Working Paper 4
October 2009

Capturing carbon in the rural landscape

Opportunities for Queensland

A Premier's Council on Climate Change report

An initiative of the

Toward Q Tomorrow's Queensland | Queensland Government

The information contained in this paper is current as at October 2009. Readers should be aware that some information may be superseded as a result of further policy developments and/or scientific studies.

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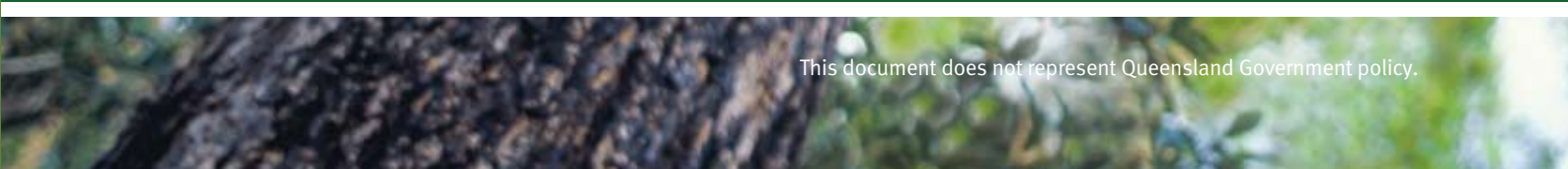


Letter of commendation

Dear Premier

Please find attached the Premier's Council on Climate Change fourth working paper, Capturing carbon in the rural landscape: Opportunities for Queensland.

This paper builds on the interim paper on this topic, which presented the results of the nationally significant CSIRO assessment of Queensland's biosequestration opportunities, which your government commissioned for the Council.

The CSIRO report confirmed the enormous potential terrestrial carbon holds for reducing state and national greenhouse gas emissions. In advising on the relative size and readiness for implementation of different land use processes, the CSIRO report provided valuable sign posts for Queensland's policy path forward on terrestrial carbon.

It confirmed that, in the near term, the great bulk of the carbon saving potential is in trees. The inclusion of forestry offsets in the national Carbon Pollution Reduction Scheme in 2011 provides an opportunity to realise this great potential and will revolutionise land management across the state. As the science in this area develops there will be further opportunities, in areas such as biochar and rangelands management, to use market incentives to drive carbon positive land use changes.

If implemented with foresight and planning, a price on carbon stored in the landscape can be much more than just a critical tool in the fight against climate change. It also has the potential to provide a catalyst for breathing new life into the restoration of Queensland's carbon-depleted rural landscapes, using a new source of income to help farmers become more sustainable.

If we can harness this new terrestrial carbon to drive investments away from prime agricultural land and into high priority conservation areas such as critical habitat and riparian corridors, terrestrial carbon can not only help Queensland fight climate change, it can improve the health of our farmlands and help repair our degraded landscapes.

This paper includes recommendations for a program of 'next step' State Government actions. This program can prepare Queensland to make the most of the new and emerging market incentives for increased carbon capture in the rural landscape.

I commend the paper to you.

Peter Cosier
Premier's Council on Climate Change

Premier's Council on Climate Change

The Premier's Council on Climate Change was formed in late 2007 to provide the Queensland Government with high-level strategic advice on climate change issues and actions.

The Council is chaired by the Premier of Queensland, the Hon Anna Bligh MP, and the Minister for Climate Change and Sustainability, the Hon Kate Jones MP, is Deputy Chair.

The Council's membership comprises eminent persons drawn from a range of sectors relevant to climate change.

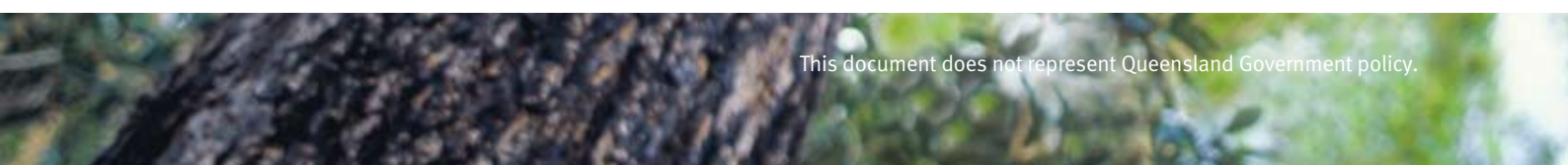
The Council provides advice to the Queensland Government on a long-term climate change strategy for Queensland that:

- is informed by the best available knowledge about measures that Queenslanders can take, collectively and individually, to address climate change
- provides practical solutions to the problems that climate change poses for Queensland communities, industries and the environment
- maintains and enhances, where possible, Queensland's economic competitiveness
- generates new growth opportunities through innovation.

Working papers are prepared at the request of Council for the purpose of providing the Queensland Government with advice on specific climate change policy topics.

This paper was sponsored by Council members Peter Cosier and Peter Kenny and prepared with the assistance of staff from the Office of Climate Change.

The views expressed in this paper are those of the Council and do not represent Queensland Government policy.



Executive summary

Queensland's rural landscape has significant potential to capture carbon. This was confirmed by a scientific assessment commissioned from CSIRO by the Premier's Council on Climate Change, which drew together expertise from across Australia. This assessment found that carbon savings of as much as 140 million tonnes (Mt) of CO_2-e per year, or more than 70 per cent of the state's emissions, could potentially be attained from rural land use over the next 40 to 50 years.

Attaining this potential will require a suite of institutional and policy reforms by government, and widespread continued adoption of changed management practices by Queensland's landholders. Not all of this potential can be realised in the immediate period in carbon market terms. In order for specific land uses to be recognised as offset opportunities in formal carbon trading schemes their sequestration value needs to be credible and verifiable. For some land use processes, further scientific investigation is required.

