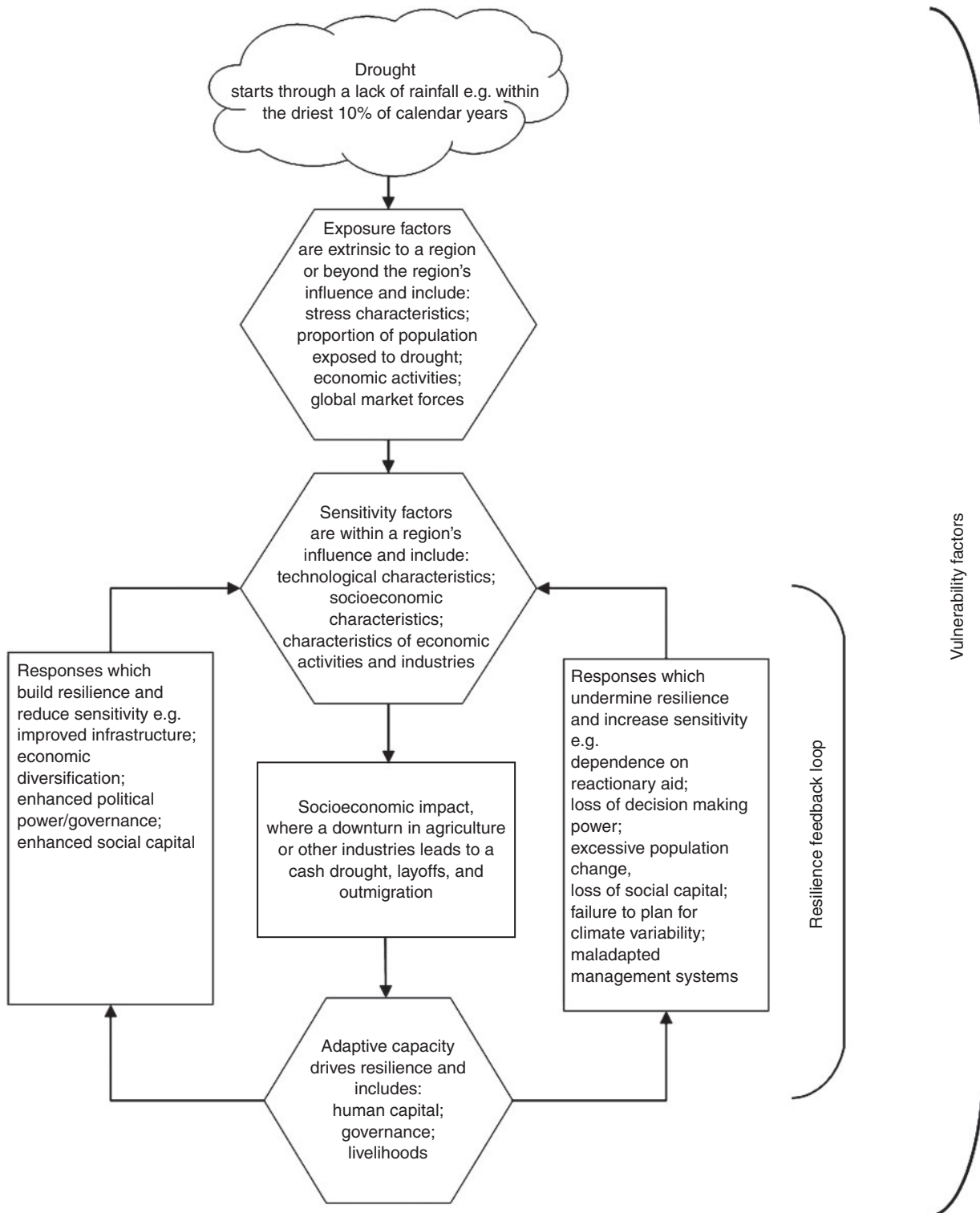


Fig. 1. Conceptual framework of drought, which starts through a lack of rainfall, with the extent of resulting socioeconomic impacts depending on the vulnerability factors of exposure, sensitivity and adaptive capacity. Subsequent socioeconomic impacts can be alleviated through responses that build resilience, or exacerbated by responses that undermine resilience within a feedback loop.

advocacy through the Remote Area Planning and Development Board (RAPAD) established in 1992 (RAPAD 2017).

European settlement grew quickly after the 1880s following the discovery of aquifers of reliable ground water (the Great Artesian Basin) in the early 1900s (Pegler *et al.* 2002), which allowed for large areas of native pastures to be grazed. Linked to this settlement were manufacturing industries and in Longreach these included a Cobb & Co. coach factory, Model-T automotive assembly, Qantas aeronautical factory, soft drink and beer breweries, and market gardening (Moffat 1987).

The region was perhaps at its richest during the wool boom of the 1950s, dominated by wool producing Merino sheep. Since the mid-1990s, sheep numbers declined due to poor commodity prices and reduced lambing rates through wild-dog predation and cattle numbers increased. Wool requires high labour inputs, and declining production led to reduced employment opportunities and greater exposure to more variable beef prices (Perkins 2013). The wool scours (processing factories) and sheep shearing services created employment for 200–300 residents in Longreach alone; and this population supported a school, shops, hotels and housing (Moffat 1987). The last of the wool scours was closed in the 1960s leading to further loss of livelihoods and outmigration (Forrest 2003).

Over the last 50–70 years, declining local industry and employment opportunities as well as improved technology has led to lower population in CWQ, a common story across agriculturally dependent regions in Australia (BITRE 2014; Productivity Commission 2017b). Overall, the regional economy – particularly the agricultural industries – is less diverse today than in was in the past. This translates into greater exposure to the key hazard of drought, with an over reliance on beef production.

The region's current economy and employment are still strongly coupled with rain-fed agriculture, accounting for 45% of town-based business activity and 26% of employment (QGSO 2018b). Pastoralists utilise services within their local towns for both business and personal needs, which in turn creates socioeconomic networks (Kelly 2018). Grazing of beef cattle (predominantly *Bos indicus* breeds) dominates a pastoral industry, followed by Merino sheep for wool production. Smaller agricultural industries within the region include sheep meat, the regulated wild harvest of kangaroos and goat production. The local value for beef cattle sales from CWQ was \$614.6 million from July 2016 to June 2017 (the Australian financial year), and wool was \$24 million (ABS 2017). There were 1.1 million head of cattle (MLA 2017a) and 485 000 sheep (MLA 2017b), which accounts for ~4% of the Australian cattle herd and less than 1% of the Australian sheep herd (MLA 2017a, 2017b).

The region is thus intrinsically exposed to factors that impact pastoralism. Drought is a key hazard not only to agricultural production, but also to the socioeconomic systems in towns and communities.

Drought and climatic variability

Like most semiarid to arid rangeland environments, CWQ experiences a high level of rainfall variability. For example, Longreach experienced 13 droughts of at least 24 months duration between 1898 and 2018 (Fig. 2). The severity of each

drought can be assessed using a 24-month moving window analysis, where the window is advanced one month at a time to determine the proportion of months within the 5th percentile of rainfall for the duration of each drought (Clarkson and Owens 1991). In the analysis, drought ceases once the rainfall exceeds the 10th percentile (Clewett 2005).

