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Contracting & Monitoring Landholder Conservation Agreements

October 2008

Research project UWA 2264 of the Social and Institutional Research Program of Land & Water Australia
Commenced in April 2006 and completed in October 2007

This fact sheet outlines a Land & Water Australia project titled 'A Bioeconomic Analysis of the Duration of Conservation Contracts'.

The project, led by Dr Ben White from the University of Western Australia, aims to inform the decision-making processes of regulators using conservation contracts to protect remnant native vegetation.

It focuses on monitoring to assess compliance and environmental outcomes, and to inform the duration of contract agreements with landholders. A simplified case study is used to explore these issues.

The Case Study Area

The southern part of the Northeastern Wheatbelt Regional Organisation of Councils (NEWROC) region in the Western Australian wheatbelt was selected as a case study for this research because of its high agricultural and environmental values.

Across this area of 273 square kilometres, land clearing and grazing since the 1950s have left small fragmented blocks of vegetation on private land.

Together with significant dryland salinity impacts, habitat loss has been high and vegetation degradation severe.

The Regulator's Dilemma

A regulator using conservation contracts to protect remnant native vegetation faces the difficulty that the environmental assets will change over the life of the contract. This change may be for better or for worse.

Fire may cause a sharp change in status, while more progressive shifts may result from, for example, weed invasion. Information on the status of the remnant native vegetation is necessary for guiding initial and ongoing investments.

A regulator needs to use optimal monitoring frequency and technique and, on the basis of the results, decide whether to initiate, revise, stop or renew a contract.

A Successful Policy

An international review of agri-environmental policies that are designed to increase both the amount and quality of environmental assets, identified the following essential elements:

- Clear definition and timing of the outcomes (social, environmental and economic).
- Specification of the actions that the landholder needs to take in order to achieve the desired outcomes for inclusion in the contract.
- Compliance monitoring to track landholder actions, and outcome monitoring to track environmental change.
- Incentives to encourage landholder participation and achieve cost efficiencies.
- Provisions that allow the regulator to re-contract or covenant the land at the end of the agreement period.

Policies from the United States of America, Europe, the United Kingdom and Australia were reviewed.

Research Team

All three members of the research team are from the School of Agricultural and Resource Economics, The University of Western Australia.

- Team leader: Dr. Ben White
- Bronwyn Crowe
- Dr. Rohan Sadler

Research Approach

A partially observed Markov decision process (POMDP) model was used to analyse optimal decisions for conservation and monitoring.

This modelling approach has had relatively few applications in environmental and natural resource economics. The model uses the concept of Markov-chains, which were initially proposed in ecology as a representation of vegetation successions (ie. changes from simple to more complex plant communities) and, more recently, ecosystem stability over space and time.

A POMDP model was used in this research because it allows for uncertainty relating to current and future states of patches of native vegetation. It is a good method for stochastic (random) control when successional states follow a Markov-chain and the regulator is unable to observe the current state of the environmental assets.

The basic elements of Markov-chain analysis are:

- the set of **states** vegetation can exist in;
- the **action(s)** that can be undertaken to change the state; and
- the probability of land moving between different states or the **transition probability** given the action taken and the initial state.

In the case study:

- the **states** were derived from classifications of Salmon gum woodland (see Figure 1),
- the **action(s)** refer to the land use decision made by the landholder and/or regulator, and
- the **transition probability** is the likelihood of conserving or degrading the vegetation as a result of the action(s) undertaken over a fixed period.

Aerial photographs of the case study region for 1962, 1972 and 1984 were used to estimate initial Markov-chains, with further analysis to include photographs for 1996 and 2007. Aerial photographs provided a historical perspective and were combined with secondary information (such as ground surveys or map) to improve accuracy, as well as matched with current Geographical Information System (GIS) data. These techniques and methods were supplemented with similar work using state-and-transition models of Australian woodlands to assess the changes in land use and land cover.

The overall aim of the analysis was to estimate the return from a set of actions for the expected states, and the associated net present value of the selected actions. Optimal conservation contracts were subsequently derived for the case study region.

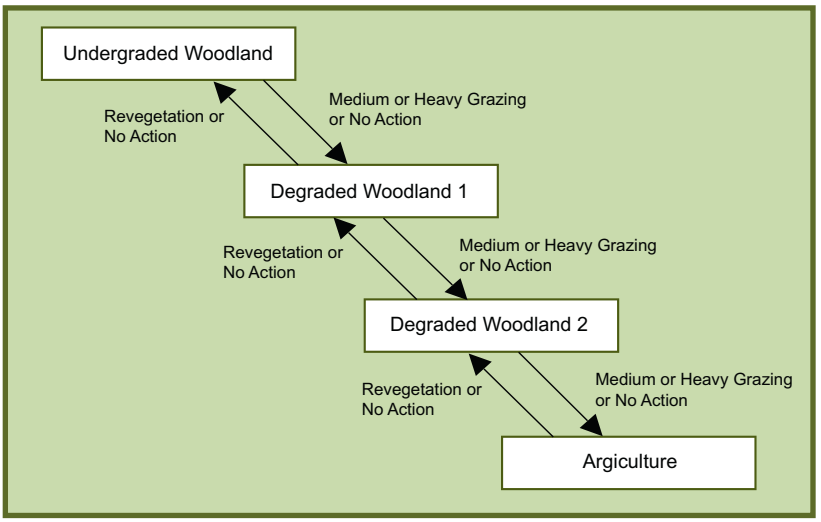

Figure 1
Transition and stable states of Salmon gum woodland (based on Yates and Hobbs 1997)

Research Findings

The Markov-chain analysis undertaken in this study indicates that remnant bushland in the case study area is likely to continue to show declining biodiversity in the absence of significant investment in restoration.

The work suggests that heavy livestock grazing of currently undegraded remnant bush will result in the ecological equivalent of agricultural land after a period of 5 years. Without grazing, 40% of the same area of undegraded remnant bush would remain after 10 years. This further degradation in the absence of livestock grazing is probably due to fragmentation, a lack of burning, rabbit grazing and salinity.

The POMDP modelling suggests that short-term contracts are largely ineffective. This is because the regulator has no incentive to engage in monitoring or adjust actions on the basis of observations. In the case study region, a contract period of 10 years demonstrated better outcomes compared to a period of 5 years. However, the costs of operating outcome-based contracts are greater than input-based contracts. Landholders were shown to make insufficient gains from increasing their conservation effort over a 5 year contract period. While their level of conservation effort varies throughout any contract term, it tends to be greater over a longer time horizon.

Conclusions

The approach described in this research has given an indication of the likely fate of remnant vegetation over different planning horizons. In the case study area, the evidence suggests that the rate of biodiversity loss can be slowed rather than stopped. The duration of conservation contracts and associated monitoring have been shown as important elements in the design of an effective and efficient conservation scheme.

The research suggests that a successful conservation scheme needs the capacity to allocate resources in response to changing circumstances and provide incentives to landholders to participate and achieve cost efficiencies. While outcome-based contracts are described as likely to produce better results, they are noted as more expensive to institute than input-based contracts.

Further Research

The researchers suggest that further investigation of the value of bushland to society is needed, as the reliability of non-market values for environmental attributes, such as particular types of remnant bush in remote areas, is limited.

The estimation of Markov-chains under different actions could be further developed to improve analysis capacity. They further recommend examining incentives for compliance and cheating in the context of both outcome- and input-based contracts.

Further Information

The final report for this project can be downloaded free-of-charge from Land & Water Australia's website: www.lwa.gov.au

For further information, please contact

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Product code: PN22024