Greenhouse gas abatement: a review of potential social implications of land-use change in Australia

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Summary

There is growing support, both within Australia and internationally, for substantial changes to the way rural land — particularly farmland — is managed, in an effort to reduce net greenhouse gas emissions. Greenhouse gas abatement is part of the pressure that is redefining agricultural practices and the nature and extent of forestry in Australia in an attempt to meet international obligations (targets) defined in the Kyoto Protocol. While a considerable investment has been made to improve understanding of the processes of carbon emission and sequestration in the land sector, comparatively little effort has been devoted to understanding the social dimension of the massive changes that some expect landholders will have to make. In broad terms, the key social issues relate to the nature, scale and rate of change by individual landholders, geographical communities and industry sectors, but a full understanding of the key social issues is yet to be attained. For instance, many farming families and agricultural industries do not have the social and economic capacity to make widespread changes to current practices, even if alternative practices are highly desirable. Furthermore, there is great variation in the feasible options available to individual farming families, regional communities and rural sectors to reduce greenhouse gas emissions — forced change may see this disparity increase. This paper contributes to the debate in favour of carbon sequestration by providing information about appropriate and feasible change which is sensitive to the social context of rural Australia.

Keywords: greenhouse gases; carbon sequestration; land use; forestry; agriculture; change; social impact; social change; Australia

Introduction

This paper concentrates on the social dimension of rural land-use change that directly results from efforts to curb greenhouse gas emissions or to increase sequestration. It discusses the broad social implications of relevant changes in grazing and cropping systems, clearing of native vegetation, establishing plantations and potential trading in carbon credits (CRC 2000).

While recognising that the social dimension of land-use change has potentially far wider implications than noted above — such as change due to telecommunication technology altering business and travel in rural Australia, change in energy generation and usage, change in rural land-use due to urban development — this paper concentrates on those areas that are of immediate interest to the agricultural and forestry sectors.

The need for land-use change in rural Australia

It is widely believed that Australians must make considerable changes to the way we manage our farmland in order to:

- move towards sustainable agriculture to reduce rates of environmental degradation, amongst other reasons, and
- reduce land-based greenhouse emissions and increase carbon sinks.

For instance, much of the 100 million ha of Australia's wheat-sheep zone, comprising the largest land-use of the medium–low rainfall area, is now widely believed to have been over-cleared of its native vegetation and is showing signs of environmental stress — in particular, increased dryland salinity and loss of biodiversity. Research suggests that the cost of revegetating this agro-ecological zone to arrest land degradation exceeds $20 billion (George *et al*. 1999; Hatton and Salama 1999). At a national scale, the cost of environmental rehabilitation across all farmland is estimated to be $60 billion (George *et al*. 1999; Hatton and Salama 1999; VCG and Griffin Natural Resource Management 2000). This is more than 40 times the amount of funds made available through the Natural Heritage Trust — to date, the Australian Government's largest environmental rehabilitation program. Even the Commonwealth and State Governments' $1.4 billion seven-year *National Action Plan for Salinity and Water Quality* will cover only a small portion of the full costs of rehabilitating the nation's farmland.

In parallel is the international agreement-in-principle Kyoto Protocol (adopted in December 1997), which aims to commit most countries to reduce net greenhouse gas emissions to 5% below a country's 1990 level — although Australia is an exception with its emission target set at 108% of its 1990 level, in effect an increase, by the first commitment period (2008–2012). Some commentators argue that this exception makes Australia's compliance with the Kyoto Protocol a relatively straightforward task, as Article 3.7 has 'opened up a large loop-hole which only (Australia) is in a position to exploit' (Hamilton and Vellen 1999, p. 151), while others suggest that meeting the target of the Kyoto Protocol 'constitutes a significant reduction of net emissions below business-as-usual projections, and it will require significant policy initiatives to achieve this reduction' (Kirschbaum 2000, p. 83).

At a national level, the Australian Government developed the National Greenhouse Strategy (NGS), managed by the Australian Greenhouse Office (AGO), which has, as one major focus, the establishment of greenhouse sinks and sustainable land management. The AGO (2000, p. 18) stated that the NGS 'recognises that greenhouse sinks play an important role in reducing the level of greenhouse gases in the atmosphere and represents one practical means for Australia to reduce emissions and meet its international commitments.'

