Policy Choices for Salinity Mitigation: Bridging the Disciplinary Divides
1-2 February 2007 Coogee Surf Club

Systematic landscape change through agri-forestry: a collaborative approach

Peter Ampt with significant contributions from Alex Baumber, Claire Carlton, Kate Norris* and Rachael Stewart-Rattray*.

* Work completed while Masters of Environmental Management students at Institute of Environmental Studies, UNSW.

Abstract

This paper makes a case for systematic landscape change and describes a possible pathway to achieve it. Taking advantage of opportunities in emerging environmental markets, the potential use of plant biomass and planning based on landscape ecology, this paper proposes using a common property resource system to generate investment in multi-species native agri-forestry plantations that are strategically located across the landscape. The plantations will mimic many of the functions of native vegetation to achieve multiple objectives – attempting to optimize environmental benefit while generating investment and commercial return. A project proposal to put these concepts into practice on the western edge of the Blue Mountains World Heritage Area is described and a preliminary analysis of opportunities and threats is presented.

1. Introduction

Australian landscapes have been subject to significant modification by humans for thousands of years, with a rapid increase in extent and severity in the past 200 years. This has caused varying degrees of fragmentation due to the impact of livestock grazing, clearing of native vegetation, proliferation of permanent watering points and increasing urbanisation. The fragmentation is particularly severe in the cereal growing and livestock grazing areas of the Murray-Darling Basin and Western Australia. These are the areas that are most adversely affected by dryland salinity, and on which climate change is already having an impact. Ecosystem services provided by these areas have declined dramatically in the past.

Recent laws, regulations and policies (such as the property vegetation planning initiatives in NSW) are constraining continued loss of native vegetation from private land but the most under-represented types of vegetation are those on the most productive agricultural land such as grassy box woodlands in eastern Australia. Re-establishing what has been lost or attempting to reverse the loss of ecosystem services caused by 200 years of landscape fragmentation is largely left up to some individual landholders. These landholders display an exceptional degree of altruism in attempting to revegetate specific areas and establishing conservation covenants. Programs exist to provide incentives for revegetation and conservation but these are orders of magnitude too small to have a

landscape-scale impact. There are also well recognized barriers to the adoption of sustainable land management practices by individual landholders.

The dominant existing paradigm for natural resource management (NRM) has created a division between land managed for production and for conservation. Under this mindset, landholders are on a production-driven treadmill where they are challenged to continue to improve productivity to counter declining terms of trade. They view native vegetation regulations as restraining them from maintaining their livelihood by preventing the development of new areas for cropping and by restricting grazing. Also under this paradigm, conservationists advocate 'locking up' areas of land for conservation using a protected area approach, in the assumption that the land will largely look after itself. Neither the commercial use of areas managed for conservation nor acknowledgement of the conservation value of areas that are sustainably managed for production are generally recognized as relevant or significant. Conventional strategies to achieve revegetation or management for conservation are to provide incentives for adopting sustainable practices or to foster environmental stewardship through, for example, the use of market-based instruments.

In areas dominated by agricultural land use, acceptance of revegetating strategic areas by individual landholders is hampered by:

- The cost of the process with no real prospect of support, of future economic return or of being able to meet the cost of ongoing management of the revegetated land;
- Skepticism about whether the revegetation will achieve the ecological benefit claimed;
- Uncertainty about the balance of conservation and production areas across the landscape;
- Perceived loss of income through lost production if those practices are adopted;
- Continued declining terms of trade leading to reduced incomes and return on investment from conventional agricultural land use.

In peri-urban areas, increasing land values are driving sub-division into smaller blocks and this is having an impact in a number of ways, including:

- greater diversity in landholders in terms of what they want to do with the land;
- reduced necessity to earn money from land;
- fewer full-time residents and
- lower level of local knowledge and expertise in land management.

In both these cases and within the existing dominant paradigm, a goal of systematic revegetation across the landscape would seem very difficult, if not impossible. However, there are a number factors emerging that could provide opportunities in the near future. For example, opportunities are opening up for increased private investment in systematic landscape change due to:

- the diversification of investment strategies by funds managers, the increasing influence of corporate social responsibility and the emergence of ethical investment brokers;

- emerging environmental markets for carbon biosequestration whereby revegetation and could generate carbon credits which offset the cost of establishment and management;
- programs to provide biodiversity offsets while allowing development;
- Precedents for payment for provision of improved and consistent water quality in a catchment;
- new products derived from plant biomass which could generate a sustainable harvest from native vegetation or mixed species plantations;
- Managing the increasing risk due to fire as a result of climate change;
- The impact of adverse climatic events such as cyclones on the global re-insurance industry is generating pressure to invest in climate mitigation and adaptation projects

Taking advantages of these opportunities will require some significant shifts such as:

1. Acceptance of the concept of conservation through sustainable use (CSU) whereby land can be managed primarily for conservation but can generate income through sustainable use. This income can support ongoing management.
2. Further development of environmental markets for carbon, water and biodiversity.
3. Recognition of the need to manage access to common pool resources and to generate institutions that control free riders at the same time as generating appropriate property rights to encourage investment.
4. Generating a collaborative approach beyond the prevailing paradigm whereby stakeholders accept a 3 pronged approach to NRM:
    a. Recognition of the need to maintain agricultural production on areas most appropriate for that purpose while generating incremental improvement in the sustainability of production systems;
    b. Recognition of the importance of maintaining areas of high conservation value but recognize that they need ongoing management and that CSU might be an appropriate strategy to fund that management;
    c. Develop new forms of land use across property boundaries that utilize strategic landscape planning and establish common property arrangements to generate sufficient economies of scale to stimulate investment.

In an attempt to capture these opportunities, the FATE Program and the Blue Mountains World Heritage Institute are embarking on an ambitious project to capture and harness these opportunities in an effort to revegetate strategic areas of the Hawkesbury Nepean Catchment that impact on the World Heritage values of the Blue Mountains.

2. The Case for Systematic Landscape Change

Many of the threats facing the BMWHA are reflected across Australia as a whole, with ecosystem loss since European settlement totaling more than 50% of forests nation-wide, 90% of temperate woodlands and 99% of south-eastern Australia's temperate grasslands (Australian Museum Online 2005). Land degradation has been estimated to cost Australia's rural sector over $1 billion a year (CSIRO 1998) in lost production and over

300 native vertebrate animals are listed as nationally threatened (with a further 55 already extinct) (Department of the Environment and Heritage 2006).

Through programs such as the $3 billion Natural Heritage Trust (NHT) and $1.4 billion National Action Plan for Salinity and Water Quality (NAP), Australian landholders have been urged to adopt a variety of practices to make existing land-use more sustainable, including maintaining ground cover, encouraging deep rooted perennials in pastures, strategic tree planting, pest and weed management, water conservation and protecting sensitive areas from stock (such as riparian zones, wetlands and high conservation areas).