National policy initiatives such as the Carbon Pollution Reduction Scheme (CPRS) and the Renewable Energy Target (RET) will create new markets for land use products and services in the near term. It is important to position Queensland to make best use of these opportunities. The Queensland Government can use its natural resource management and land use planning powers to influence the way in which these markets act to transform the state's rural landscape.

The CPRS will create incentives for landholders to provide reforestation services, and CSIRO assessed that the majority of the sequestration potential from rural land use lies in this area. A first order priority for Queensland is to make the policy and investment adjustments needed to promote carbon forestry uptake in ways that restore the environmental health of the state's landscapes and minimise any loss of agricultural productivity and other environmental assets.

Recommended actions to prepare Queensland for these new carbon market incentives include a review of the adequacy of existing water, biodiversity and land management regulations to manage the impacts of large scale carbon forestry. Land use planning processes, including Natural Resource Management (NRM) and statutory regional plans, can be adjusted to direct carbon forestry into areas where it can deliver landscape restoration benefits and away from areas that are critical for food production.

Similarly NRM groups, through assisting with market advice and property design, can help guide landholders towards reforestation services that deliver landscape restoration and biodiversity benefits in addition to sequestering carbon. This guidance will need to be supported by finer scale mapping to identify land suitable for carbon forestry and economic modelling by region to determine where carbon forestry will be profitable.

In the mid to longer term, improved agricultural processes, including rangeland, crop land and livestock management, and managed savanna burning, can play an important role in reducing Queensland's emissions. On the whole, these land use processes are less ready for inclusion in carbon markets, with remaining uncertainties about the effect of particular practices on carbon levels, and difficulties in achieving accurate and affordable measurement. A Queensland research effort that is closely coordinated with the national effort and focused on areas of agricultural production in which Queensland has a key interest is required.

Irrespective of coverage under the CPRS from 2015, the agricultural sector will face market forces for further emissions reductions. Queensland's agricultural sector is dominated by livestock production. Emissions from this sector are high and reduction strategies, particularly ones that can work in Queensland's open rangelands, are proving difficult to achieve. Queensland could play a leadership role in research in this area through supporting the establishment of a hub for targeted livestock research and through hosting a cooperative research effort on terrestrial carbon.

The agricultural process of managed savanna burning has the potential to play a modest role in reducing Queensland's emissions, but could deliver an important market opportunity for Indigenous communities in Queensland's remote north. The current trials of savanna burning projects in Queensland's remote north are in their early stages and may warrant state investment in enterprise development in these communities.

Bioenergy, including biofuels and biochar, can make a modest but ongoing contribution to the state's emissions reduction effort, with markets being created through the new national RET and the Queensland Government's ethanol mandate.

The sequestration and other environmental benefits biofuels can provide vary greatly based on the feedstocks that are used. Queensland could provide a market edge to its biofuels industries by focusing its research investment and policy support more clearly on biofuels that perform well against sustainability criteria.

Rural land use change cannot provide a 'cure-all' solution for climate change and action is required across all sectors of the economy to curb emissions. Rural land use can, however, make a strong contribution to Queensland's overall climate change strategy, particularly over the next few decades while other emissions reduction technologies come on-line.

Through careful policy adjustment and well targeted research investment, Queensland can utilise carbon market opportunities for its rural sector to achieve significant emissions reduction, landscape restoration and economic outcomes. In this paper, the Premier's Council on Climate Change suggests a program of 'next step' responses to begin this process of policy and investment adjustment.

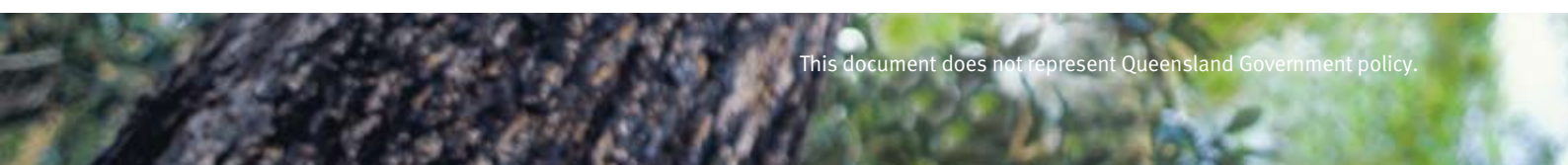


Table 1: Summary of issues and recommendations

	Land use process[i]	Issue / Opportunity	Current response	Recommended further action
Forestry	CARBON FORESTRY* (55% of carbon savings) Difficulty to implement: **Low** *Refer to page 11	• Opportunities from CPRS market • Extensive areas may be profitable in Qld • Natural resource implications not assessed by CPRS regulator • Need for information and business support to landholders	• Investment ($3.5M) in CATER • Negotiating with Commonwealth for recognition of regrowth • 'Caring for Country' NRM programs • Amendment to State legislation for carbon forestry on leasehold land	• Business support for landholders through NRM groups • Online information resource • Spatial mapping and economic modelling • Review adequacy of existing natural resource & land use regulations
	NATIVE FOREST MANAGEMENT* (15% of carbon savings) Difficulty to implement: **Moderate** *Refer to page 20	• Remaining measurement challenges	• Statewide Forest Process: – long term program to reduce harvesting and provide sawlogs for industry (State-owned forest) • Code of practice for native forest timber production on State lands	• Consider opportunities to increase carbon stocks through review of Code of Practice in State and privately owned native forests • Further investigate carbon sequestration rates
	REGROWTH* (5% of carbon savings) Difficulty to implement: **Low** *Refer to page 22	• Not covered by CPRS • Need for other policy mechanisms to reduce emissions	• New laws to regulate clearing of high value native regrowth vegetation	• Develop incentives approach for discussion with Commonwealth (deforestation) • Carbon offset options for essential clearing • Review enforcement mechanisms
	TIMBER PLANTATIONS* (1.4% of carbon savings) Difficulty to implement: **Low** *Refer to page 18	• Some institutional, legislative and resourcing impediments to industry development	• Sustainable expansion of timber plantation industry & address CPRS requirements through: – planned Queensland Timber Plantation Strategy – reviewing tree tenure legislation	• Support the sustainable development of the timber plantation industry through the development of the Queensland Timber Plantation Strategy

