Agriculture, Ecosystems and Environment 222 (2016) 38–47

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Some primary producers are more likely to transform their agricultural practices in response to climate change than others

Nadine A. Marshall[a,b,*], Steve Crimp[c], Matt Curnock[a], Murni Greenhill[d], Geoff Kuehne[e], Zoe Leviston[d], Jackie Ouzman[e]

[a] CSIRO, Land and Water Flagship, ATSIP Building based at James Cook University, Townsville 4811, Australia
[b] James Cook University, College of Marine and Environmental Sciences, Townsville 4811, Australia
[c] CSIRO, Agriculture Flagship, Black Mountain, Canberra 2601, Australia
[d] CSIRO, Land and Water, Floreat, Perth 6041, Australia
[e] CSIRO, Agriculture Flagship, Adelaide 5000, Australia

ARTICLE INFO

Article history:
Received 30 July 2015
Received in revised form 2 February 2016
Accepted 5 February 2016
Available online 12 February 2016

Keywords:
Social resilience
Vulnerability
Adaptive capacity
Trust
Resource dependency
Diversification
Transformation

ABSTRACT

Climate change is altering the productivity of natural resources with far-reaching implications for agriculture. In some instances, the scale and nature of the likely impacts means that transformations of function or structure of agriculture and/or agricultural enterprises will be required if communities dependent on agriculture are to be sustained. However, industry-wide transformations are unlikely to be supported unless individual primary producers have sufficient capacity to undergo transformational change. We look at: (i) the extent to which primary producers in Australia would be willing to transform, (ii) the extent that transformational capacity is likely to exist within producers, and (iii) the common attributes of producers with high levels of transformational capacity. We conducted a telephone survey of 195 primary producers (response rate 59%) across livestock, cropping and mixed enterprises across five national transects on the Australian continent with a high to low rainfall gradient. About half of the sample (55%) suggested that their land would be suitable for diversification and 45% would consider land-use change. These producers were more likely to come from a dry region rather than a wet region, came from an already mixed production enterprise, were more likely to irrigate and have completed university or a trade. These producers were also more likely to have a higher transformational capacity, particularly in their level of interest in adapting to the future. Across our sample, 23% had high levels of transformational capacity, whilst nearly half (45%) had either low or extremely low capacity to implement such change. Producers with a higher capacity were more likely to have a mixed enterprise, an internal locus of control, and higher levels of trust in networks, government, researchers, and agronomists and in self. Our results provide some important insights into what makes some producers more successful or able to transform than others. Investment in the capacity of producers to transform is likely to be an effective strategy to support Australian agriculture in the face of climate change.

1. Introduction

Climate change predictions suggest that the scale and rate of change driven by increases in concentration of greenhouse gases in the atmosphere is unprecedented in human history, and will significantly – and in many cases dramatically – alter the accessibility and quality of natural resources (IPCC, 2014). Changes in key climatic variables such as temperature and rainfall will act to push natural resource systems towards their thresholds of change, in some cases threatening the future of industries and communities dependent on them (Lenton, 2011). Primary enterprises and industries, which include the sectors of agriculture, forestry, fisheries and mining, are especially vulnerable to climate change because of their dependency on climate-sensitive natural resources for their prosperity and sustainability (Zamani et al., 2006; Bennett et al., 2014). These enterprises are expected to contend with more frequent climate crises (such as drought and flood), environmental degradation (such as eroding soils and limited production during drought periods), cultural change (such as implementing new practices or using climate technology) and even climate-related regulatory change (IPCC, 2014). These stressors occur against an existing backdrop of

* Corresponding author at: CSIRO, Land and Water Flagship, ATSIP Building based at James Cook University, Townsville 4811, Australia.
E-mail address: nadine.marshall@csiro.au (N.A. Marshall).

http://dx.doi.org/10.1016/j.agee.2016.02.004
0167-8809/

conventional drivers including economic, biophysical, institutional, cultural and political pressures (Howden et al., 2007; Marshall et al., 2012; Kiem and Austin, 2013).

The specific challenge for producers is to build productivity and profitability without depleting the resources on which they depend. However, current observations of climate shifts suggest that meeting this challenge through undertaking incremental developments may be insufficient; primary industries and enterprises may need to undergo transformations that include changes in function or structure if they are to remain viable (Park et al., 2012). Producers, including farmers, fishers, foresters, graziers and their respective industry organisations, may need to consider innovative strategies such as diversification, using different energy sources, accessing different markets, developing new networks, experimenting with new labour options, using new technologies or translocating to where conditions are more amenable to making a living (Folke et al., 2002; Marshall et al., 2012). If the process involves crossing ecological or social thresholds, where some of the biophysical or socio-economic components of a system are fundamentally changed from one form, function, nature or location to another, and not necessarily irreversibly, then it is defined here as a transformation(Walker et al., 2004).