While these practices are becoming more widely accepted as necessary, their adoption has been patchy. Non-adoption or low adoption can generally be explained by the relative economic advantage they provide and how difficult it is for landholders to trial them (Pannell, Marshall *et al.* 2006). All of these efforts are costly and while some support is available for protection of high conservation value and sensitive areas (such as fencing and some revegetation), the ongoing cost of managing these areas is considerable and is rarely factored into government incentives funding.

Many landholders hold the view that the 'lock up and protect' approach is fundamentally flawed. Fully functional ecosystems may be expected to be self regulating, however smaller fragments of native vegetation and areas that have previously been grazed, logged or cleared generally require ongoing management. Regrowth can be heavily dominated by one species and weed and pest animal control is usually necessary. In fact, many schemes involve conservation covenants, which ensure that the land set aside will remain non-commercial in perpetuity. The prospect of meeting the ongoing cost of managing conservation areas without any income being gained from them is a severe disincentive to undertaking conservation works.

Furthermore, while the environmental problems being addressed have often been created systematically by deliberate landscape-scale alterations (e.g. by systematic policies of clearing mallee woodlands for wheat production), the attempts to address them have not been systematic or focused on the landscape scale. Efforts have generally been patchy and focused at single properties, despite the fact that many target outcomes clearly require cross-property action including:

- Riparian zone regeneration efforts on waterways running across numerous property boundaries;
- Revegetation of groundwater recharge zones to mitigate dryland salinity which will generally benefit farms further down the slope more than it will the owners of the land actually being revegetated; and
- Connectivity of vegetation across the landscape to provide for movement of species.

There are significant barriers to achieving this sort of landscape scale change, both in terms of finding sufficient economic incentives and in overcoming the traditional attitudes of landholders as fiercely independent and unwilling to work too closely with neighbours. If anything other than patchy incremental change is to occur, a more radical

approach may be required, following a "conservation commons" model whereby landholders communally manage selected lands across all their properties for a combination of production and conservation outcomes.

Enterprises such as native agri-forestry for timber, bio-energy, carbon credits and other products could provide the economic drivers for revegetation activities across such a conservation commons, for which the common-property approach would offer many advantages over a single-property enterprise model. Economies of scale would be created through the combining of lands and each landholder would not need detailed knowledge of all the markets involved in what could be a diverse and complicated enterprise. Management of the land within the commons could be undertaken more efficiently by an appropriate corporate entity, leaving individual landholders to focus on their traditional farming activities, or in the case of 'lifestylers", to focus on their off-farm activities.

3. Drivers for Investment in Landscape Change

In order to drive landuse change and reforestation on a landscape change, suitable economic and social drivers need to be found that provide landholders with incentives to undertake these activities. Timber harvesting, bio-energy production using woody biomass and markets for environmental services (principally carbon sequestration) have been identified as the most promising enterprises for delivering economic incentives. These activities may also provide a social driver for targeted landholders who value forested landscapes and the lower time burden that may be involved in managing these activities.

Agri-forestry on private land (or farm forestry) is a rapidly growing industry in Australia and taps into growing world markets for wood and wood products. More than 1.7 million ha of plantations exist in Australia, with the plantation estate growing at an average of almost 5% a year between 1999 and 2004 (National Forest Inventory 2005). Most of this recent growth has been on private land (87% of 2004 plantings) and has mostly consisted of native hardwood plantings (largely blue gum). Australia's forest and wood industry has an annual turnover of $18.1 billion, consisting largely of sawnwood, panels and paper products (Department of Agriculture Fisheries and Forestry 2006).

Continued growth in the existing agri-forestry industry may well result in increased areas west of the BMWHA going under forestry plantings without any intervention by this project. However, without landscape scale planning, these areas are most likely to consist of monocultural plantings using non-local species (current plantations in the district are dominated by radiata pine) and established in a disjointed and uncoordinated manner without consideration of potential benefits for riparian areas, salinity mitigation or habitat connectivity. By pursuing mixed-species plantings in strategic areas, the project may obtain lower returns from forestry markets than monocultural plantings (e.g. by producing lower value composite wood products that are less dependent on wood quality and consistency), but could capitalise on other compatible economic opportunities.

Biomass energy (bioenergy) offers one such commercial driver for landuse change that requires a degree of collaboration across a number of properties to generate viable volumes of energy feedstock. Electricity production from biomass would most likely offer a lower return than forestry, but is less dependent on quality or consistency of feedstock, allowing a wider variety of species to be used, as well as forestry wastes. Conversion of woody biomass to ethanol is another option, but one which requires further technological advancement to prove its viability. The economic viability of these bioenergy options is highly dependent on future price trends for competing energy sources, including the potential impact of carbon pricing on fossil fuels (through taxes or tradable allowances) and world commodity markets (e.g. continued high oil prices improves ethanol viability).

The continued development of carbon markets in Australia and internationally offers a double opportunity for this project – firstly by making carbon-neutral bioenergy production more competitive with conventional fossil fuel production and secondly by allowing landholders to sell credits for carbon permanently sequestered in their plantations. Although Australia has not ratified the Kyoto Protocol, NSW has implemented its own Greenhouse Gas Abatement Scheme (GGAS), which is one of the world's first carbon trading schemes to allow credits generated by carbon sequestered in new forest plantings to be traded. At present, NSW and ACT electricity retailers and other big carbon emitters provide the potential market for forest-sequestered carbon credits, but other States have expressed interest in linking with GGAS to form a nation-wide carbon trading scheme.

On the international scene, indications are that carbon trading will become increasingly significant and it is unlikely that Australia will remain locked out of indefinitely. Global reinsurance and other industries are increasing seeing the value of having an international 'shadow price' for carbon that allows the cost of carbon emissions to be factored into business models. Within the existing European Union Emissions Trading Scheme (ETS), operating under the Kyoto Protocol, there are increasing calls to include carbon credits generated by overseas afforestation/reforestation projects (originally excluded for a variety of reasons). Future prices for bio-sequestered carbon are dependent on these national and international developments, however, credits for sequestered carbon would not need to be traded immediately and early investors in local projects will be well placed to take advantage of future market conditions.

Other markets for environmental services are less developed, but there is potential for landholders to obtain payments for reducing salinity impacts further down the catchment through strategic plantings, as well as for improvements in biodiversity and water quality. In the absence of developed markets for these environmental services, Catchment Management Authorities and other NRM bodies have been charged with distributing Commonwealth and State funds to achieve these outcomes. These bodies may support a strategic landscape scale project such as this that aims to restore ecosystem services.

The remainder of this section is a discussion of the potential influence of environmental drivers by Rachael Stewart Rattray.

Carbon trading

Some of the challenges faced in implementing carbon trading in the target area include:

- There are high up front costs associated with establishment of a carbon plantation. This also includes the complexity of requirements for becoming accredited under GGAS.
- Issues with complexity of on-going management and potential risks to the plantation associated with pests, fire etc.
- Financial gains are not realised immediately due to waiting time for carbon to be sequestered.
- These factors are all made more difficult for small landholders as characterised by the landholders in the target area.