	Land use process[i]	Issue / Opportunity	Current response	Recommended further action
Agricultural Processes	RANGELAND MG'MT* (13% of carbon savings) Difficulty to implement: **High** *Refer to page 27	• Large measurement difficulties • Uncertainty about effectiveness of management practices	• Substantial ($20M) Commonwealth investment to address measurement challenges	• Investigate benefits of hosting a Cooperative Research Centre on terrestrial carbon
	LIVESTOCK* (5% of carbon savings) Difficulty to implement: **Moderate – High** *Refer to page 31	• Qld's largest primary industry sector & high emitter • No single, high impact strategy available to reduce emissions • Significant R&D effort required on strategies	• Significant Commonwealth Investment ($26.8M) • Remaining funding need for most promising technology for Qld grazing systems	• Investigate establishment of research hub in Qld
	SAVANNA BURNING* (1% of carbon savings) Difficulty to implement: **Low** *Refer to page 24	• Potential to contribute to Qld's Indigenous employment objectives	• Substantial ($10M) Commonwealth investment including in 2 Qld projects	• Invest in supporting Indigenous enterprise development if warranted by project outcomes
	CROPPING LAND MG'MT* (<1% of carbon savings) Difficulty to implement: **Moderate** *Refer to page 29	• Limited emissions reduction potential other than from reduced fertiliser use • Large measurement challenges for soil carbon	• Substantial ($20M) Commonwealth investment to address measurement challenges • Reef regulations – to improve fertiliser use	• Ensure Qld Govt investment is coordinated with national approach
Bioenergy	BIOFUELS* (6% of carbon savings) Difficulty to implement: **Moderate** *Refer to page 34	• Market drivers not aligned with optimal carbon savings and other benefits	• Alternative Fuels Action Plan • Ethanol target of 5% by end 2010 • R&D investment into 2nd gen biofuels (sugar cane waste; algae) • National RET 20% by 2020	• Investigate benefits of linking mandates to sustainability standard • Prioritise research investment against sustainability criteria
	BIOCHAR* (3% of carbon savings) Difficulty to implement: **Moderate** *Refer to page 39	• National R&D gaps for Qld • Opportunities in Qld's sugar industry • Incentives for bioenergy production from RET	• Australian Government investment ($1.4M) into research (focused on forestry residue)	• Support biochar demonstration utilising sugar cane waste

i Based on assessment of attainable carbon savings and difficulty of implementation for each land use process in the CSIRO report[1].

Introduction

This paper builds on the Council's interim paper, *Capturing carbon in the rural landscape,* to consider the investment and policy priorities for Queensland to achieve optimal carbon savings and co-benefits from rural land use change in the near term.

The interim paper summarised the findings of a CSIRO report, *An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use* (the CSIRO report), on the greenhouse gas emission savings that could be attained from each of 11 land use processes. This report, commissioned for the Premier's Council on Climate Change, drew together scientific expertise from across the country. It found that significant carbon savings (140Mt CO_2–e year or equivalent to 77 per cent of the state's current emissions) could be attained from changes in rural land use and management in Queensland. It highlighted that attaining these emissions savings would require a concerted effort to solve technological and management barriers and change land management approaches.[2]

The CSIRO report provided an assessment of the state of 'readiness' of each of the land use processes based on: the maturity of the required technology; the relative ease with which it could be implemented and measured; the certainty of the carbon savings it offered; and the extent of co-benefits it could provide. It found that some land use processes could be implemented (and included in carbon market frameworks) while other processes were not ready to be realised in the short to medium term. This CSIRO assessment of the sequestration potential and relative difficulty of implementation of each of the land use processes is summarised in figurative form at Appendix 1.

This paper examines each of the land use processes assessed by CSIRO in terms of the co-benefits and risks associated with utilising them for increased carbon capture. It then considers headline policy and research activity currently underway. This paper builds on the CSIRO report to suggest some 'next step' investment and policy priorities for Queensland to take advantage of the immediate carbon market opportunities and to achieve additional emissions reductions in the longer term.

The State Government role

While the architecture for emissions accounting frameworks is created at an international level and reflected in domestic emissions trading arrangements developed by the Commonwealth, state governments will play a key role in determining how carbon markets act to transform their rural landscapes.

Climate change is a policy challenge that cuts across national, state and local government jurisdictions and requires whole-of-government responses at each level. The Australian Government has chosen the Carbon Pollution Reduction Scheme (CPRS) as its primary policy tool for driving emissions reduction. It will be complemented by other policy initiatives, such as the national Renewable Energy Target (RET). The markets created by the CPRS and complementary measures will require policy adjustment at each level of government in order to fully harness emissions savings and to balance other policy considerations.

The state has a range of responsibilities in land use planning, natural resource management and primary industries development which will shape rural land use change in response to these national policy drivers.