For Longreach, the most severe drought was August 2012 to May 2016 (Fig. 2). Well above-average winter rain between June and September 2016 provided relief, with conditions returning towards drought by February 2017 (Clewett 2005).

The Queensland Government officially declares drought for each LGA based on rainfall, on-ground pasture and water availability as advised by local drought committees. CWQ has been progressively drought declared since 2013 following well below-average rainfall (Long Paddock 2017a, 2017b) and remained drought declared in 2019 (Long Paddock 2019). The outlook is for continued below-average rainfall conditions (BoM 2019). Rainfall variability is expected to increase for CWQ under the majority of climate change scenarios (Stokes and Howden 2010), increasing the region's exposure to drought.

Rainfall across CWQ is summer dominant and high temperatures result in soil moisture loss through high evaporation rates and reduced potential pasture growth. In many areas infertile soils further constrain pasture growth. The resulting variability in pasture growth is extremely high and increases towards the south-west where it reaches a coefficient of variation of 1.5–2.0 (Fig. 3). This magnifies the exposure of pasture-based grazing businesses to drought, and of the risk to cascading socioeconomic impacts across the region.

Exposure factors in CWQ

The exposure factors for CWQ are summarised from official sources (e.g. OQTA 2018; QGSO 2018a, 2018b), lived experience and local knowledge in Table 1. The CWQ example could be used as a template for other rangeland regions to summarise their exposure factors and for prioritising actions to reduce sensitivity, improve adaptive capacity and thus build resilience.

Exposure factors reflect current socioeconomic conditions, based on stress characteristics, the population and the economic activities of the region. They will have developed over time as described in the previous section but can be mitigated (in the longer term) by policy designed outside the region or by activities developed within the region. The next section describes how communities are strongly linked to drought, and indicates other external factors which can influence exposure and exacerbate the impacts of drought.

Exposure to drought

Exposure discussed in this paper is characterised by the risk, frequency and duration of drought. Risks are high for pastoral enterprises, through the high frequency of drought. All pastoral businesses are exposed to periods of pasture shortages, with additional costs associated with feeding high value sheep and cattle as well as risks involved with selling livestock into oversupplied markets during drought. Other agricultural enterprises in the kangaroo and goat industries are similarly affected (Grigg 1987; Chapman 2003; Ampt and Baumber

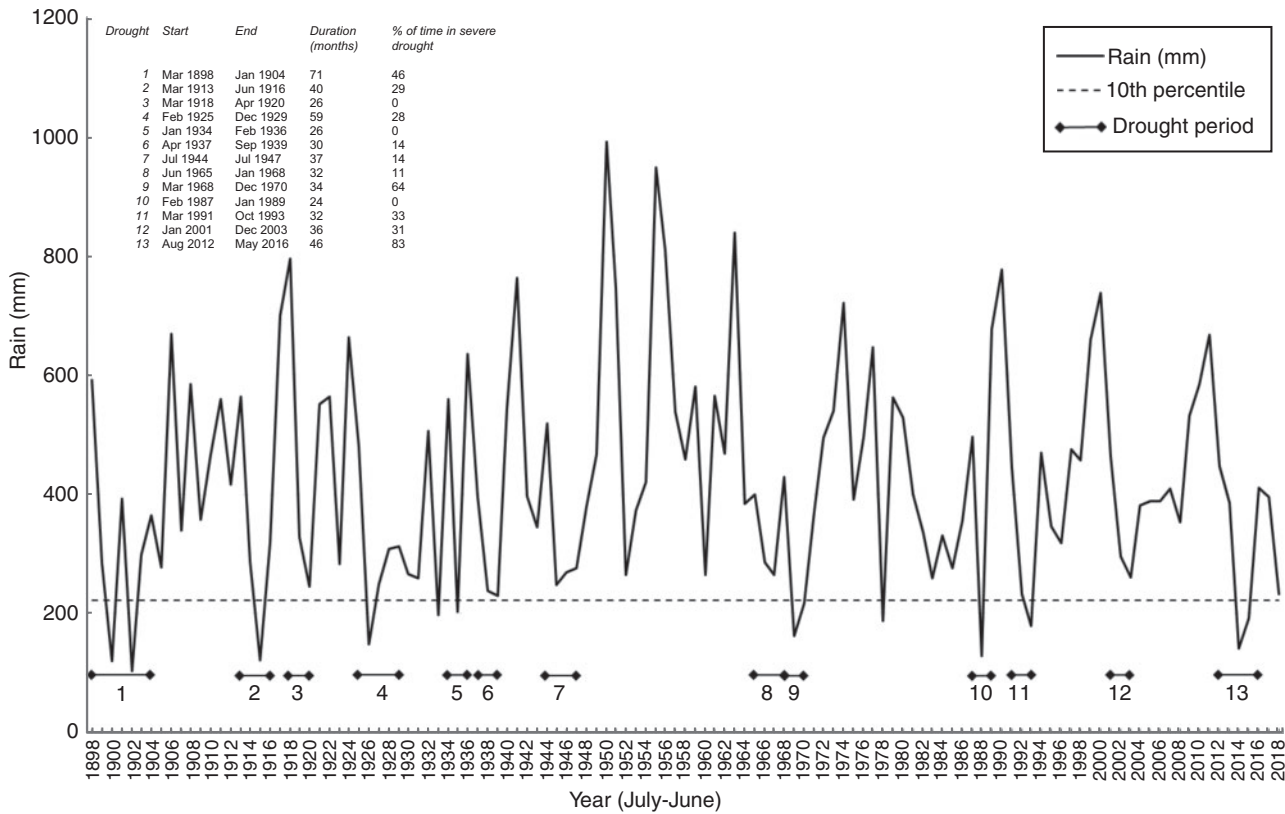


Fig. 2. Historic rainfall patterns and incidence of extended drought periods for Longreach, in central-western Queensland (Clewett 2005).

2006). This high exposure to the risk of suboptimal production or failure in agricultural systems in CWQ, leads to extremely variable cash flow (Drought Policy Review Expert Social Panel 2008). For example, the value of agricultural commodities produced in the Longreach region was \$84.6 million in the 2010–2011 financial year, before the current drought, yet only \$38.2 million in 2015–2016 (ABS 2017). The cascading effects of exposure to drought for communities are substantial (Kelly *et al.* 2017; Kelly 2018; Kelly and Phelps 2019).

This ‘cash-drought’ of the current drought (2012–2019) has led to a severe downturn in town economies with reduced town business turnover of 30–60% in Longreach, the region’s largest town (Kelly 2018). These mainly family run businesses are already facing structural challenges through increasing input costs such as electricity (Kelly 2018). The resulting domino effect saw local employment opportunities evaporate, unemployment rise and families begin to leave, seeking employment elsewhere.