Some of the factors that will make a positive contribution to implementation of carbon trading include:

- There is a definite market for carbon credits in NSW due to mandatory GGAS scheme requiring electricity companies to offset their emissions.
- This market is backed by legislation of carbon credits which helps to guarantee the investment and provide specific guidelines for how the credits should be created and measured.
- Credits are cheaper in Australia than overseas which creates additional demand for any carbon credits generated in the target area.
- There are market intermediaries available for trading credits which reduces the transaction costs associated with having to find buyers directly.

Biodiversity Banking

Some of the challenges associated with the implementation of biodiversity banking in the target area include:

- Credit sale is dependent on the type of biodiversity conservation being conducted and this could limit available buyers of the credits. It is currently difficult to estimate potential buyers of credits in the Blue Mountains area without being aware of a specific development project to be undertaken.
- A market intermediary is proposed, but this is still being developed. Therefore there will be higher transaction costs associated with seeking out buyers and also limited assistance with establishment and recording of credits in the first instance.

Some of the factors that will make a positive contribution to implementation of biodiversity banking include:

- As the guidelines are still in progress for NSW, there is the opportunity to get involved in being a demonstration site and getting official backing as part of this program.
- There is success of similar initiatives in the US where wetland mitigation banks and conservation banks have become viable businesses.

Discussion of drivers

Do environmental service markets meet the project objectives of provision of environmental services, economic returns to landholders and contribution to sustainable development? There is no question that markets for environmental services will contribute to environmental goals such as carbon sequestration, biodiversity conservation, salinity, water and soil quality improvements. It is, on the other hand, not always quite as clear how easily private investment and hence economic returns to landholders can be provided. Carbon trading has only recently developed an active market in NSW, with only four companies currently registered for carbon sequestration, however there is a strong market for credits due to the mandatory GGAS scheme, combined with overseas demand. Biodiversity banking, soon to be legislated in NSW has been an extremely successful model overseas in terms of providing returns, but is yet to be proven in Australia. Salinity credit trading has no overall NSW scheme, but has been shown to be a successful business model for individual cases in specific areas such as the Hunter River Salinity trading scheme. Objectives for regional sustainable development are supported by the provision for environmental services, the positive contribution to protection of the world heritage area and the productivity improvements to existing agricultural activities. In order to ensure that it will be sustainable over the longer term, many of the challenges described would have to be overcome to ensure economic returns provide sufficient incentives for farm forestry.

One of the key ways to ensure that environmental service markets provide sufficient economic returns is to implement a combination of different markets so that the landholders are not just dependent on one source of income. The benefit of markets for environmental services is that multiple services can be generated from the same farm forestry activity. In addition it is recommended that these markets are combined with other farm forestry activities, such as biomass harvesting or more traditional farm forestry activities, but without compromising the environmental service being provided.
Another issue that most of these markets face is high initial establishment costs and complexity to get the project up and running. Getting started with carbon trading and becoming accredited under the Greenhouse Gas Abatement Scheme, appears to be quite complex and difficult for small landholders. One way to handle this issue is to amalgamate holdings into a common pool for the purposes of carbon sequestration. This can help to improve economies of scale and reduce risks. It also fits in well with the goals of management under a common property regime. Another way to deal with the complexity is to seek assistance from companies that are already accredited under GGAS such as CO2 Australia. To overcome complexity with getting Biodiversity banking up and running, it may be possible to get involved as a demonstration site as part of the NSW BioBanking scheme, if an appropriate development project can be identified in the Blue Mountains area.

4. Common property resource systems (CPRS)

This section of the paper is a review of the literature by Kate Norris around CPRSs that is relevant to a collaborative, across-property approach to NRM that is trying to generate economic returns from land managed for conservation as advocated by the FATE Program.

FATE is seeking improved sustainability on biodiversity, social resilience and economic viability grounds. Williamson *et al.* (2003) takes sustainability of the CPRS to mean persist in the long term – not forever. Dolsak and Ostrom (2003) present a model comprising six common property resource system components: the resource itself, users, technology, politics and law, economics and institutional rules. These components interact and determine how a given resource is used. This model provides a useful framework within which to summarise the characteristics of a sustainable CPRS. In this paper, a system or regime means these six elements interacting together, and the institution is taken to be the rules and organisation of that system.

Agrawal (2001: Table 2) identifies 33 factors which contribute to sustainable collective resource management, but only analysed 3 studies for this result. In addition, in comparing different cases Agrawal (2001) notes that there were differences in method and omitted variable biases between the studies. Poteete and Ostrom (2004) report on findings from comparing more standardised data, collected for the International Forestry Resources and Institutions Programme (IFRI). For this paper, Poteete and Ostrom (2004), Baland and Platteau (2003), Dolsak and Ostrom (2003), Williamson *et al.* (2003), Agrawal (2001) and Bromley (1991) proved useful sources of information for establishing a summary of characteristics. These papers include good surveys of CPRSs, from which themes have been extracted.

Resource

Perhaps stating the obvious, Bromley (1991) requires that the resource has not been already squandered. Williamson *et al.* (2003) adds that the resource must be used at a rate less than or equal to the sustainable yield.

There is agreement that the boundaries of the resource need to be stable and clear (Ostrom 1990, Bromley 1991, Dolsak and Ostrom 2003, Agrawal 2001), and importantly, despite inherent costs, it must be possible to exclude others from using the resource (e.g. Williamson *et al.* 2003). The resource needs to be rival and subject to a non-negligible (but not high) level of use (Dolsak and Ostrom 2003), which Bromley (1991) terms as relative scarcity. As Agrawal (2001) finds, if there is greater mobility or unpredictability inherent in the resource, this makes monitoring and institutional solutions more difficult.

However, there is disagreement about the appropriate size of the resource for successful governance (Poteete and Ostrom 2004). Some authors have found that a resource is more likely to be governed successfully, if it is small in size and uniform (Dolsak and Ostrom

2003, Bromley 1991, Agrawal 2001). The main reason is that it is more likely to be manageable, e.g. Dolsak and Ostrom (2003) regard that local and regional scale is more manageable than global resources. However, others regard that it is important to match the scale of the resource to the ecosystem boundaries, as this will yield better understanding (Williamson *et al.* 2003). It is by no means impossible to manage global scale resources in a common manner – The Montreal Protocol is one example. The forests in IFRI ranged in size from 1Ha to 45,000Ha. (Poteete and Ostrom 2004), so the definition of large is not clear.

Technology (and information)

There is consensus in the literature that information about biophysical condition and structure of the resource needs to be detailed and accurate. This includes knowledge of the past and current situation and the dynamics of the resource (stocks and flows) – how it responds to changes. Such information needs to be accessible, thoroughly understood and effectively monitored by the resource users (Dolsak and Ostrom 2003, Williamson *et al.* 2003, Devlin and Grafton 1998, Bromley 1991, Ostrom 1990). Williamson *et al.* (2003) extends this further, saying that the benefits and costs of actions and outcomes with respect to the resource need to be known.