The tools available to the state to support optimal rural land use change resulting from carbon markets include, but are not limited, to:

- the regulatory and policy frameworks for the planning and development assessment system (such as the *Sustainable Planning Act* and State Planning Policies, including for the conservation of good quality agricultural land)
- legislative frameworks to protect native vegetation and manage vegetation clearing
- advanced vegetation mapping capabilities and spatial information
- a range of incentive programs to promote landholder engagement in natural resource management, including the 'Caring for our Country' program (in partnership with the Commonwealth), and biodiversity and carbon offset schemes
- the creation of markets for environmental goods and services other than carbon, such as Nature Assist
- ownership of the nearly 65 per cent of the state that is under leasehold tenure
- catchment scale water resource planning and regulation
- a variety of strategies to support primary industry development
- research capabilities in climate change, natural resource and primary industry sciences.

Policy challenges

Using these tools to achieve optimal benefits from carbon markets is a challenging task given the volatility of international and national policy frameworks that are creating these market opportunities.

The Kyoto Protocol accounting rules that cover the Agriculture and Land Use, Land use Change and Forestry (LULUCF) sectors are often complex and can limit opportunities to develop carbon sinks. For the first commitment period, 2008 to 2012, Australia must account for all emissions or sequestration from deforestation, afforestation and reforestation activities. Australia also had the option to account for all emissions or sequestration from other land use activities - such as forest management, soils management, revegetation and grazing land management - but chose not to select these activities because of the risk of emissions from large 'natural' events such as bushfire.

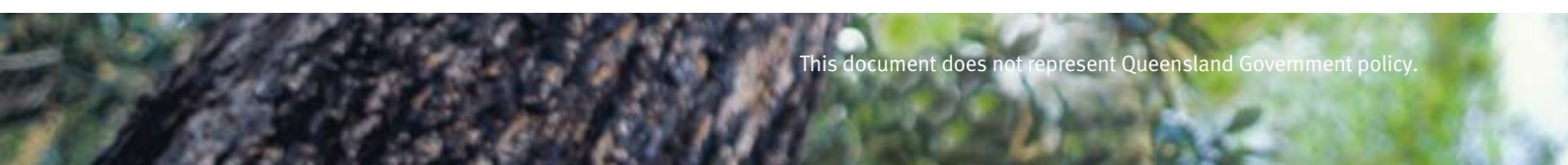
The details of the next international climate change agreement (beyond 2012) are under active negotiation through the United Nations Framework Convention on Climate Change (UNFCCC). Key trading partners or competitors, including the United States and New Zealand, are also developing the details of domestic emission trading schemes and the outcomes may require adjustments to Australia's scheme. The Australian Government is currently negotiating changes to the international accounting rules for the land sector that could provide greater opportunities for developing carbon sinks. However, any new rules would not be operational until after 2012, when the next commitment period for the international climate change agreement will begin.

The final details of the domestic approach to the CPRS coverage of the agricultural sector will need to be resolved over the coming years, with a decision flagged for 2013.

Within this evolving policy framework there are some certainties: that the CPRS will provide economic incentives for Kyoto-compliant reforestation in the immediate term; and that, in the mid term, the agricultural sector will need to find successful ways to reduce its emissions. If agriculture is not covered under the CPRS there will be other market and regulatory requirements for the sector to reduce its emissions.

In addition to the CPRS some land use change will be driven by complementary carbon savings measures. In particular the national Renewable Energy Target (RET), of 20 per cent by 2020, will provide incentives to produce biomass for renewable energy generation. The voluntary carbon offset market will also provide opportunities for developing carbon sinks and generating returns for landowners.

The science required to inform decisions about the inclusion of land uses in carbon markets is also in a state of development. To be successful in reducing emissions, policy positions need to be linked to knowledge about what works in reducing greenhouse gas emissions. The effects of some land management practices on greenhouse gas emissions are well understood, while there are significant remaining uncertainties about the impacts of others.[3]



Carbon markets require that these changes are able to be affordably measured and verified, and there are remaining challenges in this area for a number of land use processes. The CSIRO report outlined a future research agenda of considerable breadth required to resolve these challenges.

As with other sectors, there is a need to focus on 'low hanging fruit' to utilise the large and affordable gains that can be made in emissions reduction in the land use sector. The CSIRO report provides a clear indication of the land use processes that can deliver large sequestration benefits and which are relatively 'ready to go'.

Research and policy investment decisions also need to take into account the potential environmental and economic co-benefits attached to each land use process.

This paper provides an overview of the sequestration potential, readiness, environmental and economic impacts, and research and policy priorities for each of the land use processes. It provides recommendations for the 'next step' actions required to harness markets for emissions savings from rural land use to best effect.

Achieving carbon savings from forestry

The CSIRO report identified a very substantial potential for the land use and forestry sectors to become the net sinks for greenhouse gas emissions. Forestry activities and reduced land clearing offer the largest attainable level of bio-sequestration in Queensland. A combination of carbon forestry, timber plantations, forest management and reduced land clearing was estimated to have a total attainable level of carbon savings of 105Mt CO_2-e per year. Delivering this level of sequestration for these land activities will require a range of policy instruments, including regulations, incentives and carbon markets.

The largest source of greenhouse gas emissions from the land use sector is land clearing primarily for agriculture. In 2007, land clearing emissions were estimated at 49.7Mt CO_2-e or approximately 27 per cent of Queensland's total emissions. Reductions have been achieved from the ban on broad-scale land clearing introduced by the Queensland Government in 2006. Accounting methods for land use change mean that effects of this land clearing reduction have not yet been factored into Queensland's greenhouse gas accounts. Overall, forestry related activities in Queensland currently sequester approximately 0.3Mt CO_2-e per year.

