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Integrating biophysical and socio-economic evaluations to improve the efficacy of adaptation assessments for agriculture

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ABSTRACT

This paper demonstrates how biophysical and socio-economic assessments of adaptation options can be integrated to test the effectiveness of options and anticipate social risks and potential barriers to adoption. We present the approach by combining a model analysis with a multiple-criteria evaluation of 12 adaptation options by graziers from the Australian rangelands. Our results show that strategies to manage stocking rates and pasture spelling are likely to be effective in improving climate resilience in the rangelands and are easy-to-implement, short-term solutions. Improving land condition is found to have the greatest potential long-term benefits, but was not considered by the graziers to be feasible or effective due to perceived difficulties of implementation. Areas of concordance identified in the assessments may be used to engage with stakeholders and build a foundation for incorporating climate change considerations into management and policy. The approach also highlights discordant views within the assessments that may result from differing management objectives, adaptive capacity and climate-risk perception. These factors are potential impediments to adaptation. The integrated assessment approach enables adaptation strategies and policy recommendations to be developed that have greater relevance to individual stakeholders, and supports capacity building to facilitate the most effective adaptation actions.

1. Introduction

Assessments of adaptation options are required to prepare agricultural systems for climate change (Howden et al., 2007). While a number of adaptation responses are available to agriculture, few options have been tested sufficiently to inform management and policy decisions (Stokes and Howden, 2010). The focus of agricultural adaptation research has been to evaluate adaptation options for cropping systems (e.g. Tingem and Rivington, 2009; Moriondo et al., 2010; Mercer et al., 2012). Particular emphasis has been given to testing the biophysical and economic performance of farm-level management strategies (e.g. Antle et al., 2004). Less attention has been given to understanding the social acceptability, feasibility or desirability of adaptation options, and without this the options that are likely to be successful and pay off may not be identified (Marshall et al., 2011; Nicholas and Durham, 2012). There remains an ongoing need to evaluate adaptation options across a range of primary industries, and to improve the efficacy of adaptation assessments by better linking evaluations of option performance with the adaptive capacity of stakeholders (Adger et al., 2005). These requirements can be addressed by considering the socio-economic aspects of adaptation options, and by integrating biophysical and socio-economic assessments of option performance.

A number of frameworks have been developed for conducting adaptation assessments (e.g. Benioff et al., 1996; Smit et al., 1999; Jones, 2001; Wilby and Dessai, 2010). A core component of the assessment process has been identifying tools and approaches to evaluate the utility of adaptation options. While the importance of evaluating the socio-economic aspects of adaptations has been recognised for some time (Thornton et al., 2009), the majority of published assessments test the effectiveness of options using theoretical or empirical models (Easterling et al., 2003). The potential utility of options is then reported in terms of biophysical and economic performance metrics, such as crop yields and farm income (e.g. Benhin, 2008; Reidsma et al., 2009). Although attention has been given to exploring social questions about adaptation, this has primarily sought to determine the resilience and adaptive capacity of stakeholders as a means of facilitating the uptake of adaptation strategies (Smit and Wandel, 2006; Crimp et al., 2010; Engle, 2011; Marshall et al., 2011). Few studies have sought to integrate the biophysical aspects of climate change science and assessments with 'bottom up' approaches to involving stakeholders in adaptation planning (Lorenzoni et al., 2000;

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Wilbanks et al., 2007; Mastrandrea et al., 2010; Deressa et al., 2009).

Integrating both biophysical and socio-economic elements in the assessment process requires adaptation assessments to consider: the economic and social impacts and implications of implementing management or policy changes; whether options are flexible and represent no-regrets strategies under a range of climate changes; how options fit within current management practices, social institutions, the policy environment and political economy across spatial scales; whether stakeholders would aspire to making a particular management change; if there are foreseeable barriers or constraints to the uptake of options; and whether, in light of these considerations, options have the potential to become maladaptations (Dolan et al., 2001; Adger et al., 2009; Barnett and O'Neill, 2010). This requires a range of tools for evaluating whether adaptation options can effectively moderate the responses of agro-ecological systems to climate change.