This keen knowledge of the ecosystem and how it interacts is necessary to aide coordination (Poteete and Ostrom 2004) and more specifically to establish rules of use which will be ecologically conservative and therefore sustainable (Ludwig 2001, Williamson *et al.* 2003). However, Dolsak and Ostrom (2003) note that stocks and flows of resources are often difficult to define with precision. And as Ludwig (2001) rightly emphasises, even good information does not inherently achieve sustainable use of a resource; users must develop and apply rules which act on this knowledge. This underlines the fact that the different elements of this framework must gel together in order to achieve successful collective action.

Users

A cooperative approach to resource management necessitates a group of rightful users be defined (Agrawal 2001, Williamson *et al.* 2003). Coordination is more likely to be possible if the group of people is smaller (Dolsak and Ostrom 2003, Bromley 1991, Williamson *et al.* 2003, Agrawal 2001). However, in a similar vein to the resource size, this is easy to stipulate but there is the problem of defining what constitutes too large a group. As Poteete and Ostrom (2004) rightly ask, is a group of 50 people small or large? Then what about 100 or 1,000? It is likely, as Agrawal (2001) notes, that the influence of size of the group is likely to be mediated by other factors in the system.

Like size, it follows that if the group does not have a singularity of purpose, it will be harder for them to reach agreement. Bromley (1991) says users must have an interest in the careful management of the resource. This could be interpreted as a long-term commitment to a property (Williamson *et al.* 2003). However, it seems if interests differ within the group, this can reduce the chance of success (Poteete and Ostrom 2004, Dolsak and Ostrom 2003). Poteete and Ostrom (2004) list other variables indicating heterogeneity within the group which have been associated with unsustainable systems,

these include: income, assets, values, knowledge and skills, and location. Therefore, just as a smaller group facilitates cooperation in the long-run, so does a homogenous group because coordination is easier (Williamson *et al.* 2003). But it should not be assumed that these interests are being applied by users to the resource level of management (Campbell *et al.* 2001), which is important. This amounts to having different user groups, and Poteete and Ostrom (2004) note that it becomes far more complex if there are multiple groups of users accessing a resource (e.g. forest foragers and tree fellers).

There are examples of heterogenous, large groups being successful, so Adams *et al.* (2003) says it may be a matter of delving deeper into the matter. A component of achieving effective group participation and dialogue is carefully and transparently dealing with differing perceptions users may have of the management problem (Adams *et al.* 2003). Williamson *et al.* (2003) describes it more generally – that users need to understand their differences and be willing to develop strategies together. A capacity to experiment and adapt does not go astray (Williamson *et al.* 2003).

Although Poteete and Ostrom (2004) list location as an attribute related to homogeneity in the group, there is a more fundamental reason that this is associated with success. People who reside close to the resource will necessarily be more likely to be able to effectively exclude non-owners from it (Bromley 1991, Williamson *et al.* 2003). In addition, neighbours are more answerable to each other (Williamson *et al.* 2003), because they have to interact continually.

Different management plans and strategies are likely to have substantially different distribution of benefits for the stakeholders. This will make it difficult to agree on a course of action, and ensure that all stakeholders cooperate with agreements (Poteete and Ostrom 2004).

Dolsak and Ostrom (2003) say groups with traditions of mutual trust will be more likely to succeed in building an institution and sustaining it. In particular, user groups are usually self governing. Therefore, user groups who have experience with similar local organisations have an advantage (Bromley 1991, Williamson *et al.* 2003, Agrawal 2001). Traditions of trust and experience will help increase the probability that promises are kept, which is especially important in establishing a new system (Williamson *et al.* 2003). Following from this, the stability of the CPRS will be threatened if use-rights are transferred to inappropriate individuals (Williamson *et al.* 2003).

Legal/Political

Incentives and sanctions which the group has established for the management of the common resource can be undone, either by internal or external forces (Bromley 1991). Therefore, it is not only the internal relationships of the group which matter, but also the relationships between users and external factors which need to be good. These include the market, technology and politicians (Williamson *et al.* 2003, Agrawal 2001). External intervention can prevent collective decisions holding; therefore Bromley (1991) regards common property as dependent on the state's esteem for it. Ostrom (1990) takes it back further, saying that the government must at least recognise the group's right to organise.

Economics

The sustainability of the system, from an economic perspective, necessitates that the benefits of cooperating outweigh the costs. This will provide overall incentive to cooperate. Bromley (1991) says claims that private property regimes are often held up as promising increased output. Seemingly trying to counter this, Williamson *et al.* (2003) probably overstates the ability of common property to deliver good economic outcomes, saying CPRS allows flexibility, financial viability, diversification, fewer externalities, economies of scale and general administrative efficiency. Bromley (1991) sets the record straight, explaining economic potential will suggest the type of regime suitable in each particular case.

Interestingly, diversification is noted by Dolsak and Ostrom (2003) and Agrawal (2001) as a negative, because it weakens the reliance of the community on that source of income, hence weakening their responsibility to it. On the other hand, others see diversification as risk sharing, therefore positive (Williamson *et al*. 2003). Perhaps the distinction is that diversification may be dangerous for the resource's sustainability but good for the user's. However, there is no clear theme from the literature about this.

There are transaction costs associated with group governance which are generally higher than for private property (Baland and Platteau 2003). Bromley (1991) divides these into information costs, bargaining costs and enforcement costs. Transaction costs are generally thought of as a burden, a cost. Bromley (1991) suggests that they can sometimes be a source of social capital. Coop and Brunkhorst (1999) are more forthright, claiming without much evidence that transaction costs can build both social capital and resilience that can address rural decline. Easier to accept, is the notion transaction costs are likely to be high in the early periods of a CPRS, but fall with time as institutional learning occurs (Williamson *et al.* 2003).

Agrawal (2001) emphasises the 'configuration of conditions' – that elements interact with one another to determine the sustainability. The section above about Users highlighted the way transaction costs can be exacerbated or eased by the make-up and characteristics of the users. Due to high transaction costs, success of the system may depend on achieving economies of scale and increased income in the early phase (Williamson *et al.* 2003).

There also needs to be attention given to the distributional aspects of the system. O'Connor and Thompson (2001) discuss the relationship between voting rights and capital for cooperatives, and find that it is the most important determinant of long term sustainability: one member, one vote can generate a power issue, because it doesn't reflect their capital contribution. Williamson *et al.* (2003) suggests benefits should be distributed according to inputs of time and effort. Coop and Brunkhorst (1999) explain that benefits are usually distributed equally or according to the economic resources a member brings.

Institutional

Campbell *et al.* (2001) call for a tempering of enthusiasm for common property resource systems, given that the formal rules have broken down in many existing institutions.

Bromley (1991) and Williamson *et al.* (2003) agree: the social institutions are what make common property resource systems work. If rules, regulations, monitoring and enforcement fail; then CPRS can lead to resource depletion because compliance is not achieved. However, as Figgis (2004) notes, too much legal security may scare off potential participants in conservation schemes.