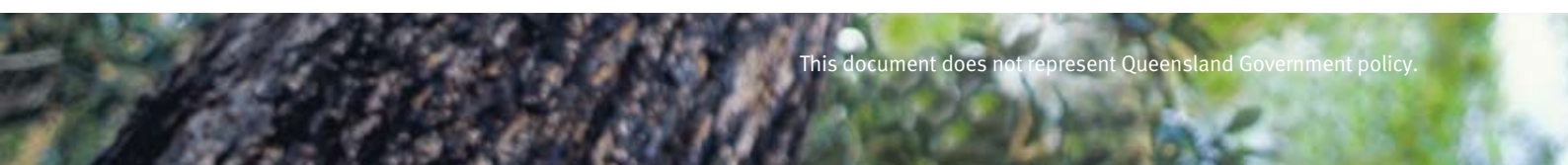
Carbon forestry

Key points:

- The CPRS will provide financial incentives for landholders to invest in carbon forestry projects.
- There are likely to be extensive areas of Queensland that are profitable for carbon forestry, mostly on marginal grazing lands in higher rainfall areas.
- In some locations carbon forestry may lead to adverse impacts on biodiversity, water availability and food production.
- The CPRS regulations will not assess the natural resource management or biodiversity conservation implications of carbon forestry.
- This failure in the CPRS market needs to be managed through a set of complementary market and regulatory mechanisms.
- Queensland's regulatory framework for managing biodiversity, water and good quality agricultural land may require adjustment to manage adverse impacts from carbon forestry.
- Policies that support carbon forestry should be integrated into regional NRM plans and statutory regional plans, and aligned with resource management and biodiversity objectives.
- Carbon forestry will need to be supported by improved biophysical information systems.
- Landholders will need technical, land management and business support to engage in carbon markets.
- NRM groups can provide technical and business support to landholders.
- Landholders can achieve optimal returns from carbon forestry, agricultural production and biodiversity outcomes through careful property design.

Carbon forestry refers to the conversion of cleared agricultural land to reforestation and afforestation projects for the primary purpose of sequestering carbon. There are likely to be a range of commercial carbon forestry options across different scales including farm forestry, agroforestry, broad-scale plantations, and trees planted for a combination of commercial and environmental purposes. Carbon forestry can be either permanent environmental plantings, often with mixed species, or single species plantations that may be harvested for timber products.[4]

To date there has been limited development of carbon forestry, but it is likely that increased market demand from the CPRS will drive carbon forestry investment.



'Kyoto compliant' afforestation and reforestation is the only greenhouse sink activity that is currently covered under the Australian Government's proposed CPRS. The Kyoto Protocol accounting rules allow sequestration from afforestation and reforestation projects to contribute to Australia's assigned amount of emissions for the first commitment period of 2008 to 2012. The Kyoto Protocol rules specify that eligible afforestation and reforestation must occur on land that was clear of forest on 31 December 1989, and that it must be established by human-induced methods including planting, seeding or the promotion of natural seed sources.

Sequestration potential

The CSIRO report estimated that profitable reforestation of cleared land could sequester approximately 77Mt CO_2-e per year in Queensland, at a carbon price of $20 a tonne of CO_2. This includes reforestation based on a combination of single species hardwood plantings and mixed species environmental plantings. The CSIRO report also showed that requiring environmental co-benefits from carbon forestry projects, such as biodiversity conservation and managing impacts on water interception, would limit the overall area used for carbon forestry and reduce the average sequestration potential to 52Mt CO_2-e per year.

One of the key factors influencing carbon forestry uptake will be the availability of land that was clear of forest in 1989, and therefore complies with the Kyoto Protocol. As evidenced in the CSIRO report, there are likely to be extensive areas of Queensland that are profitable for carbon forestry. There is an estimated 33 million hectares of cleared land in Queensland, with the majority of this land used for agricultural purposes.[5] Of this agricultural land, approximately 3.8 million hectares (Mha) land is under cropping, including fallow.[6] The majority of remaining cleared land is used for livestock grazing activities.

Land use for carbon forestry will also be determined by the profitability of forestry versus other land uses. Large areas of Queensland are unlikely to be profitable for carbon forestry production due to low rainfall averages, and unsuitable climate conditions and soils for forest plantings. For example, grassland areas in the arid central, west and north of Queensland are unsuitable for planting forests and would require substantial irrigation to be viable. State land clearing regulations will prevent the clearing of remnant vegetation and some native regrowth vegetation for the establishment of carbon forestry plantations.

The costs of establishing and managing reforestation projects, and fluctuations in carbon price, will also affect rates of uptake in Queensland. Modelling by the Australian Bureau of Agricultural and Resource Economics (ABARE) indicated that a market price on carbon is likely to drive an expansion of carbon plantations.[7] Under different pricing scenarios, carbon forestry will be more profitable on 'marginal' grazing land in higher rainfall areas where the opportunity costs for forestry outweigh existing land uses. However, an increase in the CPRS cap and unit price would likely result in an increase in the area of land that is profitable for carbon forestry.[8]

Impacts and opportunities

CPRS and carbon markets

Carbon forestry projects established for carbon markets could provide substantial opportunities for businesses and landholders in Queensland. Carbon reforestation projects could be established as commercial ventures designed to generate returns from carbon markets. Alternatively landholders, such as graziers, could establish reforestation projects to offset emissions from livestock and reduce their emissions liability.

Under the proposed CPRS, landholders will be able to establish reforestation projects and apply to the Australian Government to generate tradeable credits for any net increases in greenhouse gas removals. These credits can then be traded on the carbon market, providing revenue for landowners and project investors. However, the obligations of the scheme require that any emissions from forests through logging or removal will require that credits are revoked or purchased to account for these emissions.

Environment and natural resources

One of the critical issues that may arise from an expansion of carbon forestry is the potential for environmental impacts. Changes from existing agricultural land uses to carbon forestry could have a range of positive and negative environmental implications.[9] Native and non-native monoculture plantations could have adverse impacts on biodiversity, dependant upon the location, type of plantation and management activities.[10] Planting monoculture forests on land that displaces regional ecosystems, such as native grassland, could have adverse impacts on ecosystem function and biodiversity. However, some studies indicate that single species eucalypt plantations in cleared landscapes can restore habitat for native species such as birds.[11]

Research conducted in Australia shows that large-scale plantations could increase ground and surface water withdrawals, leading to reduced environmental flows in river catchments.[12] This could have serious long-term impacts on water availability for downstream users and compound other climate change impacts, including changes to rainfall and reduced inflows.