Understanding greenhouse gas emissions

In terms of the scope of this paper, rural land-use has implications for greenhouse gas emissions largely due to:

- clearing of existing woody vegetation for other land-use, with clearing of native vegetation contributing about 20% of Australia's 1990 level of emissions (AGO 1999);
- operations of existing agricultural industries, with agricultural emissions (mainly methane from beef cattle and sheep) contributing about another 20% to the national 1990 level of emissions (Howden and Reyenga 1999); and
- plans to expand the area of forestry on farmland, to act as a carbon 'sink' (AGO 1998).

Although arguably much of the detailed science is still to be fully understood (AGO 2003), undoubtedly the nature, scale and rate of land-use change required in rural Australia to develop more sustainable farming systems and establish large areas of plantations to considerably reduce net greenhouse gas emissions will have important social implications for individual landholders, regional communities and primary industry sectors.

Principal social issues for research and development

The key aspects of the social implications of widespread land-use change for communities and landholders within Australia are mirrored in the international setting (Rosa 2001), and are outlined below.

Key social issues

The key social issues relate to the nature, scale and rate of change for:

- individual landholders, groups of similar landholders and their surrounding communities (which of these have the capacity for change?);
- differing groups of landholders (e.g. farm families, corporate farms, indigenous communities) and agricultural sectors willing and able to make changes voluntarily, compared to those compelled by regulation to make changes; for instance, opportunities for profitable joint ventures between forestry companies and landholders exist only in some medium–high rainfall regions;
- differing agricultural sectors (e.g. cereal cropping compared to livestock, dairying compared to horticulture), regions dependent on agriculture and forestry, and the individual businesses associated with agriculture and forestry;
- markets, such as those for trading carbon credits, and the extent to which commercial incentives will emerge for desired land-use change (will small-scale growers be commercially competitive?);
- equitable or fair distribution of the benefits and costs of land-use changes between agricultural sectors, between regions, and between landholders within a region (also between countries, see Roberts 2001); and
- government agencies responsible for policy initiatives and responses to land-use changes (do primary industry agencies have the institutional capacity for change?).

Capacity for change by regional communities and landholders

Declining terms of trade for some farmers and regions

In terms of land area, cereal cropping (largely wheat) and sheep farming (largely wool) are the dominant private land-uses in Australia's low–medium rainfall (400–700 mm y^{-1}) areas. Areas of irrigated agriculture (e.g. cotton, rice) and horticulture (e.g. fruit) occur within this agro-ecological zone, but occupy far less, yet highly valuable, land. Wheat–sheep farming and associated industries have been experiencing declining terms of trade over the last four decades, and have recently been affected by extended periods of drought (arguably natural climate variability) — especially in inland Queensland and western NSW. Also, wool has dropped more than five-fold in value to the nation's economy in real terms since its peak period in the 1950s, with wool now contributing about 0.5% to the GDP (ABS 1998).

Within the wheat–sheep zone, 50–80% of household income is derived from agriculture, so it is not surprising that there was a steady rate of population decline in this zone during the 1990s, with the median age of farmers increasing. While just 4% of Australia's workforce is employed in the agricultural sector, its importance is much greater for regional centres and rural towns, where 30–50% of workforce is employed in agriculture and associated businesses (ABS 1998; Haberkorn *et al*. 2000).

During the last few decades, grain prices have generally been steady with occasional peaks in market prices. Wool prices, however, have generally been very depressed and are only just starting to make a slow recovery following the economic downturn of traditional customers (i.e. in Asia, Europe, former Soviet Union). Despite stronger world economic activity and increased numbers of consumers, retail demand for wool remains subdued. Some woolgrowers, however, are successfully exploiting what many in the industry see as the best long-term chance to remain viable — to produce low-volume, high-value wool for the luxury market. On such properties, changes in land-use to reduce emissions or increase sequestration (e.g. by adopting farm forestry) will need to generate \$180–200 ha^{-1} per year to match returns from wool production, or play a supporting role to sustain or improve wool production.

In the medium–high rainfall (>700 mm y^{-1}) areas of rural Australia, the major land-uses include livestock grazing (beef cattle and sheep), dairying, forestry and horticulture. The recent de-regulation of Australia's dairy industry is causing considerable structural change: about a third of dairy farmers are expected to exit the industry (with support of the Australian Government's

$1.7 billion *Dairy Structural Adjustment Package*) during the next few years as small or marginal dairy farms give way to larger and more efficient operations. It is uncertain if this structural change will reduce the size of the national dairy herd, or simply allow the remaining farms to expand with no net reduction in the size of the national herd. In general terms, dairy farms are located on fertile farmland with ample freshwater supplies (either from being in high-rainfall areas or with access to off-farm supplies), with land value usually exceeding $3000 ha^{-1}.