As Bromley (1991) says, a necessary condition for a sustainable CPRS is that the co-owners are not in a perpetual state of anarchy. The institution does the job of gelling all the elements of the system together – to secure the benefits of cooperation for the group and exclude others (Williamson *et al.* 2003). Therefore, as Ostrom (1990) says there needs to be congruence between the owners, the local conditions and the rules. Agrawal's (2001) concern for the interactions between factors is another expression of this. The rules should make good social, economic and environmental sense for that situation.

Williamson *et al.* (2003) advises that it is essential to sort out that business structure, property law, resource access arrangement, process of developing informal rules responsibilities and collective decision mechanisms. Ostrom (1990) considers that arrangements which allow for most users to be part of the decision making process, will improve institutional performance.

Institutional mechanisms, including reprimand, need to be in place in a CPRS to create pressure to comply and thereby prevent free-riding (Williamson *et al.* 2003, Ostrom 1990, Dolsak and Ostrom 2003, Bromley 1991). The structure must balance long-term security for planning with flexibility so that people will take the risk on. (Williamson *et al.* 2003). Mechanisms for resolving conflict are needed, and Ostrom (1990) adds that these need to be cheap and easy to access, or they will be more prone to falling into disuse. Ostrom (1990) also recommended graduated sanctions be applied to users who do not obey the rules. For large and complex problems, Ostrom (1990) suggests the construction of multiple layers of nested enterprises with small local CPRs at their bases.

More generally than CPRS, but likely still relevant here, Irons (1997) provides some guiding principles to cooperative action for conservation including: a purpose, inclusiveness, voluntary participation, self design, flexibility, equal opportunity, respect for diversity, accountability, time limits and implementation/review.

5. Blue Mountains World Heritage Institute: Western Edge Native Farm Forestry Project Proposal

Description

The Greater Blue Mountains region contains 8 protected areas and significant urban, peri-urban, industrial and rural areas. An area of more than a million hectares (the Greater Blue Mountains World Heritage Area or GBMWHA) was inscribed onto the World Heritage List in 2000 primarily for the extent and diversity of its temperate eucalypt forests. The region also provides ecosystem services including clean water, air and recreation to Sydney, a major city immediately to the east. Its World Heritage values and its ability to provide ecosystem services are coming under

increasing threat due to the combined pressures of population growth and urbanization, variations in rural land-use and climate change.

On its western edge there are particular land degradation, stream and water quality problems in valleys that flow east through the GBMWHA and provide water to the Sydney Catchment. It has been proposed that native farm forestry would provide a range of solutions with economic benefits for landholders as well as increase native vegetation within the catchment and provide a significant buffer to the World Heritage area.

This project will complete the preparatory work required to establish an economically viable native farm forestry industry in the target area. Using an expert team, a local working group and consultants, the project will develop a land-use plan and a framework that can generate investment in strategic revegetation that sequesters carbon, increases biodiversity, improves riparian zones, delivers improved water quality and provides a biomass harvest. The result will be a land-use mosaic that is resilient in the face of climate change, beneficial to local landholders and their community and compatible with values of the World Heritage Area.

The project will explore how a common property regime will provide the framework for the full range of environmental services and economic goods which meet the needs of landholders, investors and buyers of farm forestry products. The project also aims to identify regional development opportunities that flow from the farm forestry initiatives.

Aim

To develop farm forestry options that can be implemented systematically across target areas that adjoin western edge of Blue Mountains World Heritage (BMWH) area and that provide environmental services, economic returns to landholders and investors and contribute to sustainable regional development.

Potential farm forestry outputs include:

- **Biomass** – to produce products from plant biomass including fuels from dry organic matter or combustible plant oils, composite building materials, extractable oils, charcoal, activated carbon and mulch material for nursery industry.

- **Timber/Wood Products** – timber required for building materials, furniture, wood craft and wood chips for paper pulp.

- **Environmental goods and services** – the proposed systematic revegetation addresses salinity, water quality, erosion and threats to biodiversity in line with catchment management action plans. The provision of environmental goods and services may attract incentive funding and investment from individuals and corporations supporting long term environmental programs. Use of Biodiversity Banking will also be possible to generate offsets for development nearby.

Economic opportunities deriving from farm forestry include:

- **Carbon trading** – carbon that has been biosequestered which can then be traded on the emerging carbon market either as part of the NSW scheme of internationally

- **Regional industry** – creation of a new industry that is derived from farm forestry and may result in processing plants being established.

- **Regional Tourism and Eco Tourism** – within the areas being revegetated there is a range of possibilities such as horse riding, bush camping, bird watching, outdoor pursuits and holiday accommodation.

Objectives

- Develop a systematic plan to strategically revegetate areas of land to achieve catchment natural resource management targets.
- Identify a suite of species for revegetation that optimises carbon capture, biomass harvest and achievement of natural resource management targets, including water management.
- Generate interest among land holders to develop farm forestry on their land.
- Generate interest among possible investors and buyers of farm forestry products and services, and secure industry support.
- Carry out biophysical, social and economic analyses to assess costs and probable returns from the range of farm forestry options.
- Carry out GIS analysis of land use capability and landscape planning to design a mosaic that optimizes environmental and economic outcomes.
- Develop a management regime that optimises economic, social and ecological objectives at a landscape scale.
- Develop an institutional framework to establish a common property regime at a landscape scale that will provide economies of scale, attract participation from landholders and generate investment confidence.
- Translate options into a commercial prospectus and recruit industry drivers, investors and landholder participants.

Project deliverables are:

I. a landscape plan for strategic revegetation;
II. an incorporated body for multi-farm collaboration and management;
III. a detailed development plan and prospectus to facilitate investment and landholder participation;
IV. development of a model for use in other areas.

Scoping – Phase One

This first phase of the Project is designed to ensure that all relevant research for the farm forestry project is carried out, synthesised and applied to the location. It will be directed by a management group in consultation with an expert panel. Experts will be sought from fields including forestry, landscape ecology, environmental economics, carbon sequestration and trading, biomass production and use, regional development and landscape planning. A core group will remain with

the project throughout, participating in a number of the research activities. The final product of this phase will be a Development Plan which will drive Stage 2 of the project.

Scoping will include:

- **Land Capability:** detailed land capability analysis using GIS to target areas that, if revegetated, would generate the optimum NRM benefit and opportunity for economic return under farm forestry;

- **Land Holder survey/needs analysis:** observation and interview-based survey of landholders and key community members to understand needs and aspirations in the potential target areas and to determine key social, cultural and economic drivers;

- **Desktop Study:** all possible farm forestry options matched to target sub-catchments and social and economic factors;

- **Cost Benefit Analysis:** analysis of each farm forestry option to determine which will be most attractive to target land holders, investors and buyers;

- **Common Property Regime:** developing a common property regime (CPR) that provides a flexible and efficient institutional framework for landholder collaboration and a legal entity which generates economies of scale and investment confidence;

- **Industry Options:** assessing industry options for the possible range of products and seeking industry partners;

- **Modeling:** conducting modeling for selected farm forestry options that would simulate the planting and forecast plant growth and quantity calculations;

- **Production system development:** designing a system that provides continuity of supply, maintains productivity for continued carbon sequestration, maintains landscape function, integrates with other land-uses and manages the risk of fire;

- **Investor analysis:** determine who will be the likely investors in this farm forestry Project for each phase;

- **Expert panel participation:** establish a panel of relevant experts to direct and oversee all phases the Project. Experts will be sought from fields including farm forestry, environmental economics, carbon sequestration and trading, biomass production and use, regional development and landscape planning. A core group will remain with the project throughout, participating in a number of the research activities and contributing to the synthesis and production of the development plan.