One approach to incorporating socio-economic perspectives into adaptation assessments is to directly involve stakeholders in identifying adaptation options, and in option evaluations (Saligner et al., 2005; Vogel et al., 2007). This enables stakeholder knowledge of systems to be used in testing the benefits and limitations of options, and through this process empowers stakeholders with ownership of the adaptation challenge (Reed et al., 2006). Stakeholder involvement in adaptation assessments can be managed through workshops, discussion groups or surveys, and can range from self-mobilisation, with stakeholders implementing adaptation assessments, to the provision of information and evaluation of adaptation options facilitated by a third party (e.g. scientists) (Conde and Lonsdale, 2004). Combining more traditional model-driven adaptation assessments with stakeholder evaluations of options has potential to significantly increase the value of adaptation assessments by enabling the biophysical and socio-economic aspects of the overall utility of options to be considered together.

This research seeks to integrate model and stakeholder evaluations to assess the biophysical and socio-economic performance of adaptation options. The objective of the research is to demonstrate how biophysical and socio-economic approaches to assessing adaptation options can be combined to develop improved adaptation strategies that consider not only the biophysical effectiveness of options, but also anticipate social risks where there may be impediments to adoption. We test the approach using a case study of the livestock industry in the north-east Australian rangelands.

2. Methods

2.1. Study area

The study area lies around Charters Towers (20°4′ S, 146°15′ E) in the savanna rangelands of north-east Queensland, Australia. The study area is within the tropical savanna climate zone (Peel et al., 2007), with an average rainfall of 635 mm yr^{-1}. Rainfall is seasonal, with 70% falling during the months of November to April and

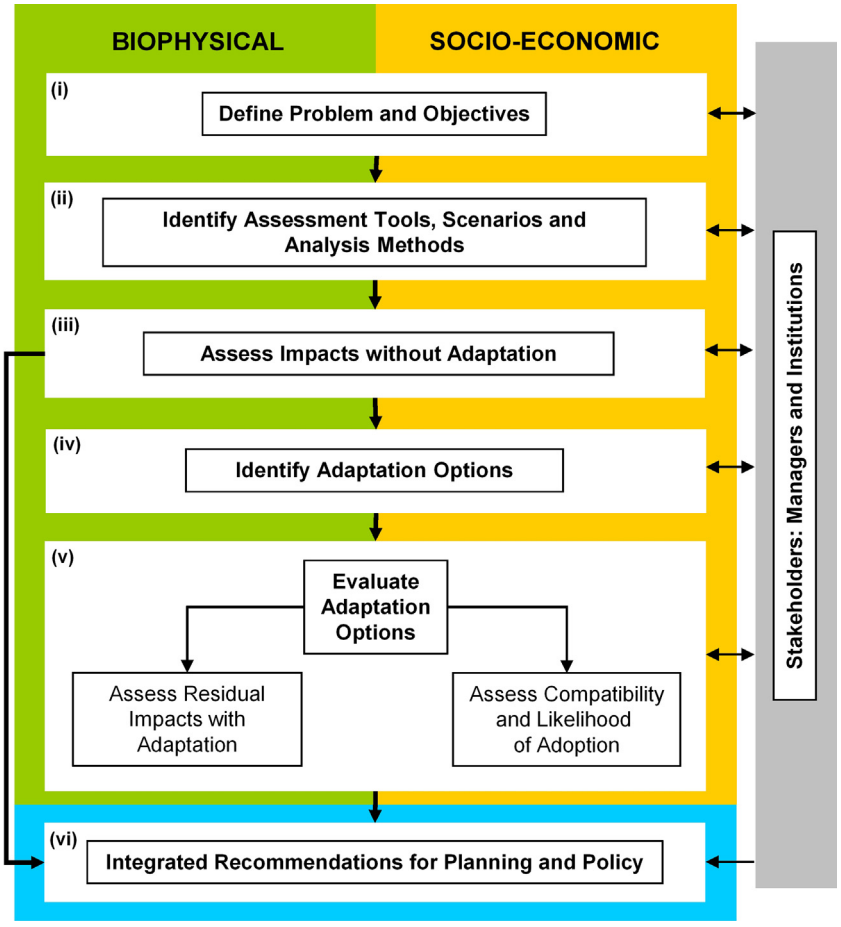

Fig. 1. A framework for assessing climate change adaptation options, applied in this study to evaluate options on the basis of their biophysical and socio-economic performance. Integrating the two assessments enables adaptation options to be evaluated in the context of their benefits and the residual impacts following adaptation, and of the compatibility of options and their likelihood of adoption by stakeholders.