Forestry projects established through environmental plantings or from young regrowth vegetation could have positive environmental and climate adaptation benefits. Well designed projects could restore degraded or cleared ecosystems, increasing habitat for wildlife, and expanding vegetation connectivity in the landscape.[13] Environmental plantings would have other benefits such as reducing erosion and improving water quality in river catchments and downstream marine waters, such as the Great Barrier Reef lagoon. Planting tree species native to the region or area, or native regrowth vegetation, will be more robust and resilient to both climate change and non-climate disturbances.

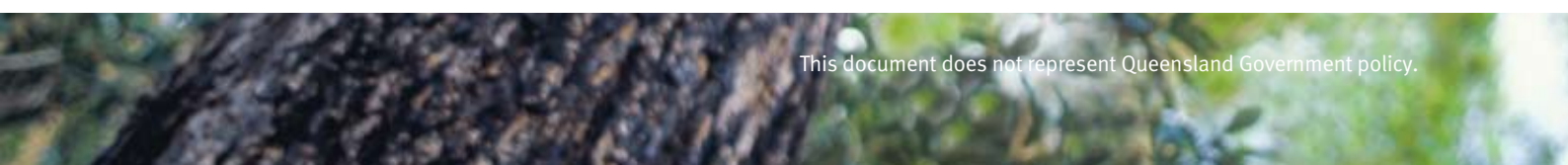
The introduction of the CPRS will create a market for carbon capture, but other environmental services such as biodiversity, native vegetation and water quality will be missing from these markets. The CPRS may create investment in reforestation and land use change, but will not address these other environmental requirements, leading to market failure. Currently the CPRS is not linked with state based water markets, with incentives for environmental services, or with state based land use and environmental legislation.

In Queensland there are existing market based incentives to deliver vegetation and biodiversity benefits, such as Nature Assist, and water markets to allow the trading and selling of allocations.

The Council of Australian Governments (COAG) has developed a set of complementary principles to address market failure from the CPRS. These complementary measures can target sectors not covered by the CPRS, such as deforestation, or sectors of the economy where price signals may not be as significant a driver of decision making - for example, land use and planning. An efficient set of complementary policy measures could improve the environmental outcomes from forests established under the CPRS, for example by giving further consideration to the impacts on water availability.

The Natural Resource Policy and Programs Committee (NRPPC), with members from state and Commonwealth jurisdictions, is currently scoping options for the integration or streamlining of carbon markets with biodiversity and water markets. These may include the establishment of a biodiversity standard to ensure biodiversity claims in the carbon market can be verified. The NRPPC is also investigating options such as environmental impact assessment for biosequestration projects or appropriate regulatory measures, such as water allocation and vegetation management frameworks. This investigation will provide greater guidance on effective policy mechanisms to address CPRS effects on biodiversity and water. The Queensland Government, through its engagement in the NRPPC, will contribute to the development of options to integrate carbon markets with other environment and natural resource markets or regulatory mechanisms.

Queensland's *Water Act 2000* establishes a framework for water resource planning and the allocation and trading of water entitlements. Under the Act, water resource plans and resource operations plans establish the overall water allocation from the system, provide for existing and future entitlements, and ensure adequate environmental flows to maintain aquatic ecosystems. Within a planning area some water access entitlements can be traded, sold, leased or transferred to enable movement of water resources to higher-value water users. Some water resource plans regulate the use of groundwater, depending on the level of extraction and aquifer recharge rates.



Queensland does not currently require that water entitlements be acquired for agricultural or forestry activities. However, the National Water Initiative (NWI), to which Queensland is a signatory, recognises that some large interception activities, such as plantation forestry, could affect water availability for other users. The NWI recommends that forestry operations hold a water entitlement if the plantation will affect water allocations for other water users, particularly in fully allocated catchments. If carbon forestry expands rapidly, Queensland will need to further consider the water allocation requirements of forestry activities.

Management of biodiversity and land uses in Queensland, including forestry activities, occurs through a number of state regulatory frameworks. In addition, there are a range of strategies and action plans at a national scale to which Queensland is a signatory or has commitments. However, current regulations and land use planning frameworks do not specifically address the impacts of large scale carbon based forestry operations. The creation of new market incentives for carbon forestry projects also creates a need to assess the requirement for regulatory measures to assist in the capture of potential benefits and manage the risk of perverse impacts on biodiversity and natural resources.

Agriculture and regional land use

Some concern has been expressed that a shift from more intensive agricultural land uses to large scale carbon plantations could result in changes to rural employment opportunities, with possible broader effects on rural community. Early modelling by ABARE suggests that carbon forestry will most likely be focused in marginal agricultural land. However the financial demise of plantations established through managed investment schemes has raised community concerns regarding large scale carbon plantations.

Given that carbon forestry development is still in its infancy in Australia, there is little evidence about these effects. Some research has been undertaken in relation to the employment effects of timber plantation establishment. While carbon forestry will not create employment in harvesting and milling, the employment effects could be expected to be analogous with the establishment and maintenance phases of timber plantations.

Research by the Bureau of Rural Sciences indicated that plantation forestry development in south-west Western Australia and southern New South Wales resulted in employment growth in establishment and processing facilities, and flow on jobs in regional towns from service provision and supplies.[14] The research concluded that diversification of agricultural areas into plantation forestry can lead to economic growth in rural towns and regional centres, increased population trends and increased services. While these effects were lower in the establishment phase they were still found to be positive.