- **Development Plan:** all the above will be consolidated into a development plan

Development – Phase 2

The second phase will, through extensive consultations, field analysis and detailed planning under the guidance of the local working group, translate the development plan into an implementation plan and prospectus to attract landholder participation and industry and stakeholder investment.

The development phase will include:

- **Consultation:** with potential land holder participants, investors and industry partners to determine level of interest and likelihood of participation and commitment

- **Labour analysis:** for revegetation and how to source this from relevant organisations (Conservation Volunteers Australia, Greencorp).

- **Seed and seedling supply:** where can they be obtained? Locally? Does the project need to produce its own or can existing suppliers provide it?

- **Fencing requirements:** assess quantity and type required, source and cost of materials.

- **Common property regime:** develop institutional rules in consultation with land holders.

- **Management support:** establish the nature and duration of support required for land holders when the farm forestry is being established and maintained. This will include the critical issue of ongoing fire management,

- **Industry:** develop Memoranda of Understanding (MoUs) and/or contracts between key land holders and those that will be supplied with the products from farm forestry or an in-principle agreement to participate for early phases of project. Ideally a critical mass of stakeholders will already be committed to the project before prospectuses are released.

- **Prospectus:** develop and print a prospectus targeted for the relevant stakeholders such as land holders, investment brokers, investors, carbon emitters and industry.

- **Sponsorship:** assess possible sponsorship options for components of farm forestry such as fencing, seeds, processing.

Implementation – Phase 3

This final Phase of the Project will only occur after a specified period following the release of prospectuses if there is sufficient uptake to make the project viable in the long term. This phase must be self-funding. It will involve:

- **Contracts:** draft all relevant business contracts to be signed by land holders, investors, industry, labour providers and suppliers of relevant materials.

- **On ground works**: conduct any pre-surveying /site assessment, fencing, planting etc.

- **Other possible works required:** weed and feral animal control, water management.

- **Management:** recruitment, administration, training, investor engagement, land holder extension, monitoring and evaluation.

- **Industry process:** harvest product and transport for processing. Transportable products could include pulp for paper, fibre for building, biomass for fuel/charcoal/carbon, mulch and compost.

- **Linkage:** with local and regional goals, social and economic benefits such as tourism and local industry employment.

Carbon Sequestration and Biomass projections

Applying calcuations given in the ***National Carbon Accounting Toolbox*** to mixed environmental plantings on Kyoto-compliant lands in the Lithgow region, indicates that approximately 40 tonnes of carbon dioxide will be sequested per hectare within 10 years and 60 tonnes per hectare within 20 years. These figures compare to a steady 20t/ha for grazing or cropping for the same area.

Based on these conservative estimates, the additional carbon sequestered as a result of the revegetation will be 20 t/ha within 10 years and 40t/ha within 20 years. For every 1000 hectares that are revegetated, an additional 20,000 t of carbon will be sequestered within ten years and 40,000 t within 20 years. There is potential for an area greater than 1000 ha if uptake is high, and a bias towards revegetating riparian zones would see higher soil moisture and fertility levels leading to higher rates of C sequestration due to higher growth rates.

Regular biomass harvest will probably start after 10 years and continue indefinitely. It will not be a clear-fell harvest but a harvest analagous to thinning or controlled burning. Growth, and thus carbon sequestration, will continue after harvest. The 3-PG forest model, indicates that the probable growth of Eucalyptus grandis sp. in the Lithgow region will produce approximately 60 tonnes of stem dry mass per hectare at 20 years and 96 tonnes per hectare at 30 years. Accumulation occurs at a rate of 3.5 t of biomass/ha/year between 20 and 30 years after establishment. A biomass harvest of at least that should be possible after 20 years without significantly reducing carbon sequestration as most of the plant biomass will remain intact.

Data are not yet available on the emissions associated with the biomass harvest or the ultimate use of the biomass. If the biomass is burnt as fuel, some of the carbon it contains may be emitted so cannot be counted as positive gain. If the biomass is used to produce hardboard for building, the carbon it contains will remain locked up indefinitely. The project will also manage fuel loads using biomass harvest and controlled burning which will reduce the risk of large losses of carbon to the atmosphere through uncontrolled wild fires.

Other Benefits from Native Farm Foresrty

(i) This project will provide of number of natural resource management benefits including salinity control, improved biodiversity conservation, bushfire mitigation and improved water quality. It also provides the opportunity for landholders, the catchment management authority and local government to take the lead in investigating and implementing innovative strategies to mitigate and adapt to climate change.

(ii) There will be excellent opportunities for local Indigenous communities to be engaged in on-ground works so that they can obtain Land Conservation Certificate III, which provides them with important skills for future employment and establishing farm forestry on their lands.

(iii) The development of native farm forestry and associated processing of bio-mass will provide social and economic opportunities by attracting industry and corporate investment to purchase products and build locally based processing plants. The flow-on effects of establishing locally based enterprises include increased job opportunities, a more vibrant regional economy and retention of skilled labour.

(iv) An increase in native vegetation that encourages retention and expansion of native wildlife has the potential to add value to current regional tourism and eco-tourism, as well as building resilience.

(v) The project will provide opportunities for landholders, both traditional and on smaller blocks, to contribute to improved environmental management at the same time as diversifying their income

streams. This will result in more expendable income and greater economic and social engagement in the community. Greater community participation generally results in culturally vibrant and caring communities.

(vi) When their external environment reflects the lifestyle they desire there is a stronger tendency to want to give back to the community and environment by way of volunteering, a core element of a successful community, to ensure that all relevant services are provided.

(vii) The project will provide a model for other peri-urban areas.

This project will provide a model, a set of products and a consultative group to facilitate the use of project outcomes in other contexts. Local government, Landcare groups, CMAs and farmers' associations will be potential beneficiaries. It will be of particular interest to other peri-urban areas facing rising land values and resulting sub-divisions which make coordinated NRM difficult.

6. Opportunities and Threats

In addition to the commercial drivers of forestry, bioenergy and environmental services, there may be other possible economic spin offs and opportunities for regional development arising from the project. Increasing the area of land that is revegetated with native species may also provide additional opportunities for tourism and increased land values by appealing to "tree changers". Communities could also develop a whole new range of cottage industries utilising by-products from agri-forestry activities, such as cut-flowers, native foods, native oils and firewood.