Forestry — both plantations (1.5 million ha) and native forests (13.3 million ha) — fulfils an important socio-economic role in rural and regional Australia in the >700 mm y^{-1} rainfall zone, with 35 small towns having more than 20% of the workforce employed in the forest industries (BRS 1998, 2001). When companies have run land-lease schemes offering farmers $160–240 ha^{-1} y^{-1} so they can establish plantations on farmland, these have been popular amongst landholders with grazing enterprises (Race and Curtis 1999). Yet, in recent years, the leasing of farmland in northern Tasmania and south-western Victoria by companies establishing plantations has caused mixed perceptions about the extent of benefits from forestry (Petheram *et al*. 2000; Schirmer *et al*. 2000). While in general forestry may serve as an important greenhouse 'sink', not all in rural Australia view the current approach to plantation forestry as providing broad social benefits — making the assumption that landholders will voluntarily establish large areas of plantations problematic (Gerrand *et al*. 2003). An added complication for a strategy for widespread land-use change involving commercial forestry is that global warming, in part due to human-induced greenhouse gas emissions, appears already to be contributing to more frequent climatic extremes — making forestry in marginal areas an increasingly risky business (Pearman 2004).

What change for wheat–sheep farmers?

General figures for profitability of farming within the wheat–sheep zone disguise the great disparity between individual farming businesses (Locke 2003). While most farms within this zone have been unviable in economic terms during the 1990s, a significant number — about 40% of cropping and 20% of sheep farms — still generated a reasonable household income (FarmBiz 500 uses a taxable income of $50 000 p.a. as the threshold). The profitable wheat-sheep farms are characterised as having:

- larger farm sizes (>500 ha);
- lower debt;
- continual investment in upgrading technology, equipment or genetics; and
- high quality produce.

A typical strategy for wheat–sheep farms without the above features is to increasingly gain off-farm income, thereby maintaining the household income. This option is available only on an appreciable scale near large regional/urban centres.

As discussed earlier, those with viable wheat–sheep enterprises are more likely to adopt farm forestry as an additional enterprise if it sustains or improves their current farming systems. That is, they are likely to integrate farm forestry with wheat–sheep production, rather than abandon the latter. Young farmers (<40 y) with large farms — in size and business — and those families with a positive intention of passing the farm onto the next generation, are most commonly associated with farm growth and making a serious investment in long-term farm improvements (Tanewski *et al*. 2000).

Even though wheat–sheep enterprises tend to have lower opportunity costs than dairying or horticulture, most wheat–sheep farmers do not have sufficient finance to invest in widespread land-use change, even if change is demonstrably commercially prudent. Also, suggesting that these farmers should have equity in the processing stage of a value-added industry (e.g. sawmilling based on farm forestry) denies their lack of liquidity for any type of investment. However, as seen in the medium–high rainfall zone, many farmers will be attracted by commercial forestry that provides annuity payments (i.e. regular and reliable income equal to, or higher than, that from their current enterprises), or provides them with the opportunity to sell-out and exit agriculture. Some of these farmers appear to be deferring their exit from agriculture until wool prices improve to allow the sale of the farm at a reasonable price to support their retirement (Barr and Cary 2000).

Outside finance needed for change

Given the low returns for much of Australia's dryland farming (particularly wool production) and its dependent regional industries (Lockie 2003), it appears farmers are unlikely to have sufficient financial reserves to undertake major changes to reduce greenhouse gas emissions or establish large-scale sinks, particularly within the first reporting period of the Kyoto Protocol 2008–2012. Such changes will require considerable injection of finance from outside these regional economies. Access to outside finance may be possible, as illustrated by the recent expansion of blue gum planting on farmland (in the 600–1000 mm y^{-1} rainfall zone) largely financed by urban-based investors and overseas companies. However, even if outside finance became available (e.g. via trading in carbon credits or taxation incentives), it will be important to identify which agricultural sectors, regions and landholders have the capacity for voluntary change, so those without that capacity are supported adequately.