Concerns have been raised by some agricultural industry sectors in Queensland that carbon forestry could replace cropping on good quality agricultural land, displacing food production and affecting food security for both the domestic and international markets. As outlined above, the carbon price will be a primary driver of reforestation projects that replace existing land uses. The displacement of cropping on good quality agricultural land by carbon forestry will likely require a high carbon unit price.

However, the existing economic modelling on carbon forestry has been undertaken at a national and state level and does not provide detailed information on where forestry will be profitable at a regional scale.[15] Further detailed modelling is required across different regions in Queensland to identify where carbon forestry will be profitable compared to other land uses.

The Queensland Government has recently reviewed the *State Planning Policy 1/92: Development and the Conservation of Agricultural Land* (SPP 1/92). The SPP 1/92 is designed to give a level of protection to good quality agricultural land in local and regional planning schemes, preventing undue encroachment by other land uses, such as urban development, into farming areas. While the review considered plantation forestry impacts, it did not explicitly deal with a consideration of large scale carbon forestry projects. The Queensland Government has recently announced an intention to consider the requirement for regulatory reform to address the loss of cropping land to mining, urban development and other uses such as carbon forestry projects.

Current and future initiatives

The draft CPRS legislation allows for eligible reforestation projects that are established by human induced methods. Further eligibility detail will be provided in the regulations. The Queensland Government has committed to working with the Australian Government to allow CPRS eligible reforestation projects to be established from native regrowth vegetation on cleared lands. This would enable landowners to establish reforestation projects by actively managing the regrowth vegetation, and to receive credits from the CPRS market. Reforestation projects established from regrowth would deliver co-benefits including low cost abatement and the restoration of native ecosystems leading to biodiversity and climate adaptation benefits.[16]

Recent research by the Rural Industries Research and Development Corporation (RIRDC) on central Queensland grazing properties showed that reforestation with regrowth vegetation strips can increase economic returns from grazing properties.[17] Based on a carbon price of $25 per tonne of CO_2-e, the research found that graziers could increase financial returns by establishing regrowth strips and selling sequestered carbon to the market. Excluding methane emissions, graziers under the scenarios examined in the study would be $84,107 better off on Brigalow lands and $136,989 better off on eucalypt lands compared to conventional grazing systems.

This research shows that planned property design incorporating forestry in grazing lands provides a viable approach to mitigating emissions from livestock. It also provides a business model for graziers to diversify production in the carbon market. However, there is a need for the integration of information and models for grazing and forestry, into grazing business operations and land management.

Effective planning and decision-making on reforestation projects will require substantial biophysical information systems, including on soils, rainfall, and tree and vegetation growth rates. Spatial mapping at a regional and local scale is required to support the design and placement of carbon forestry projects in order to deliver biodiversity benefits, such as landscape connectivity and biodiversity corridors. Queensland currently has substantial ecosystems and vegetation mapping capability though the Department of Environment and Resource Management (DERM), but may require further resources to support planning for reforestation projects. The identification and mapping of areas for biosequestration will need to be consistent with the Australian Government's biosequestration modelling framework, the National Carbon Accounting System (NCAS).

To assist landowners to develop carbon forestry projects and participate in the carbon market, the Queensland Government is investing $3.5 million through the *ClimateQ: toward a greener Queensland* (ClimateQ) strategy on the Carbon Accumulation through Ecosystem Recovery (CATER) project. This will provide a web based source of information to landholders including:

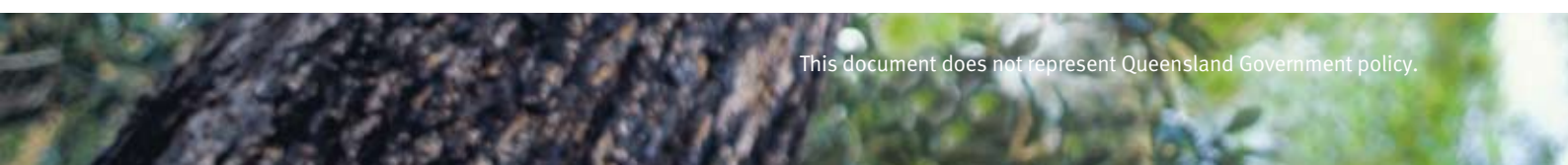
- estimates of the carbon sequestration potential of different native forests
- mapping to support the placement of forestry projects
- management actions to restore carbon in native forests and improve biodiversity benefits.

Information delivery and business support: Regional NRMs

There are 14 regional natural resource management (NRM) bodies responsible for protecting and managing natural resources in Queensland.

These NRM bodies prepare regional NRM plans that identify the regions' major NRM issues and ways of addressing them, including land and water management, biodiversity and agricultural practices. NRM regional investment strategies provide details on the specific actions, costs and timeframes that are required to implement a regional plan and achieve targets. NRM plans also outline the contributions that all involved groups will make and how to achieve the NRM plan objectives.

NRM plans provide an important framework for developing sustainable regional industries and delivering natural resource management and biodiversity outcomes. Integrating biosequestration, particularly forestry, into regional NRM plans will be an important step to delivering positive land use change in regional Queensland.



The Commonwealth and Queensland Governments provide major investment into Queensland's community-based regional NRM bodies. The national natural resource management program, 'Caring for our Country', establishes six national priorities and a program of targeted investment. The State Government provides a complementary funding program. Queensland Government agencies are working to identify possible areas of regional NRM investment emphases for Queensland, including climate change. These investment emphases will inform and support a new bilateral agreement with the Commonwealth for delivering 'Caring for our Country' in Queensland through to 2012-2013.