Changes in rural demographics in the area west of the BMWHA provide potential opportunities for this project, but also threats. An influx of "tree-changers" attracted by the rural lifestyle and proximity to Sydney is a significant component of sustained population growth for the region. Anecdotal evidence suggests that such landholders are likely to value the existence of native forests on their land, and revegetation activities may increase land values for this reason.

Tree-changers and hobby farmers are also less likely to depend on their land for an income and often have the financial means to invest in alternative land-uses without necessarily expecting to recoup a maximum rate of return on their investment. In contrast to money, when it comes to time and labour, tree-changers are likely to have less to invest in managing their land and may also value the flexibility of being able to be away from their property for long periods. This could make agri-forestry activities managed by separate corporate entity an attractive proposition.

However, there are also threats inherent in these demographic shifts. Rising property prices could mean that other landholders, particularly older traditional farmers, are less attracted to agri-forestry, because subdividing and selling off their property may be far more financially attractive than investing in plantations that may not pay off for a number of years. Tree-changers may also be harder to engage with because they may not use traditional community networks like Landcare or the Rural Fire Service.

Finally, it must also be recognised that many tree-changers and other landholders may not actually place aesthetic value on increasing the amount of native forest in the area, but are instead attracted to rural landscapes consisting of rolling green paddocks. To many landholders, forested land also poses a threat of bushfire that outweighs any aesthetic value. One person's "wildlife corridor" is another person's "fuse" and these concerns have the potential to increase under the influence of a warming climate that will produce more and higher intensity bushfires in an area of growing population with ever-increasing investment in rural residences.

Other threats to the project include the uncertainty in the markets that have been targeted and the long lag time between investment and return from forestry or bioenergy production. The economics of the project are subject to international market forces for timber and energy as well as government policy relating to carbon trading. Producing a diversity of products through a diverse multi-species project is one means of managing this risk and this approach could also provide an opportunity by allowing landholders to "hedge their bets" in a way that is not possible with monocultural farm forestry.

The project will involve assessment of all of these opportunities and risks, including the economic, social and environmental risks involved in agri-forestry activities. It must also be recognised that failing to act quickly enough represents a major risk – both in terms of missed opportunities to capitalise on developing markets at an early stage and in terms of serious and irreversible damage to the landscapes of the Blue Mountains World Heritage Area and its surrounding region.

References

Adams, W.M Brockington, D. Dyson, J. and Vira, B. (2003) 'Managing Tragedies: Understanding conflict over common pool resources', *Science*, 302(5652), pp.1915–1916.

Agrawal, A. (2001) 'Common property institutions and sustainable governance of resources', *World Development*, 29(10), pp.1,649-1,672.

Ampt P., Baumber, A. and Norris, K. (2006) 'Using common property resource approaches to achieve systematic landscape change', paper for the eleventh biennial conference of the International Association for the Study of Common Property (IASCP) in Ubud, Bali 19-23 June 2006.

Archer, M. (2002) 'Confronting crises in conservation: a talk on the wild side', in A Zoological Revolution: Using native fauna to assist in its own survival. Lunney, D. and Dickman, C. (eds.), Royal Zoological Society of New South Wales and Australian Museum, pp.12-52, Mosman.

Archer, M. and Beale, B. (2004) Going Native: living in the Australian environment, Hodder.

Australian Greenhouse Office, Murray-Darling Basin Comission (2001) 'The contribution of mid to low rainfall forestry and agroforestry to greenhouse and natural resource management outcomes.' Australian Greenhouse Office, Commonwealth of Australia, Canberra Act.

Australian Museum Online (2005). Australia's Biodiversity: Loss of Habitat**:** http://www.amonline.net.au/biodiversity/happening/habitat.htm. Accessed 1 May 2006.

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC and ARMCANZ) (1999) 'Managing Australia's Rangelands: National Principles and Guidelines for Rangeland Management', Commonwealth of Australia, April, available http://www.mincos.gov.au/pdf/rangeland_management.pdf accessed on 1/4/06.

Baland, J.M. and Platteau, J.P. (2003) 'Economics of Common Property Management Regimes', Chapter 18 in Handbook of Environmental Economics, 1st edition, edited by K.G. Maeler and J.R. Vincent (eds.), Amsterdam, Elsevier.

Bromley, D. (1991) Environment and Economy: Property rights and public policy, Blackwell, Cambridge, USA.

Bromley, D. (2005) Book Review, of The Commons in the New Millennium, Dolsak, N. and Ostrom, E. (eds.) in *American Journal of Agricultural Economics*, 87(1), February, pp.265-267.

Buffier B, Allen Consulting Group (2002) 'Environmental and commercial outcomes through agroforestry.' Rural Industries Research & Development Corporation, RIRDC Publication No 02/057.

Campbell, B., Mandondo, A., Nemarundwe, N., Sithole, B., De Jong, W., Luckert, M., and Matose, F. (2001) 'Challenges to proponents of common property resource systems: despairing voices from the social forests of Zimbabwe', *World Development*, 29(4), pp.589-600.

Chapman, M. (2003) 'Kangaroos and feral goats as economic resources for graziers: some views from south-west Queensland', *The Rangeland Journal*, 25(1), pp.20-36.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2000) 'Sustainable Use of Rangelands in the 21st Century: on the road to a better future for the Western Division of NSW', *Booklet*, CSIRO, NSW Department of Land and Water Conservation, Land and Water Australia.

CSIRO (1998). Building and Sustaining Australia's Billion Dollar Industries: Beating Land Degradation**:** http://www.csiro.au/promos/billiondind/contents/beating.htm. Accessed 1 May 2006.

Coop, P. and Brunkhorst, D. (1999) 'Triumph of the commons: Age-old participatory practices provide lessons for institutional reform in the rural sector', *Australian Journal of Environmental Management*, 6(2), pp.48-56.

Department of Agriculture Fisheries and Forestry (2006). Australia's Forest Industry.

Department of Environment and Conservation (DEC) (2006) 'Draft NSW Kangaroo Management Plan 2007-2011', Available http://www.nationalparks.nsw.gov.au/npws.nsf/Content/kmp_2007_2011_draft , Accessed 10/6/06.

Department of Environment and Heritage (DEH) (1999) [online] 'Australia's Rangelands: factsheet', Available http://www.deh.gov.au/land/publications/rangelands/index.html Accessed 1/4/06.

Department of the Environment and Heritage (2006). EPBC Act List of Threatened Fauna**:** http://www.deh.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna. Accessed 28 April 2006.

Devlin, R.A. and Grafton, R.Q. (1998) Economic Rights and Environmental Wrongs: Property rights for the common good, Northampton, MA, USA, Edward Elgar.

Dolsak, N. and Ostrom, E. (2003) The Commons in the New Millennium: Challenges and Adaptation, MIT Press, Cambridge Massachusetts, USA.

Figgis (2004) 'Conservation on Private Lands: the Australian Experience', IUCN, Gland Switzerland and Cambridge USA, i to 31 pp.

Future of Australia's Threatened Ecosystems (FATE) (2005) [online] 'The FATE Program', Available http://www.fate.unsw.edu.au Accessed 1/4/06.