Employment opportunities in CWQ are primarily dependent on the pastoral sector (e.g. farm manager positions) or indirectly dependent through secondary town service jobs (e.g. contract labour such as shearers, musterers, fencers) which rely on economic activity in the pastoral sector (details in Kelly and Phelps 2019). Although not to the same extent as agriculture, other employment is provided within health, education, construction and tourism (see details in work by Kelly and Phelps 2019), e.g. the accommodation and food service industries employ only 6% of the population (QGSO 2018b). These activities are largely decoupled from the impacts of drought.

Public sector services are indirectly linked to the risks of drought, as services are generally tied to the size of the population. With population out-migration the demand for services declines, the number of support staff (e.g. teachers) invariably declines as well (Kelly 2018).

The total out-migration from CWQ between 2011 and 2016 was 2250 individuals, ~20% of the population (see fig. 3 in Kelly and Phelps 2019). By 2016, 30% of all houses in Longreach were vacant and for sale or rent. School enrolments declined by 19% (Kelly 2018) and many social and sporting clubs struggled to maintain support (see Kelly and Phelps 2019). The cascading impacts of drought are interrelated and complex, not only affecting agricultural industries, but impacting the whole community.

Exposure to factors other than drought

In addition to drought, Australian beef and wool producers are exposed to multiple external factors outside their control (e.g. global and domestic beef prices). For example, most beef and wool is exported and the prices received are exposed to changes in exchange rates between major trade partners, to trade barriers, to declining terms of trade, and to market volatility (Browne *et al.* 2013; Ash *et al.* 2015). Other agricultural industries are also affected, such as the kangaroo industry which is exposed to a high risk of market suspension through trade barriers (Mawson 2010) or lobbying from conservation and welfare groups (Hamilton-Smith 2018).

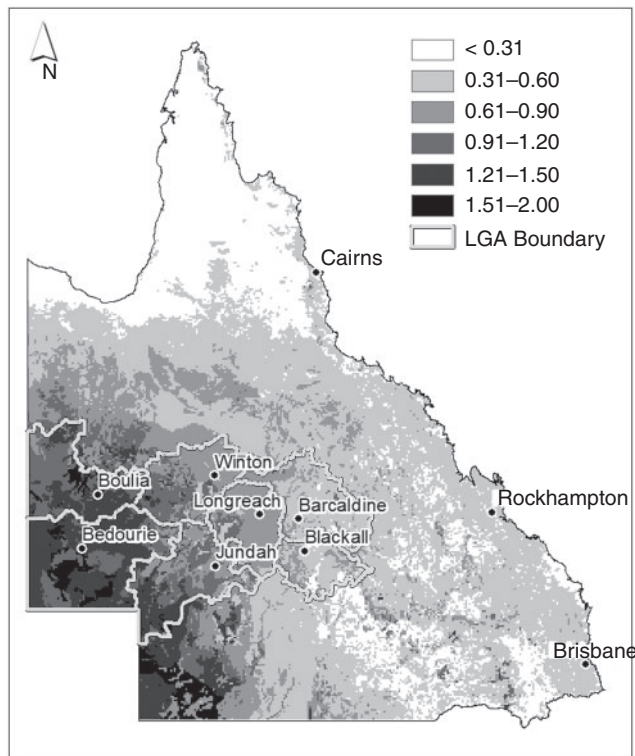


Fig. 3. Coefficient of variation of annual pasture growth in Queensland (shaded categories). The central-western Queensland (CWQ) local government areas (LGA) that comprise this case study, and their administrative centres, are indicated. Data source: Queensland agricultural land audit (Agriculture and Fisheries 2018a, 2018b).

The broader context of socioeconomic activities is also important, and the way in which these interact with drought. For example, grazing businesses would normally increase financial reserves during a series of higher rainfall years. In the lead up to the current drought several factors such as an oversupply of cattle across northern Australia (Perkins 2013) led to poor cattle prices. This prevented savings and debt levels increased quickly as the drought progressed (AgForce 2015; QRIDA 2017). The north Australian beef industry also has constraints to viability e.g. due to high input costs, which need to be addressed through policy, research and extension services and capacity building (Hunt *et al.* 2014; Holmes and McLean 2017).

Remoteness is a key exposure factor limiting population growth. Rangeland towns are often perceived as less desirable locations to relocate to by city and coastal residents, for example due to the long distances (>500 km) to urban services.

These factors are very interrelated with complex cascading effects (see fig. 4 in Kelly and Phelps 2019), it is impossible to determine the relative impact of any individual factor, such as drought. These additional exposure factors also need to be considered when describing the region's sensitivity factors and options to build resilience.

Sensitivity factors

Sensitivity factors are those able to be mitigated by technology (e.g. infrastructure and telecommunications to support the

socioeconomic system) and regional activities (pastoralism, public services, construction, tourism and minor agricultural industries) to buffer against the exposure to drought. In CWQ, sensitivity to drought is high. We conceptualise (Fig. 1) that sensitivity is strongly influenced by the short-term actions taken during drought, for example, responses that build long-term resilience also reduce short-term sensitivity.

As highlighted earlier, diversification is lower in the 2000s than it was in previous decades. Employment opportunities are limited, and certainly decline further during periods of drought. The population of CWQ is sensitive to the impacts of drought as a high proportion (28.1%) of residents classified as 'most disadvantaged', compared with only 18.4% in eastern Queensland (QGSO 2018a). Reflecting this, education levels are relatively low, with 46% of residents having completed year 11 or 12, compared with 60% for eastern Queensland (QGSO 2018a). Although there is limited access to tertiary education in the region, Longreach State High School has won numerous awards and recognition for excellence in academic and trade traineeship (Harris 2011; Queensland Government 2017) and the Rotary Club of Longreach have provided youth training opportunities to build community leadership. These are some examples of the local community's adaptive capacity.

Adaptive capacity

Adaptive capacity is the ability to maintain livelihoods, services and basic human rights – in this context during drought. It is characterised by high human capital and robust governance systems, and is determined by how well individuals, groups and industries respond to droughts, volatile markets or other stress factors. This section explores the adaptive capacity of CWQ, emerging and potential industries that can contribute to resilience and describes the effect of existing policies and actions during the 2012–2019 drought on resilience within CWQ.

CWQ has demonstrated capacity to recover from drought and extreme events since at least the 1960s. This suggests the region is capable of mitigating the socioeconomic impacts of drought by concentrating on responses which address sensitivity factors and build resilience. In the early 1900s the pastoral industry and some towns (e.g. Winton, Barcaldine and Blackall) mitigated risks through the sinking of bores to access good quality underground water in the Great Artesian Basin (Pegler *et al.* 2002). In the past 12 months, local governments have boosted supply to regional towns with further bores.

Adaptive capacity is also demonstrated by visionary community leaders who fostered the local tourism industry in CWQ following the 1960s drought (Moffat 1987). The early rural history of the region has been highlighted at museums such as the Stockman's Hall of Fame (celebrating Australian rangeland pioneers) and the Qantas Founders Museum (a tribute to the origins of Australia's international airline). Such attractions provide reasons for tourists to stay longer, and in 2004 such tourism activity added \$136 per person per day to the local economy (Greiner *et al.* 2004).