As in any adaptation, in order for transformation to occur, there must be the capacity to do so. Moser and Ekstrom (2010) suggested that the distinction between adaptive and transformational capacity is mostly one across temporal, spatial and social scales, where transformational change occurs at the long-term end of the adaptation spectrum whilst coping measures occur in the short-term. In their analysis, they found that transformations typically require greater time and effort than shorter-term coping or adaptation measures. Correspondingly, being able to identify and distinguish a transformational change is dependent on being explicit about scale. For example, in larger socio-economic or ecological systems, transformation is signified by change in core functions and can involve institutional change and collective action, both co-ordinated and un-coordinated, by constituent members (Olsson et al., 2006). At an industry scale, radical changes in function and structure may come about due to a myriad of small changes made by individuals, resulting in an overall transformation. Land use change is an example of transformation at larger scales. At individual scales, however, transformation may be indistinguishable by outsiders and signified by major changes in social variables such as occupational identity, place attachment, values, vulnerabilities, capacities and networks (Adger et al., 2012; Marshall et al., 2012). For example, an individual may transform their identify from being a “cattle producer” to a “land steward”. Autonomy and choice, as well as government leadership, action and support, will be central to how individuals perceive and undergo transformation (Webb et al., 2013; Claassen et al., 2013; Wu 2000). Recognising the importance of scale in decision-making and climate adaptation, we focus on the primary producers involved in decision-making at the property or enterprise level. These actors are critical to the process of climate adaptation where success is only likely to occur when decision-making processes are streamlined and complementary with government initiatives. A key challenge for governments then in responding to changing agro-climatic conditions, will be to ensure that sufficient capacity exists amongst individual primary producers and that transformations result in outcomes that benefit both society and ecosystems (Adger et al., 2002).

At the individual scale, transformational capacity has been assessed according to four measurable attributes reflecting an individual’s skills, circumstances, perceptions and willingness to change (Marshall et al., 2013a, 2014a). These attributes, or ‘preconditions’ for successful transformation explicitly are: ``(1) how risks and uncertainty around transformations are perceived and managed (where some individuals are better able to plan for an uncertain future), (2) the extent of skills in planning, learning and reorganising for transformation, (3) the level of financial and/or psychological flexibility to undertake transformational change; and (4) an interest and willingness to contemplate and undertake transformational change (Marshall et al., 2012). These attributes are not unlike those associated with adaptive capacity, but focus on addressing changes that are larger in scale. We use this conceptual model for transformational capacity in this study.

Primary producers are known to be diverse in their capacity to adapt and whilst there are many factors that are known to influence capacity, the influence of resource dependency has been well observed (Marshall et al., 2007, 2013a; Moon et al., 2012). Resource dependency describes the relationship that primary producers have with a natural resource and the extent to which they are sensitive to changes in that relationship (Marshall, 2011; Marshall et al., 2014c). For example, primary producers might be dependent on a natural resource because of their level of occupational attachment to their resource-based industry (Gonzalez and Benito, 2001), or their level of attachment to their place (Marshall et al., 2014b). For example, regardless of the untenability of a situation, primary producers are likely to resist adaptation options that require a change in occupation, making them especially sensitive to changes that threaten their ability to remain within their occupation (Marshall et al., 2012). In this study, we test the influence on transformational capacity of; (i) climate change awareness and attitudes, (ii) sense of place and identity, (iii) level of engagement and trust with networks, (iv) business approach, and (v) local knowledge and environmental attitudes.

We also test for the influence of the locus of control on transformational capacity. The locus of control has not previously been tested for its influence on the capacity to adapt or transform within any context. A sense of being able to control one’s destiny is known to be an important precursor for engaging in sustainable land management (Leviston et al., 2014; Price and Leviston, 2014) and a likely influence on the ability of a producer to cope and adapt to transformational change. The concept ‘Locus of Control’ was first introduced by Rotter (1966), who divided individuals into two groups based on their general expectancies about where control over events and outcomes is located. Those with an internal locus believe that outcomes are contingent on their own actions; those with an external locus believe that chance, fate or powerful others control outcomes. An internal locus of control has been found to predict environmentally responsible behaviour and environmental concern (Leviston et al., 2011). An internal locus is also associated with entrepreneurial innovation strategies, higher levels of farm planning and operation and farmers’ managerial style and ability (Darner, 2009; Leviston et al., 2011; Price and Leviston, 2014). Locus of control has been identified as an important personality trait that may influence farmers’ interpretation of events and, subsequently, levels of stress (Pannell et al., 2006).

The aims of this study were thus to; (i) assess the extent that primary producers in Australia were likely to transform their activities in order to be resilient to climate change, (ii) assess the extent that transformational capacity is likely to exist within agricultural Australia, and (iii) identify factors that are associated with producers with high levels of transformational capacity. Australian agriculture crosses a broad spectrum of land and climatic conditions, supports a range of primary products from irrigated, broad acre cropping to grazing and provides diverse social and economic benefits to local communities and the nation. This study represents a preliminary study of farmers’ adaptation behaviours along particular national transects with rainfall patterns ranging across high to low rainfall.