Community concerns with widespread land-use change

Rapid and profound changes in land-use, particularly for rural and regional communities dependent on agriculture, have led to considerable anxiety. For example, while there are claims that widespread farm forestry can have positive outcomes for some aspects of the environment and communities, this opportunity needs to be carefully appraised and explored by the target communities before they adopt it. Even if farmers are favourably disposed to establishing trees on farms, developing the critical mass of plantations within a catchment to support a viable processing industry is far more complex — particularly when a perception emerges that forestry may displace existing agricultural enterprises (Gerrand *et al*. 2003; Williams *et al*. 2003). For example, during the 20+ y it takes a plantation to sufficiently mature for harvesting, science and public debate in relation to forestry can shift dramatically (Rolley 2001; Gerrand *et al*. 2003; Pearman 2004).

Widespread land-use change is unlikely to affect everyone similarly, nor even provide benefits to all (Vanclay and Lawrence 1995; Lockie 2003). New forms of land-use may simply be part of the response to long-term structural change, particularly in the wool industry, but assumptions about the extent of community acceptance of major land-use alternatives should be avoided. Also, despite the long-term decline in terms of trade in wheat–sheep farming, farmers and rural communities still retain considerable allegiance to these industries, reflecting the historical importance to their region's, and the nation's, development during the 20th century. Opportunities will need to be fully explored in partnership with communities so the nature, scale and rate of land-use change can be appreciated and tailored to the local context. As a general rule, the more forestry is integrated with (and supports) current agricultural practices — rather than displacing farming — the less likely it is that widespread community anxiety will arise (Tonts *et al*. 2001).

Land-use changes that increase business prosperity, allow for business diversification, encourage population growth, and add to the aesthetic appeal of a region are likely to be welcomed at a broad level by regional communities. However, as increased development does not affect everyone equally, communities can be divided over the type and extent of development that is preferred for their region. As such, an expanding primary industry that causes rapid and widespread land-use change is likely to be of concern for some segments of a community, with their concerns usually being that:

- existing agricultural industries will be replaced, leading to the demise of associated businesses;
- loss of economic activity will lead to population decline and loss of important social and community services (e.g. schools, hospitals and allied health facilities);
- uncompetitive markets and unfair trading partnerships may leave farmers with little scope to negotiate prices and trade arrangements;
- large-scale corporate businesses contribute less to the social structure and services (e.g. volunteer fire brigade, landcare) than small local businesses;
- new industries (e.g. industrial forestry) can undermine a region's aesthetic characteristics (e.g. restrict views);
- new industries will cause the decline of a region's already deficient transport infrastructure; and
- their neighbour's new activities will cause problems for themselves (e.g. pest plants and animals).

Several reports provide further detail on the socio-economic impacts of the expansion of forestry on Australian rural communities (Spencer *et al*. 1989; Dargavel 1990; Race and Curtis 1997; Race and Fulton 1999; Barr *et al*. 2000; Petheram *et al*. 2000; Tonts *et al*. 2001; Schirmer 2002; Schirmer and Tonts 2003; Williams *et al*. 2003).

Capacity for industries to change

Many of the small/medium-scale intermediate processors in rural towns and regional centres that are dependent on cereal cropping and grazing industries (e.g. initial processors such as cereal millers or wool scourers) have been struggling to remain viable over recent decades. These industries are unlikely to have sufficient financial reserves to allow for investment in new energy-efficient technology with low levels of carbon emissions.

Small-scale and geographically-remote processors are tending to be replaced by vertically integrated grower–processor–retailer partnerships, with the location of processing capital now more likely to be determined by low costs of processing (low land value, access to existing transport infrastructure and routes, economies of scale with other food and fibre industries), rather than necessarily being close to the primary feedstock.

Also, establishing efficient processing centres for food and fibre products at major towns or regional centres allows businesses to benefit from good power, telecommunication and transport infrastructure, reliable water supplies, and adequate social and community services for employees. The aggregation of small/medium-scale businesses in such locations allows them to benefit from economies of scale — as a 'cluster' economy. Examples of this approach appeared to work well for wine and olive oil businesses (Stayner 1999). It will be important for existing and new rural industries to acknowledge this trend, because many farms generate high-volume low-value products, with most of the benefits being associated with the processing stage that is often located outside the growing region.

Adoption of technology to reduce agricultural emissions

There appears to have been relatively little direct investment by the agricultural industries in research and development to create technology to reduce greenhouse gas emissions, compared to that sponsored by government. This is particularly noticeable within the livestock industries, which are responsible for most emissions from agriculture. This seems reasonable given that the likely changes are not yet mandatory and that the cost of change for some agricultural sectors may be considerable. This may not necessarily represent a deficiency in Australia's National Greenhouse Strategy, as continuing structural and technological change within the livestock industries may still deliver reductions in emission levels (e.g. steady decline in sheep numbers). The main areas for reducing emissions from agriculture that are relatively cost-efficient, low-risk and have a high chance of success include reducing livestock numbers and improving the efficacy of fertiliser application (also, a vaccine is being developed by CSIRO that aims to decrease methane emissions by livestock).