Outback tourism now makes a strong contribution to the regional economy; growing at a rate of 9.5% per annum, with a record 886 000 visitors to the outback in 2017 and a total value of \$573 million (Tourism and Events Queensland 2017). This is

Table 1. The drought vulnerability profile of central-western Queensland, based on describing: exposure factors (stress characteristics, degree of exposure of the population and economic activities); sensitivity factors (socioeconomic, technological and economic activity characteristics); and adaptive capacity (human capacity, governance and livelihoods) based on official sources (e.g. REMPLAN 2017; QGSO 2018a, 2018b; OQTA 2018), lived experience and local knowledge

Factor/Region	Central-western Queensland (CWQ) factors
	<i>Exposure factors</i>
Stress characteristics	Very high exposure: semi-arid to arid zone with high rainfall variability and increasing temperatures and evaporation; agricultural terms of trade continuing to decline; town economies dependent on agriculture and thus also exposed to declining terms of trade in addition to global business factors such as on-line shopping; relatively low and unstable population, where the loss of one family can lead to the closure of a local school and a domino effect of loss of services
Exposed population	Very high exposure: 60% living in very remote areas; relatively low public and private service availability, vulnerable to shocks such as out-migration or policy changes to service delivery based solely on micro-economic factors; relatively low levels of education; relatively low access to local tertiary education; high indigenous population disadvantaged by a number of factors; relatively low numbers of professional positions, career paths and external peer networks
Exposed activities	Very high exposure: 45% of all businesses directly involved in agriculture, and agriculture directly exposed to the high risk of meteorological drought, tempered by availability of underground water from the Great Artesian Basin
	<i>Sensitivity factors</i>
Socioeconomic characteristics	High sensitivity: 25.7% of regional population employed in agriculture; the population of the region has shrunk through the loss of the sheep and wool industry; minor economic benefit from the mining boom; reduced diversity in economic base over last 50 years (e.g. the loss of aeronautical and vehicle manufacturing and wool processing); high percentage of population disadvantaged through poor access to tertiary education, low median income and other factors
Technological characteristics	High sensitivity: poor telecommunications, <2% land mass covered by mobile network; slow rollout of the NBN; on-farm technology expensive, with strong desire to utilise new technology; in town access to technology and training expensive
Characteristics of the activities	Many factors lead to high on-farm sensitivity to drought: rain-fed pasture systems supporting grazing, with no option for mitigation through irrigation; feed substitution (e.g. hay) is expensive; reduced capacity to naturally rebuild herd/flock through breeding following forced sales in drought; high freight costs due to long-distances to market; low businesses skills a barrier to increased profitability in many instances Very high sensitivity in most town business: sales of goods and services highly dependent direct to farm business and non-essential during cash drought e.g. contract mustering, motorbikes, fencing materials, hair dressers; main street business high sensitivity with majority of sales to farm sector directly or indirectly e.g. groceries, fuel, but with less dependence during peak winter tourist season: global forces, such as on-line purchasing: tourism – transient population of visitors, high age and risk of non-return due to ill health; tourism – exposed to exchange rate (overseas may visit more if AUD low, but low AUD leads to more Australians travelling overseas instead of domestically): in-transit population with long-haul road transport, military and other through traffic
	<i>Adaptive capacity</i>
Human capacity	Despite a low and disadvantaged population, there is a very high adaptive capacity due to: incubator conditions which lead to commonplace innovation and self-reliance; social capacity (e.g. CWQ has twice the level of volunteering as the rest of Queensland); high levels of interconnectedness and trust On-farm adaptive capacity includes: a strong to moderate desire to prevent resource degradation; increasing ability to control total grazing pressure through exclusion fencing; increasing ability to exclude predators through fencing; experience through managing previous droughts

Table 1. (continued)

Factor/Region	Central-western Queensland (CWQ) factors
Governance	Currently high adaptive capacity, historically high with periods of lesser leadership: visionaries established tourism industry, brought electricity grid to region, agricultural training and research facilities; other periods where local leadership increased vulnerability e.g. closure of bore water system; current development of a drought mitigation plan for future resilience; off-set by poor political influence at State and Federal levels through low number of electoral seats based on low population
Livelihoods	Highly variable adaptive capacity, with above average wages and low unemployment, but a highly transient population of seasonal workers in both agriculture (e.g. contract shearers and musterers) and tourism (e.g. kitchen staff and tour guides), currently more vacancies in tourism sector than can be filled locally

similar to the value of agriculture during the drought, but much less than agriculture in the good years (change in turnover by industry sector is indicated in Fig. 2 in Kelly and Phelps 2019).

Tourism has provided opportunities for pastoralists and the region to diversify. One pastoral business which responded during the Millennium drought has expanded from a river cruise to include an outdoor show, cafe, a shop, a horse drawn coach trip, a farm stay and a cruise on an old paddle wheeler (Radio National 2015). Another has established an Outback Yacht Club in conjunction with a new tourist business on their sheep and cattle station (Radio National 2016a).

However, a successful tourism industry should not be taken for granted. The domestic tourism period is generally confined to the months of April–September (Kelly 2018) as southern based Australians seek warmer temperatures but avoid the hot temperatures of the summer. Domestic tourism is road-based and thus sensitive to fuel prices. There is a current skills shortage in tourism, which is expected to intensify as the industry continues to grow, exacerbated by high tourism business staff turnover (TRA 2015; QTIC 2017). In CWQ, retail trade and accommodation and food services each have ~40% part-time workers, compared with 10% within agriculture. Skills and other issues will need to be addressed for the outback tourism industry to continue to build the region's drought resilience.

An innovative partnership between James Cook University (JCU), the Mount Isa Centre for Rural and Remote Health and the Central West Hospital and Health Service has established a clinical teaching facility in Longreach (James Cook University 2016). This increases the capacity for JCU students to experience generalist medical training in CWQ (James Cook University 2018) and improves the retention rate of medical staff in rural and remote locations (Dolea *et al.* 2010). Aged care facilities in the major towns provide opportunities for elderly residents to stay and maintain social networks, and contribute to the retention of social capital (Kelly 2018), as well as economic capital through government pensions provided to older people. Adaptive capacity can sometimes make substantial change to the local systems.

An example of effective agricultural policy driving adaptation is the Farm Management Deposits (FMD) scheme. This scheme was established by the Australian Government to reduce risk and smooth farm income over time (Australian Government 2019). Its use has increased within Queensland's beef industry (QRIDA 2017), with money from cattle sales during drought set aside for re-purchasing livestock under improved seasonal conditions. Policies such as this scheme

create opportunities for industries to transform the way they operate, and could be applied to build community and regional resilience.

Transformative adaptation

Transformation (defined as 'a change in the fundamental attributes of natural and human systems' IPCC 2014) is an essential aspect of resilience (Walker *et al.* 2004; Bahadur 2016) and extends beyond current adaptive capacity. The Productivity Commission (2017a) highlighted the importance of diversifying the regional economic base to create jobs, grow the regional population and ensure long-term adaptive capacity. There are examples of innovations emerging in CWQ with the potential to transform the economic base and maintain livelihoods, services, basic human rights and building human capital.

