Climate Change Adaptation, Risk Management and Education to Meet Needs in Rangelands

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A robust stand of perennial native pastures with thriving cattle (Photo: W. D. Mills).

The development of applied climate knowledge and skills through education and extension programs is fundamental to our current livelihoods and future development in sustainable primary industries and rangelands, and is a proven, effective way for individuals, businesses and communities to address and overcome environmental challenges and enhance adaptive capacity (UNESCO, 2019a,b; AGO, 2006).

Despite our depth of knowledge of the ecology and autecology of Queensland's rangelands and their components (Burrows et al., 1988; Pressland, 1984), management of climate risk and its effects is difficult because of the high levels of climate variability that have contributed to past economic hardship and damage to environmental resources (Ash et al., 2012; AGO, 2006; Johnston et al., 2000; Marshall et al., 2011; McKeon et al., 2004). Although we can well learn from the benchmarks set by history, climate change is a new and evolving challenge that is placing increasing downward pressure on the productivity of landscapes, long-term livestock carrying capacities and the social and economic fabric of the rangelands (McKeon et al., 2009). This new challenge for managing climate risk needs to be addressed by further developing the knowledge and skills of those in rangeland communities to identify and improve adaptive capacity, and derive and apply best management practices (Clewett, 2012; George et al., 2019).

The evolving science of climate change is well developed and understood. This has allowed scientists to make definitive statements

supported by scientific evidence. Their three pre-eminent claims are:

- Warming trends are supported by datasets locally, nationally and internationally. This is not part of a short-term cycle, but a trend that will prevail for the foreseeable future (IPCC, 2013; IPCC, 2014a,b).
- The trending increase in temperature is caused by increasing greenhouse gas (GHG) [carbon dioxide, methane, nitrous oxide, ozone, water vapor] concentrations in the atmosphere during the past 150 years (IPCC, 2013).
- Climate change and global warming are inexorably linked with global changes in rainfall, the health of ecosystems, agricultural productivity and the food chain, including in the rangelands of Australia (Clough et al., 2011). In Australia, that warming is demonstrated by the average mean temperature between 2011 and 2018 being the highest on record since recording began in 1910, at 0.77°C above the average (BoM, 2018).

The best graziers manage seasonal climate variability reasonably well and apply best management practices to minimise risks in sustaining production (AgForce, 2019). Those same graziers are generally aware of climate change. However, there is strong evidence (Michaels & Crossley, 2012), that agricultural communities require further development of skills to enhance risk, adaptive capacity and apply best management practices to avert the threats associated with climate change (Clewett, 2012). This includes skills that properly integrate financial costs, risk management, expectations concerning reliability of production, and the impacts on vulnerable natural resources (McKeon et al., 2004; Lloyd & George., 2008; George et al., 2016; Lloyd & George, 2016; Selby, 2007). Increased emphasis on education processes is a priority for better drought management (Wade & Burke, 2019), because it improves adaptive capacity of individuals and organisations (AGO, 2006; George et al., 2007a,b). Mitigating against and adapting to the complexity of climate change in primary industries will require best production-management skills, new climate change management skills, and informed decision making (Smith & Oleson, 2010; FAO, 2013). An effective response to climate change is beyond the scope of many landholders because management options are constrained by the pressing need to manage for immediate circumstances. Therefore, the need for industry leadership, direction and support is paramount (George et al., 2019).

Climate variability already creates a major challenge for agriculture in Australia, and climate change ratchets up even more risky extremes (McKeon et al., 2004). Because climate change is all-encompassing along the food chain (an example of the "threat multiplier of climate change") (Goodman, 2019), there is a need to strengthen strategic planning, risk management, and education and extension, at both the farm and national level (IPCC 2014a,b; Wade & Burke, 2019). There must be authentic, collaborative consultation processes and simultaneous strategies developed to establish ways forward that include ongoing development of best management practices (George et al., 2019) by farm managers, agricultural businesses and organisations, financial businesses, scientists, consultants and governments working together. Adaptation to and mitigation against climate change is essential and not optional.

An endorsed method for knowledge building to better manage climate and enhance adaptive capacity (George et al., 2007a) is the ClimEd accredited climate education process (George et al., 2007b), which involves building individual and industry competencies in:

- surveying climate and enterprise data (including natural resources);
- analysing climate risk and opportunities; and
- developing climate risk management strategies.

ClimEd is a unit of competency in the Australian Government Training Package and is referenced as "AHCAGB501 – Develop climate risk management strategies". It has been widely used by educational institutions throughout Australia over the last two decades in many diploma and certificate level courses in agriculture, natural resource management and agri-business (George et al., 2016).

Further developing resources to support ClimEd (and so further building adaptive capacity), as a self-paced online course with interactive participation and greater emphasis on climate change science developments, risk management, deriving best management practices and proactive marketing to engage rural communities would add value to the existing package. It would provide an immediate and long-term vehicle to assist the implementation of recommendations in the Drought Program Review (Queensland) Report by Wade and Burke (2019). Continuing to build more resilient rangelands with increased adaptive capacity via accredited competencies in management of climate risk is an important goal.

Governments, in concert with industry, should be urged to act as the catalysts to implement new recommendations to avert the effects of climate change on agricultural and pastoral production systems and the environment (COAG, 2018). Alongside the specific recommendations made in the Drought Program Review (Queensland) Report (Wade & Burke, 2019), the implementation would be best facilitated through collaborative, autonomous processes involving all stakeholders – as described above – in designated agro-ecological regions (George et al., 2019). This will require urgent and continuing investment in education and extension programs as standard components to building adaptive capacity. Business as usual, 'no action' or maladaptation is contrary to the best interests of Australian agriculture and natural resources (Garnaut, 2008, 2011).

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Author Profiles

David Lloyd was responsible for managing the QDPI component of pasture plant improvement and development for pasture/crop systems in sub-tropical southern inland Queensland; including the release of 24 new legume and grass cultivars, and the 'LeyGrain' pasture education program.

Dr David George has developed, delivered and evaluated applied climate courses in the primary industries sector. He established national accreditation of *Developing climate risk management strategies* into the Australian Qualifications Framework.

Dr Jeff Clewett is a research scientist seeking to improve management of climate risk. He has developed several tools to analyse climate data and assess the influence of climate (variability and change) on crop and grazing systems, and has greatly valued many interactions with producers and business people while contributing to climate education and training throughout Australia.