Griffiths T (2002) How many trees make a forest? Cultural debates about vegetation change in Australia. Australian Journal of Botany 50, 375-389.

Grigg. G. (1991) 'Kangaroos, land care and animal welfare, a proposal for change', *Bulletin of the Ecological Society of Australia*, vol 21, pp.30-35.

Grigg, G. (2002) 'Conservation benefit from harvesting kangaroos: status report at the start of a new millennium', in A Zoological Revolution: Using native fauna to assist in its own survival. Lunney, D. and Dickman, C. (eds.), Royal Zoological Society of New South Wales and Australian Museum, Mosman.

Grigg, G., and Lunney, D. (1995) 'Potential conservation benefits from kangaroo harvesting', Workshop Report, in Grigg, G., Hale, P. and Lunney, D. (eds.), Conservation Through Sustainable Use of Wildlife, Brisbane, Centre for Conservation Biology, University of Queensland.

Hardin, G. (1968) 'The Tragedy of the Commons', *Science*, Vol.162, 13 Dec, pp.1243-1248.

Hardin, G. (1998) 'Extensions of the tragedy of the commons', *Science*, Vol.280, 1 May, pp.682-683.

Holmes, J. (1997) 'Adapting leasehold tenures to meet emerging conservation needs', in Hale and Lamb (eds.), Conservation Outside Nature Reserves, Centre for Conservation Biology, University of Queensland.

Irons, C.D. (1997) 'Sustaining catchment health: prioritise! co-operate! evaluate!', in Hale and Lamb (eds.), Conservation Outside Nature Reserves, Centre for Conservation Biology, University of Queensland.

Kaiser, M.J. and Jennings, S.J. (2001) 'An ecosystem perspective on conserving targeted and non-targeted species', in Conservation of Exploited Species, Reynolds, J.D., Mace, G.M., Redford, K.H., and Robinson, J.G. (eds.), Vol 6, Zoology Society of London, Cambridge University Press, Cambridge.

Landsberg, J.J., Waring, R.H. 1997. A generalised model of forest productivity using simplified concepts of radiation-use efficiency, carbon balance and partitioning. For. Ecol. Manage. 95, 209-228.

Landsberg, J.J., Waring, R.H. and Coops, N.C. 2003. Performance of the forest productivity model 3-PG applied to a wide range of forest types. Forest Ecology and Management. 172, 199-204.

Layzer, J.A. (2006) The Environmental Case: Translating Values into Policy, 2nd Edition, CQ Press, Washington D.C.

Lindenmayer, D. and Burgman, M. (2005) Practical Conservation Biology, CSIRO Publishing, Collingwood Victoria.

Ludwig, D. (2001) 'Can we exploit sustainably?', in Conservation of Exploited Species, Reynolds, J.D., Mace, G.M., Redford, K.H., and Robinson, J.G. (eds.), Vol 6, Zoology Society of London, Cambridge University Press, Cambridge.

Marshall GR (2005) 'Economics for collaborative environmental management.' (Earthscan: London)

McNeely, J.A., Miller, K.R., Reid, W.V., Mittermeier, R.A. and Werner, T.B. (1990) Conserving the World's Biological Diversity, International Union for Conservation of Nature and Natural Resources, World Resources Institute, Conservation International, World Wildlife Fund–US, World Bank, Gland, Switzerland.

National Forest Inventory (2005). National Plantation Inventory Australia 2005 Update. Canberra, Bureau of Rural Sciences.

O'Connor, J. and Thompson, G. (2001) 'International Trends in the Structure of Agricultural Cooperatives', A report for RIRDC, RIRDC publication no. 01/06, January.

Ostrom, E. (1990) Governing the Commons: The Evolution of Institutions for Collective Action, Cambridge University Press, New York.

Pannell DJ, Marshall GR, Barr N, Curtis A, Vanclay F, Wilkinson R (2006) Understanding and promoting adoption of conservation practices by rural landholders. Australian Journal of Experimental Agriculture 46, 1407-1424

Pickard, J. (1990) 'Attitudes and environmental use and management in the forgotten 70% of Australia', *Zoologist*, 26(2), June, pp.554-58.

Pickard, J. (1994) 'Land degradation and land conservation in the arid zone of Australia: Grazing is the problem and the cure', in Conservation Biology in Australia and Oceania, Moritz, C. and Kikkawa, J. (eds.), Surrey Beatty and Sons, Sydney, Australia.

Poteete, A.R. and Ostrom, E. (2004) 'In pursuit of comparable concepts and data about collective action', *Agricultural Systems*, 82, 215-232.

Productivity Commission (2002) 'Pastoral leases and non-pastoral land use', Commission Research Paper, Ausinfo, Canberra, July.

RIRDC, Australia LaW, FWPRDC (2002) 'Agroforestry and Farm Forestry.' (RIRDC: Canberra)

Robins L (2002) 'Managing Riparian Land for Multiple Uses.' (Rural Industries Research & Development Corporation: Canberra Act)

Robinson, J.G. (2001) 'Using 'sustainable use' approaches to conserve exploited populations', in Conservation of Exploited Species, Reynolds, J.D., Mace, G.M.,

Redford, K.H., and Robinson, J.G. (eds.), Vol 6, Zoology Society of London, Cambridge University Press, Cambridge.

Robinson, N.J. (1997) 'Preservation of biodiversity on grazing lands', in Hale and Lamb (eds.) Conservation Outside Nature Reserves, Centre for Conservation Biology, University of Queensland.

Stafford Smith, M. (2000) 'Grazing half of Australia: risks and returns to regional futures', Bureau of Rural Sciences, Emerging technologies in Agriculture: from ideas to adoption Conference 25-26 July, Available http://www.daff.gov.au/corporate_docs/publications/pdf/rural_science/confEtiA7-00papers/MStaffordSmith_paper.pdf Accessed 9/6/06.

Stafford Smith, D.M., Morton, S.R., and Ash, A.J. (2000) 'Towards sustainable pastoralism in Australia's rangelands', *Australian Journal of Environmental Management*, vol 7, pp.190-203.

Stirzaker R, Lefroy T, Keating B, Williams J (2000) 'A revolution in land use: emerging land use systems for managing dryland salinity.' CSIRO, 0643060804, Dickson, ACT.

Webb, G. (2001) 'Conservation and sustainable use of wildlife: an evolving concept', in Proceedings of International Joint Conference, Veterinary Conservation Biology, Wildlife Health and Management in Australia, Martin, A and Vogelnest, L. (eds.), 1-6 July 2001 at Taronga Zoo in Sydney, Aussieprint Canberra.

Western Catchment Management Authority (Western CMA) [online] 'About Us', Available http://www.western.cma.nsw.gov.au/ Accessed 10/6/06.

Williamson, S., Brunkhorst, D., and Kelly, G. (2003) Reinventing the Common: Cross-boundary farming for a sustainable future, The Federation Press, Sydney.

Wilson, M. and Croft, D.B (2005) Kangaroos: Myths and Realities, Australian Wildlife Protection Council Inc, Melbourne.