Pastoralists, indigenous corporations and cooperatives have engaged in Australia's carbon economy, with 16 Emission Reduction Fund projects in CWQ as of early 2018 (ERF 2018). Total estimated earnings to date are approximately \$425 000 through the generation of 32 732 Australian carbon credit units (ACCUs). Each ACCU equals one tonne of carbon dioxide equivalent (tCO₂-e) stored or avoided by a project, and an assumed price of \$13/tCO₂-e. The potential exists for more carbon sequestration (Witt *et al.* 2011; Gowen and Bray 2016). However, other rangeland regions are expressing concerns over the risk of perverse outcomes from carbon projects, with the potential for large areas of land to be purchased by urban investors and disengagement of land from the pastoral industries. This could reduce employment opportunities, divert economic activity towards corporate owners and reduce regional resilience through reduced regional income and population outmigration (Cripps 2018a).

Large solar farms have been established in CWQ at Barcaldine and Longreach, with a total investment of approximately \$100 million (CEFC 2018; Vorrath 2018). The longer-term contribution to the regional economy or employment is uncertain, but in Longreach the construction phase provided 30 jobs over 6–9 months (Queensland Government 2018). The potential for solar, and other renewable (e.g. geothermal, wind and biofuel) energy generation industries across Australia's rangelands is vast and largely untapped (Pittock 2011). The sector could contribute significantly to the future CWQ economy.

Improved telecommunications could help grow new industries. Investment in innovations such as shire-wide Wi-Fi coverage has boosted agricultural technology uptake and

Table 2. Government, community and philanthropic responses during the 2012–19 drought in central-western Queensland and potential impact on vulnerability and resilience

Response	Short-term immediacy or long-term structural	Impact on vulnerability (sensitivity factors and adaptive capacity)	Impact on resilience
		<i>Farm business</i>	
Farm household assistance	Currently short-term, could transform to structural	Reduced short-term sensitivity; potentially longer-term dependency and reduced adaptive capacity	Currently dependent on individual business outcomes; Potential to increase if implementation encourages self-reliance
Low-interest rate loans	Both	Improved adaptive capacity when encouraging business growth	Dependent on individual business outcomes
Freight subsidy on stock movements	Short term	Encouraging early destocking to improve land condition will improve long-term adaptive capacity, whilst potentially reducing short-term cash flow	Dependent on policy implementation and individual business responses
Reduced cost of feed supplements for production (e.g. freight subsidies or donated lick blocks)	Short term	Reduced sensitivity when used to maintain animal productivity and not incentivising overgrazing of vulnerable pastures	Generally enhanced by maintaining animal productivity, welfare and farm income
Reduced cost of substitution feeds (e.g. freight subsidies or donated hay)	Short-term	Increased sensitivity when incentivising overgrazing of vulnerable pastures and eroding land condition; Decreased when incentivising destocking e.g. ensuring stock are in adequate condition for transport	Generally reduced through reduced land condition and reduced long-term carrying capacity; May be enhanced if promotes de-stocking (e.g. hay for stock in yards awaiting transport)
Donated goods and services	Short-term	Increased sensitivity if displacement or market distortion is sizable enough to impact on local business; Decreased adaptive capacity if leads to dependency over the long-term; or Improved adaptive capacity if donations allow business to re-build, or provides a mental-health boost	Generally reduced but dependent on level of displacement (e.g. one pallet of groceries to a small one-shop town c.f. a major centre); Goods which do not displace local business (e.g. e.g. luxury items with intrinsic personal value) may be neutral or possibly increase resilience through boost to mental health
Farm business advice, education and extension services	Both	Improved adaptive capacity through skills, knowledge and decision making	Generally enhanced but dependent on level of uptake and implementation
Co-investment in water infrastructure	Both	Improved adaptive capacity by enhancing land condition when used to spread grazing pressure more evenly across paddocks	Generally enhanced by improving grazing efficiency; Could be reduced if promotes over-grazing into previously inaccessible areas
Co-investment in wild-dog exclusion infrastructure	Both	Improved adaptive capacity by improving management and business options	Generally enhanced by enhancing animal production, reducing total grazing pressure and allowing implementation of pasture rest
Mental health service provision	Both	Improved adaptive capacity and decreased sensitivity for community and business	Generally enhanced by improving community resilience, business decision making capacity
Boarding school fee subsidy	Both	Decreased sensitivity for individual farm families by off-setting costs coupled with potentially improved adaptive capacity through education outcomes; Increased sensitivity for community through erosion of regional services (less students, less resources); Decreased adaptive capacity (potentially) through detaching younger generation from their community	Short-term increased to individual families; Potential improved community or business resilience if educated children return to the region; long-term decreased to community if local education standards decline, and boarding school educated children fail to return to the region
Farm Management Deposits (FMD)	Both	Decreased sensitivity by providing a financial instrument to manage variable seasonal income	Generally enhanced
5-year tax smoothing	Both	Decreased sensitivity by providing financial instrument to reduce cash-flow impediments	Generally enhanced

Table 2. (continued)

Response	Short-term immediacy or long-term structural	Impact on vulnerability (sensitivity factors and adaptive capacity)	Impact on resilience
Direct cash donations to farm families (e.g. Western Queensland Drought Appeal, Rotary drought fund, Aussie Helpers drought card, Drought Angels drought card)	Short-term	Decreased sensitivity through local purchase of essential goods and services, stimulation of local economy, can be ad-hoc or limited in extent depending on incoming donations	Generally enhanced through mental health, essential purchases, flow on to local town business and community
Direct bill payments on behalf of farm families (e.g. CWA drought fund)	Short-term	Decreased sensitivity through local purchase of essential goods and services; Some risk of creating dependency and undermining adaptability	Generally enhanced through mental health, essential purchases, flow on to local town business and community; Some risk to reducing adaptability
Donated Q-Fever vaccination program (Longreach Rotary and Qld Health)	Both	Decreased sensitivity by reducing risk to farm labour and management productivity	Generally enhanced
Town agricultural and 'main street' business Business advisory services	Both	Decreased sensitivity but currently ad-hoc or limited in extent or longevity	Generally enhanced with flow-on benefits to community (increased employment, improved services to town and farm)
Business practice improvement (education and extension services)	Both	Improved adaptive capacity but currently ad-hoc or limited in extent	Generally enhanced with flow-on benefits to community (increased employment, improved services to town and farm)
Direct donations to town-business families (e.g. Church collective, Western Queensland Drought Appeal, Australian Government hardship fund)	Short-term	Decreased sensitivity through local purchase of essential goods and services, stimulation of local economy	Generally enhanced through mental health boost, essential purchases
Co-invested support of agricultural businesses (e.g. Baptist Church and farm business co-funded rural contractors)	Both	Decreased sensitivity through local purchase of essential goods and services, stimulation of local economy	Generally enhanced with flow-on benefits to community (increased employment, improved services to town and farm)
Tourism development	Both	Decreased sensitivity and improved adaptive capacity, with the caveat that infrastructure and services need to be planned or high-transient population can drain local resources	Generally enhanced for town business and community, with some individual farms benefitting
Sponsorship of events	Short-term Potential for long-term if linked to specific outcomes e.g. mental or physical health	Decreased sensitivity if local purchase of essential goods and services; Potential for increased if displaces local goods and services	Generally enhanced
<i>Community</i>			
Drought specific grants (e.g. FRRR Tackling Tough Times Together)	Both	Decreased sensitivity and improved adaptive capacity	Generally enhanced through improved facilities, locally relevant projects and stimulating local economy and labour force
Philanthropic community service projects (e.g. Outback Links modernising of Longreach Show pavilion)	Short-term emphasis, with potential long-term benefits	Decreased sensitivity but can be ad-hoc	Generally enhanced through improved facilities and local purchase of goods, with the caveat that careful coordination is needed to reduce displacement of local business services
Community inclusiveness (e.g. pop-up movies in the paddock, drought relief concert tours, community BBQs by Rotary, Lions, CentaCare)	Short-term emphasis, with potential long-term benefits	Decreased sensitivity by maintaining social connections	Generally enhanced by uniting farm, agricultural and town communities