As discussed above, over recent decades many primary producers — in both the food and fibre industries — have had a weakening capacity to negotiate within markets. Current market structures make it difficult for them to pass on to processors and consumers their increasing input costs, and hence their terms of trade have declined. How competitive farmers will be in future markets remains uncertain.

Trading of carbon credits

Much is still to be developed in Australia before there is a well-structured and responsive market for trading carbon credits, compared to the European Union which has had a publicly-available carbon market indicator since early 2003. This indicator tracks recent trading (currently the indicator is about AU$10 t^{-1}

CO_2; *Carbon Trader* 6 August 2004, see www.pointcarbon.com). Despite the early optimism in the potential for carbon trading, the Australian Stock Exchange (Sydney) suspended its interest in such a market mid-2000. Also, even the most optimistic forecasters are careful to point out that markets for environmental services, such as carbon credits, should be viewed only as an adjunct to the more conventional markets for farm forestry (i.e. timber) and other benefits such as provision of shade and shelter for conventional grazing and cropping enterprises.

In terms of landholders establishing farm forests and wanting to sell the carbon sequestered by their trees, small-scale growers (<100 ha) may have to aggregate their resource with others to achieve a reasonable economy of scale. Some analysts believe that a minimum of 1000 ha of forest may be required before carbon trading will be warranted, as growers will have to deduct the costs of verification and sale. Cost-effective methods of carbon accounting and verification are still being developed.

In favour of small-scale growers being able to benefit from carbon trading, Australia now has an established regional network of tree-growers' marketing cooperatives, with a cooperative in most of the major forestry regions. Adding further strength to this network is the marketing cooperation between some cooperatives. However, not all farmers are familiar or comfortable with trading through a cooperative, and ultimately cooperatives face financial challenges similar to those of other businesses. Alternatively, a number of growers could commission a broker to coordinate and negotiate on their behalf, or simply sell their carbon credits to a neighbouring large-scale grower.

Nonetheless, economic logic suggests that the diverse nature of farm forestry and poor economies of scale will tend to work against small-growers (e.g. farmers) being able to derive much benefit from the trade in carbon credits. The costs of verification per hectare — especially with non-commodity species and unconventional silviculture in non-forestry regions — presumably will be higher than for industrial forestry.

While there is now an Australian Standard for Carbon Accounting (Standards Australia 2002), much research is still required to identify who is likely to pay for carbon emissions (people, regions, industries, government?) and who will receive financial returns for creation of carbon sinks (people, regions, industries, government?).

What role is there for government in a carbon market?

At this stage, farm forestry in non-forestry regions can sell some products on open commercial markets (e.g. timber), but relies heavily on government for establishing and developing the technology and critical mass for a viable industry. A blend of market forces (inherently dynamic) with government influence (a degree of stability) can be an uneasy mix, as illustrated by the wool industry that has only recently recovered from the massive stockpiles held for several years by the Australian Wool Corporation (underwritten with government funding) when there was a 'floor' price.

This situation could be difficult for farm forestry if it relies on several unrelated markets simultaneously for business viability. That is, timber markets may fluctuate over the 30–40 y period in which some trees are grown, thereby having a varying opportunity cost (i.e. commercial attractiveness) against the emerging 'service' markets (e.g. carbon, salinity and biodiversity credits). If the different markets become mutually exclusive in terms of establishment and silviculture, then presumably the most lucrative market will tend to have the greatest influence. Alternatively, aggregating a number of low-value markets (products and services) may provide an attractive forestry package for landholders.

It is difficult for government to support cost-sharing, taxation relief, research and development, and provide establishment grants, without adversely affecting the opportunity costs of alternate commercial industries within the region (e.g. by altering land prices), or the commercial comparative advantage of neighbouring regions (e.g. reducing the demand for cleared farmland to establish forestry in one region due to government-subsidised forestry in a neighbouring region). Again, in-depth assessment of the full (direct and indirect) implications of various government roles in a region's economy, and its neighbours', is required when appraising where and how to encourage widespread land-use change.