(Continued next page)

Table 2. (continued)

Response	Short-term immediacy or long-term structural	Impact on vulnerability (sensitivity factors and adaptive capacity)	Impact on resilience
Youth leadership programs (e.g. Longreach Rotary, Longreach Regional Council)	Both	Improved adaptive capacity but currently ad-hoc or limited in extent	Generally enhanced by expanding future leadership capability
Arts programs	Both	Improved adaptive capacity, decreased sensitivity by maintaining social connections	Generally enhanced for community
General health services	Both	Improved adaptive capacity	Generally enhanced by improving quality of life and working life-time, through direct economic benefits of employment and embedding professionals within community service groups
Local education services (primary and secondary)	Long-term	Improved adaptive capacity	Generally enhanced by increasing community knowledge, employment opportunities and innovative capacity, through direct economic benefits of employment and embedding professionals within community service groups
Local education services (tertiary)	Long-term	Improved adaptive capacity	Generally enhanced by increasing community knowledge, employment opportunities and innovative capacity, through direct economic benefits of employment and embedding professionals within community service groups

enhance tourism experiences (Cripps 2017). This represents regionally driven innovation to address a lack of access to mobile phone and internet services (Telstra 2018) and the desire to connect business globally (RAPAD 2018). Improved internet services delivered to farms by the ‘Sky Muster’ satellite in late 2016 (Francis 2016) has facilitated the development of off-farm income and diversification, for example into clothing manufacture, speciality meat supply, and on-line fitness coaching businesses (Cripps 2016; MacTaggart and Wee 2016; Radio National 2016b; Anon 2017; Walker 2017). Further communications advances will increase opportunities for farm and town based businesses to diversify into global markets and build drought resilience (Kandulu *et al.* 2012). These examples highlight current and emerging adaptive capacity through tourism growth, public–private partnerships, the use of technology in agriculture and governance.

A critical threshold for resilience

Recent reports by the Productivity Commission (2017a, 2017b) suggest the adaptive capacity across the region is variable and at risk of declining. Short-term actions can move a region away from – or closer to – a critical threshold for recovery during drought, but longer-term actions and trends can also increase or decrease the region’s resilience through sensitivity factors (Berkes *et al.* 2003; Walker *et al.* 2004). CWQ may be on the cusp of a critical threshold (Productivity Commission 2017a, 2017b), and actions taken during the current drought are of long-term importance. Overall, CWQ was ranked towards the top of a group of regions with below-average adaptive capacity, with

population decline a key concern (Productivity Commission 2017a). An initial finer scale analysis suggested that the Longreach Regional Council has above-average adaptive capacity (Productivity Commission 2017b). These results suggest variable adaptive capacity within the region with some towns improving while others declining, and the need to assist CWQ to improve its adaptive capacity.

There are no local data to gauge the adaptive capacity of the region at the onset of the current drought. Local lived experience provides some examples. In 2012, the Longreach Rotary Club had less than 15 members, weak links across the Rotary International network and a focus on localised community projects, for example, local fundraising for small hospital upgrades. There were regional examples of adaptation, with RAPAD and the Natural Resource Management group (Desert Channel Queensland) delivering innovative and highly regarded services across CWQ (Kelly 2018). In line with many Australian regions, local anecdotes suggested fundraising for organisations and community groups was increasingly difficult as the regional economy contracted rapidly during the drought conditions (Kelly 2018). These anecdotes broadly support the indication of a region on the cusp of dropping further down the rankings of poor adaptive capacity (Productivity Commission 2017a, 2017b), and suggests urgent transformation is needed to build resilience.

All investment should aim to build resilience

Building regional resilience for the future will require a combination of sustained policy measures and investment to reduce the exposure and sensitivity of CWQ to drought, climate

change and agricultural market volatility. It will be crucial to focus on investment that delivers long-term resilience, even when addressing short-term needs, and provides stability in resourcing and partnerships at local, regional, state and national levels (Kelly and Phelps 2019). The major economic activities of grazing beef, sheep and of tourism need to be strengthened through private and public investment and continuously striving for product excellence. Beef and wool price cycles are relatively independent (Grain and Graze 2018), and tourism is less sensitive to the impacts of drought than agriculture. However, the evidence from the current drought's socioeconomic impact suggests that existing industries are unlikely to moderate the impact of future droughts, and that the region needs a more diverse economic base to sustain livelihoods (Kelly 2018). Drought responses should build the adaptive capacity of the region to reduce vulnerability and improve future resilience. The ways in which short-term actions may build or erode resilience are explored in the next section.

Vulnerability and resilience links during the 2012–2019 drought

The ways in which the community responds, coupled with actions from outside the region, modifies sensitivity to current and future droughts. Resilience may thus be undermined or strengthened – perhaps even simultaneously – by the feedback of socioeconomic responses to drought into sensitivity factors (Fig. 1). This section explores the implications of intra-regional (lead or undertaken within CWQ) and extra-regional (brought into, or imposed upon, CWQ) short-term drought relief actions on longer-term resilience. An overview of actions that build versus erode CWQ resilience are provided in Table 2 and key examples are explored in the following sections.

Intra-regional actions

The CWQ community responded to the drought by establishing new governance structures, strengthening internal and expanding external networks, learning adaptively and implementing a whole-of-community approach.

Locally led governance helped to create, improve or transform organisations which have developed in response to drought. The Central West Rural Wellness Network (CWRWN) was created in response to the potential for increased mental illness and suicide during drought (Page and Fragar 2002; Edwards *et al.* 2015; Hart *et al.* 2011; Ebi and Bowen 2016). The CWRWN later deliberately improved by expanding its charter to build regional resilience. This group has become influential in coordinating a range of mental health and allied services under new delivery models. They also secured financial support services for town businesses, where previously this was only available to farms (Taffa 2015) – thus meeting a critical gap identified by the community. One organisation that transformed is RAPAD who consulted the community to develop local strategies for regional resilience (Cole 2016) and identified six priorities to grow the region (RAI 2017). These have informed local government actions and policy positions for engagement with state and Australian governments.

The CWQ community identified a need for improved governance after observing disjointed, uncoordinated, often

naïve and inappropriate crises-driven drought relief increasingly imposed by groups from outside CWQ (Kelly 2018). Churches, charities, service clubs, local and state government staff together raised concerns that external organisations were inadvertently undermining resilience through a lack of local engagement. Local groups started to seek complementary actions to address these issues. A well-attended public meeting led to the formation of the Western Queensland Drought Committee (WQDC) to help provide advice and coordination for philanthropic drought assistance (WQDA 2017) and document the impact of drought on town business and the community (Queensland Rural Debt and Drought Taskforce 2016). The improved coordination and identification of gaps allowed local groups to direct efforts towards maintaining business activity, employment opportunities and the population. For example: the WQDC distributes donations through pre-paid gift cards to farm and small-business owners to spend locally; the Longreach Baptist Church provided financial assistance for pastoralists to employ farm contractors to retain families in the region; the Uniting Church distributed emergency funds to town families facing financial distress. These actions reduce financial stress on families and concentrate funds into local businesses (Moore and Moore 2016). The estimated multiplier effect of the injection of new cash from outside a region ranges from 1.2 to 3.2, and flows through a regional economy to benefit more than the primary or secondary recipients (Domański and Gwosdz 2010; Stoeckl *et al.* 2007). The need to boost the cash economy was identified through locally-led governance and strong networks.

The strongly interlinked networks of CWQ have also helped facilitate the enhanced governance. For example, in Longreach, individuals are often members of a service club, church, parents and teachers association, sport or art club, and employed locally within small business, local or state government. These overlapping memberships and personal relationships mean people are often strongly connected with groups they are not members of, and information sharing is strong. These connections provide capacity to expand networks both within the region and outside the region through existing structures. The Uniting Church, Rotary International, Lions Clubs International and state government staff have allowed more effective communication between many extra-regional groups. The actions support the assumptions made by Stafford Smith and Huigen (2009) that intrinsic and extrinsic networking (Maru *et al.* 2007) are needed to improve rangeland socioeconomic systems.

Adaptive learning has improved the local and regional responses to drought. For example, the Longreach Rotary Club adopted a policy of reviewing every drought action to ensure it would help overcome sensitivity. It began to focus on building community resilience and social cohesion through special events such as outdoor movie and BBQ evenings. The Rotary Club's initial response of delivering hay, work boots and donated hampers direct to farmers, was displacing sales from local business. Potentially affected local family businesses were consulted and the future strategies emphasised the importance of assisting the local community by stimulating economic activity through cash donations, or purchasing hampers and other goods locally. Overall, the Longreach Rotary Club sought to continuously improve its approach and has helped move charitable responses away from a disaster relief model towards

overcoming sensitivity and building whole-of-community resilience.

CWQ has also learnt the importance of influencing the public narrative, and not allowing the region to be presented as a helpless victim in the face of adversity. Local media coverage has been encouraged to focus on stories which reinforce the adaptive capacity of CWQ, providing positive advocacy.

The pragmatic focus on whole-of-community support spread throughout the local community groups, local government, regional networks and locally-based State agency staff through established network linkages. External networks, advocacy and media attention were then able to carry the momentum into the Queensland and national discourse (Cripps 2018b, 2018c).

Extra-regional actions

The unified regional voice and community advocacy in CWQ has led to support from governments at all levels as well as from other organisations. An estimated \$2.5 million in philanthropic financial support has been attracted into the region through direct donations (WQDA 2017). A range of grants for targeted community projects, such as providing youth access to leadership training (FRRR 2018), has also been secured.

Longer-term solutions have been supported by the Australian and Queensland Governments, and included several investments to address both long-term and short-term needs, including:

- \$7.6 million grants to reinvigorate the CWQ sheep and wool industry, through building wild-dog proof fences to protect sheep. By providing local employment to build fences and the anticipated growth in wages for shearing, crutching has the potential for \$96 million total benefits to CWQ (Perkins 2013), a 25% increase in agriculture's economic contribution; and
- Longreach Regional Council secured a one-off loan of \$17.9 million from Queensland Treasury Corporation under an innovative scheme where council builds fences on the behalf of pastoralists, who repay construction costs through their rates over a 20-year period (Perkins 2013; Longreach Plus More 2016; Murray 2016). Increased capital works expenditure to \$8.2 million, and \$15 million in local wages, contributes to economic resilience (LRC 2018).

These responses have all addressed key issues identified from previous droughts, research and consultation with the local communities.

This is perhaps the first time that drought relief *per se* has been directed through a whole-of-community approach within Australia and suggests a move to policy which aims to build long-term regional resilience. It also suggests a move by the Queensland Government, the academic sector and others to engage meaningfully through multi-level partnerships (Davies and Holcombe 2009). These partnerships and improved investment are key aspects of the systemic approach called for by Stafford Smith and Huigen (2009) to build resilience in rangeland areas. While there are early positive signs for CWQ, it is too early to indicate how well this long-term investment will be sustained and what lasting benefits it will deliver.

Short-term strategies also have a place in overcoming vulnerability. The Queensland Government committed to retain short-term drought support measures for affected pastoralists during the 2015 election campaign, with grants delivered

to community projects, funding for mental health support continued commitment to the Drought Relief Assistance Scheme (DRAS) to provide freight subsidies and assistance for new water infrastructure and deliver extension services through a new Drought and Climate Adaptation Program (DAF 2018). Strong public empathy is evident when severe and extended drought impacts on farming livelihoods. However, this generally leads to *ad hoc* responses from different levels of government, the charitable and aid sector, which may not build long-term resilience.

Crisis-driven responses, although of immediate benefit, can increase regional sensitivity by displacing local business, e.g. free goods provided from outside unfairly compete with locally available goods, thus impacting on local-business viability. Actions that enhance governance, such as community groups expanding their networks (Maru *et al.* 2007) to bring support and assistance into the region or the establishment of new governance and engagement structures (Davies and Holcombe 2009), can create long-term improvements, and actions that enhance the potential growth of business networks and industries (Taylor *et al.* 2008) can contribute to livelihoods. Conversely, responses that reduce adaptive capacity or undermine the local economy represent the greatest risk of eroding resilience, and can occur without the respondent realising the consequences of their actions.

Despite the best efforts of community groups within CWQ to guide external support, some individuals or groups do not consider the longer-term ramifications of displacing goods, distorting markets or removing employment opportunities (Kelly 2018). Some contradictions in policy are inevitable, and some examples of policy leading to compromised or ambiguous outcomes are:

- public sector downsizing in CWQ (as outlined in Kelly 2018) led to out-migration of professionals from drought declared locations, reducing adaptive capacity and removing a source of economic stability. Centralised governance will not always be willing to engage at regional and local levels (Stafford Smith and Huigen 2009);
- some long standing policies in the context of broader socioeconomic reform may not be appropriate in the context of drought, such as boarding school fee subsidies to farm families. While this has the positive effect of raising education levels for recipients (ICPA 2018), it also diverts placements away from local high schools, reducing enrolments and reducing funding available to local students; and
- investment in pastoral industries will continue to improve viability through labour efficiencies (Holmes and McLean 2017) which simultaneously has the potential to undermine regional resilience through continued reductions of on-farm agricultural employment (BITRE 2104).