Of interest, Europe has reaffirmed its commitment to the concept of 'multi-functionality', where landholders are paid for a composite of agricultural produce, management of land and water resources, maintaining biodiversity, and contributing to a region's aesthetic qualities. Australia may also benefit from developing a holistic approach to rural land-use, rather than focusing on individual agricultural sectors.

Introduction of regulations to limit clearing of woodlands and native forests

Recent estimates indicate that clearing of native vegetation on private land, primarily for agriculture, is a major source of Australia's greenhouse gas emissions. The contribution is about 20% of Australia's 1990 level of emissions (AGO 1999, 2000). Legislated restrictions on clearing native vegetation will hinder one historical strategy used in Australia for improving farm viability — clearing 'unproductive' bush for expanding agricultural enterprises (e.g. cropping, grazing) or commercial forestry. However, unrestricted grazing may well cause the gradual decline in health of remnant vegetation by selective grazing of palatable plants, preventing regeneration of a wide range of plants, and introducing invasive weed species. Over time, this practice could lead to the loss — intentionally or unintentionally — of native vegetation and contribute to greenhouse gas emissions and reduce the capacity for sequestration.

Clearing restrictions — which exist in all States, although to varying degrees — are perceived by some farmers as a barrier to establishing and expanding high-value farm operations, such as growing rice, cotton and wine grapes. Land and Water Australia continues to fund research into various technical and socio-economic aspects of management of native vegetation on private land (Binning and Young 1999; Cary and Williams 2000; Hamilton *et al*. 2000).

Also worthy of consideration are the decision-making processes that determine plantation location, design, silviculture and harvesting used in commercial forestry and the effect of plantation operations on net greenhouse gas emissions (CRCGA 2000).

Potential social research to support land-use change

There are calls for a more comprehensive science base to underpin our understanding of the impacts of climate change (AGO 2003). In relation to increasing our knowledge of the social implications of land-use change, there needs to be:

- greater understanding of the social and economic heterogeneity amongst Australian farmers
- increased analysis of the various scenarios for land-use change, and the implications for individual landholders, geographical communities and industry sectors, and
- in-depth exploration with target audiences to identify the greenhouse-gas-reducing strategies that are most desirable and feasible.

Table 1 outlines some of the potential areas for social research that could be explored.

Conclusion

Although there is growing support, both within Australia and internationally, for substantial changes to the way people manage rural land, it is not clear how and where this change should occur to reduce net greenhouse gas emissions. Greenhouse gas abatement is increasingly seen as a reason for re-defining agriculture and forestry practices in Australia in an attempt to meet international targets agreed to under the Kyoto Protocol. While considerable investment has been made in complex science to explain the processes and implications of increasing greenhouse gas emissions, there appears to have been comparatively little effort to understand the social dimension of the changes expected of rural landholders.

In broad terms, if a considerable change in land-use is required to reduce greenhouse gas emissions, then the social implications of the nature, scale and rate of change expected of individual landholders, geographical communities and industry sectors (e g. the dairy industry) need to be fully explored. As discussed above, many farming families do not have the social and economic capacity to make widespread changes to their current farming practices, even if alternative practices are highly desirable. Furthermore, there is great variation in the extent to which individual farming families, regional communities and rural sectors have feasible options to reduce greenhouse gas emissions — so requiring careful consideration of how land-use change to avoid increasing existing disparities.

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Table 1. Potential social research to support land-use change

1.	With various groups of rural landholders, explore and identify the important factors in their capacity and willingness to make changes to reduce greenhouse gas (GHG) emissions. Explore the most effective GHG-reducing strategies (in terms of cost-efficiency, feasibility, adoption); then explore these options with focus groups drawn from the various groups of landholders. Explore the decision-making processes and motivations of various groups of landholders which would lead to voluntary change.
2.	Evaluate the social implications for individuals, communities and land-use sectors of various scenarios, including: • continue current land-use, • undertake voluntary change, and • undertake voluntary and regulated change. Explore the distribution of the benefits and costs of the various scenarios with different social groups.
3.	Develop an 'atlas of change' that illustrates the extent to which GHG-reducing strategies are socially desirable and feasible across different agro-ecological zones and with different communities (e.g. wheat-wool dependent communities, rural Aboriginal communities). This will help to identify where some landholders are willing and able to undertake voluntary land-use changes.
4.	Develop the social capacity of regional communities (e.g. critical analysis of information, strategic planning, community leadership and cohesion, co-learning practices), so they can explore land-use changes that would favour net reductions in GHG emissions.

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