Policy makers need to be aware of such contradictions and local engagement is the only way to overcome these dilemmas.

Balancing responses to reduce vulnerability and build resilience

The generally opposing forces of vulnerability and resilience noted in this study and by Maru *et al.* (2014) are in the process of being addressed in CWQ during the current drought, as the

community expands its networks and proactively seeks to build resilience in multiple public and private partnerships. The actions of key individuals, groups and community governance structures from within the region, has led to all levels of government investing external resources towards addressing long-term structural issues in CWQ. The CWQ community has matured into actively promoting long-term investment to reduce vulnerability to future droughts by building resilience. Several initiatives to address vulnerability and build resilience are ongoing, and many local organisations are committed to supporting these on-going changes, in particular RAPAD, the various shire councils and many of the community organisations such as the WQDC and the church-based charities.

The region has modelled how grass-roots solutions can be supported by top-down investment of public, private and philanthropic resources. Drought resilience can be enhanced in regions with high exposure to drought by supporting existing community social capital and governance structures.

Generic lessons from the case study region

This paper found that a vulnerability framework (Kasperson *et al.* 2005; Adger 2006; Fussler 2007; IPCC 2014) needs to be linked with resilience (Walker *et al.* 2012; Maru *et al.* 2014; Bahadur 2016). Using both concepts will help ensure that both short-term and long-term drought responses are targeted to effectively overcome sensitivity factors, foster adaptive capacity and build long-term resilience. The most successful responses in CWQ mirror top-down support for grass roots actions, for example: external donations being distributed through the WQDC to help support economic activity; and government support of the tourism and agricultural industries.

The effective responses in CWQ align with the proposition of Stafford Smith and others, that vulnerability in rangeland systems can only be overcome through a systemic approach based around four key strategies:

- (1) capture place-based advantages (Stafford Smith and Cribb 2009; Kelly 2018);
- (2) enhance internal and external socioeconomic networks (Maru *et al.* 2007; Kelly 2018);
- (3) engage meaningfully through multi-level (local, regional and centralised) consultation and engagement (Davies and Holcombe 2009); and
- (4) build sustained financial investment (Stafford Smith and Huigen 2009).

This paper has presented examples of all of these as summarised below.

- (1) Growth within the tourism industry, which captures place-based advantages of landscapes, history and people through investment in facilities such as the Australian Stockman's Hall of Fame and the Qantas Founders Museum.
- (2) Internal and external socioeconomic networks strengthened through existing groups, such as Rotary International, and new regionally initiated groups such as the CWRWN and WQDC.
- (3) RAPAD successfully demonstrated multi-level (local, regional and centralised) consultation and engagement in uniting local government for shared services and advocacy.

- (4) Examples of sustained financial investment were scarce. However, some examples were outlined including public-private investment into solar power generation; and government investment into drought programs which all give cause for optimism.

The CWQ region appears to be better positioned for resilience than in 2015 through a range of systemic measures, but it remains to be seen if this regional rebuilding can be sustained. The consistency between the theory, conceptual frameworks and successful outcomes for CWQ suggests the CWQ examples have a much broader application for global rangeland communities.

Actions which are likely to help build resilience in other rangeland regions include:

- supporting local and regional community groups and networks to provide timely and relevant services that build social capital across regional communities;
- encouraging philanthropic responses to focus on whole communities, including town-based businesses, rural contractors and primary producers to maintain economic activity, while avoiding perverse outcomes;
- expanding intrinsic and extrinsic networks across multiple scales;
- building social cohesion in support of local support networks for mental health and wellbeing outcomes;
- supporting collaborative governance at national, state, regional and local levels to ensure consistent policy development and implementation that contributes to building long-term resilience;
- strengthening existing pastoralism through policy and investment that ensures healthy and productive landscapes, supports flexible management actions to respond to increasing rainfall variability, encourages continuous improvement of pastoralist's skills, and provides health services for the wellbeing of families; and
- creating diversified economic activities, especially place-based industries such as tourism.

The vulnerability assessment for CWQ demonstrates the usefulness of a vulnerability framework for rangeland regions, showing how to describe exposure factors, sensitivity factors and adaptive capacity (see 'Profiling vulnerability in CWQ' and Table 1). The most important aspect is how to balance actions that build regional resilience with actions that undermine resilience (the feedback loop of Fig. 1). In practice, the tables presented in this paper provide a template for others to use to describe regionally relevant vulnerability factors.

Conclusions

In this paper we recommend that other rangeland regions conduct vulnerability assessments to help understand the risks and hazards for rangeland socioeconomic systems. Whole-of-community views are powerful for informing robust regional drought plans. This will ensure effective and efficient policy implementation by considering exposure factors, reducing sensitivity and enhancing adaptive capacity to build drought resilience across the socioeconomic system.

Many communities around the world are inexperienced with climate variability. This places many communities at risk as weather patterns become increasingly variable. Without

adequate planning, sensitivity factors can increase to the point that relatively minor rainfall deficits are likely to have a major impact. The generational experience and adaptive knowledge from communities such as CWQ can help other regions plan for the resilience they need for a sustainable future.

The common theme of success in the CWQ region have resulted from local solutions supported by external networks and resources. The governance leadership shown by CWQ groups, the adaptive learning approach, strong interlinking networks and whole-of-community approach are all important aspects of this model.

The vulnerability framework could help prioritise investment to build future resilience to the impacts of drought and policies could better meet regional priorities. Grass-roots communities, local, state and national governments are beginning to recognise the need to identify issues and solutions at a regional scale, and to understand that the socioeconomic structure of rangeland regions is directly linked to variable rainfall patterns.

Assistance measures and programs to build regional resilience need to encompass whole communities, recognising that grazing and town businesses, and the social fabric of communities, are all interlinked and exposed to the effects of drought. Regional vulnerability profiles and actions to build whole-of-community resilience could become a standard approach used by local government or regional economic development agencies in drought planning. State and national governments should use these plans to guide investment and build partnerships with grass roots action.

Short-term responses to reduce vulnerability and long-term response to build resilience need to be complementary. As this case study has shown, regionally led responses can help build social cohesion, reduce the risk of suicide, enhance farm water security, stimulate economic activity and employment to reduce the impact of drought and boost regional adaptive capacity. Drought relief is now being directed through a whole community approach, and this change suggests a move towards policy which integrates short-term measures to overcome vulnerability with strategies to build long-term resilience. The question 'will this action build or undermine community resilience' needs to continue to be asked in the design of drought policies and responses.

Conflicts of interest

The authors declare a potential conflict of interest, as Dana Kelly was employed by the Western Queensland Drought Committee and David Phelps is the Chair of the Western Queensland Drought Committee, Past President of the Longreach Rotary Club and a member of the Central West Rural Wellness Network.

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