The engagement of rural industries and landholders in emerging carbon markets will require increased technical information, support for land management, and market advice. Regional NRM bodies have established relationships with landholders and support the delivery of many Queensland and Australian Government initiatives. Regional NRM bodies can address issues at the landscape and the individual landholder level. In this respect, regional NRM bodies can achieve multiple outcomes, such as landscape connectivity, wildlife corridors and threatened species habitat retention and rehabilitation.

The capacity of regional NRM bodies to provide information and business services for landholders is different in each of the state's 14 regions. Some regional NRM bodies are well-advanced in their engagement in the carbon market.

For example, the South East Queensland Regional Offsets Working Group is currently in the process of being established with the principal purpose of developing and establishing an agreed regional offsets framework. The framework will deliver on the policies and programs of the South East Queensland Regional Plan and the targets of the South East Queensland NRM Plan.

Supporting reforestation development in rural Queensland

Queensland provides legal recognition of carbon reforestation projects under existing state regulation, through *profit à prendre* arrangements (an assigned right to enter land owned by someone else and take something off the land). The *Forestry Act 1959* allows freehold landowners and lessees to enter into contracts about the ownership, use and economic benefit of natural resource products, including carbon. These mechanisms allow landowners to establish and own carbon reforestation projects and then sell carbon rights for the purposes of engaging in voluntary carbon markets. To facilitate the involvement of landowners in the proposed CPRS, the Queensland Government will need to make amendments to State legislation. These amendments will be made when the CPRS has been passed by the Australian Parliament and the regulations covering reforestation projects have been finalised.

The establishment of carbon markets will increase business investment in the carbon forestry and biosequestration projects. There are already a number of established companies that provide technical support, brokerage services and finance for the voluntary carbon market. The Queensland Government recently established Ecofund Queensland to direct investment towards biosequestration projects that contribute to biodiversity and climate change outcomes.

To assist landowners in Queensland to engage in emerging carbon markets, there is a need for information on carbon market opportunities, business information and technical advice. As outlined above, NRM organisations could deliver these services in some regions, but further consideration needs to be given to extending services to all interested landowners.

Statutory regional planning also provides an important mechanism to promote carbon forestry as a sustainable land use. Regional plans establish a 20-year regional development framework and aim to integrate economic development objectives with regional NRM plans and biodiversity conservation objectives. Regional plans have been completed for far north Queensland and south-east Queensland, and include land use policies that support development of new agricultural enterprises, such as carbon forestry.

Regional plans need to be aligned with regional NRM plans so carbon forestry occurs in locations that deliver optimum natural resource and biodiversity benefits.

The Queensland Government can play a proactive role in guiding new market incentives for carbon forestry to achieve multiple benefits. This would require a review of the adequacy of current regulatory frameworks for water access entitlements, the protection of good quality agricultural land, and natural resource management to manage the impacts from large scale carbon forestry. The Queensland Government can support landholder engagement in carbon forestry through more detailed modelling of the economic opportunities at a regional level, mapping of suitable areas, business support and advice, and promoting a stronger role for NRM groups. Given the immediacy of market drivers for carbon forestry, action in this area is a first order priority.

Recommendations

As a first order priority, the Queensland Government should undertake a program of activities to support the uptake of carbon forestry opportunities and to manage the risk of adverse impacts.

Support landholder engagement in carbon markets

NRM organisations
For NRM programs for 2010 to 2012, prioritise Queensland Government investment in carbon forestry and biosequestration to support:

- business services, including:
  - advice on CPRS and voluntary carbon market opportunities
  - develop brokerage arrangements for landholders to engage in carbon markets
- technical advice and information, including:
  - models to integrate carbon forestry into property planning and management
  - the design of carbon forestry projects to deliver multiple NRM outcomes, including biodiversity, water quality and land condition.

Regional NRM plans
Include policies and targets that support development of biosequestration projects that deliver natural resource and biodiversity conservation objectives.

Online information
Develop web based information services on carbon forestry opportunities, brokerage services, legislative requirements and forestry management.

Policy adjustment to support forestry carbon markets

Regional planning
Integrate policies into statutory regional plans that promote carbon forestry and biosequestration and align with regional NRM objectives and targets.

Managing environmental impacts
Review policies and mechanisms to manage biodiversity, vegetation, and water resource implications from large scale carbon forestry projects, including:

- water planning and allocations
- biodiversity, land management, and the requirement for specific land use planning protections for good quality agricultural land from large scale carbon forestry.

Review and develop complementary measures to address biodiversity, vegetation and water resource implications from large scale reforestation projects, including:

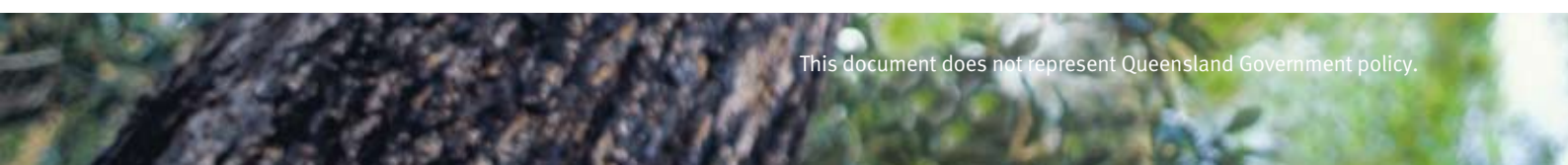
- water planning and allocations for forestry plantations
- biodiversity, land management and planning policy
- complementary market mechanisms such as Nature Assist.

Good quality agricultural land
Consider options to manage encroachment of large scale forestry onto good quality agricultural land.

Information to guide policy adjustments

Undertake spatial mapping at a regional and local scale to determine areas environmentally suitable for carbon forestry.

Undertake economic modelling at a regional level to determine where carbon forestry will be suitable.



Timber plantations (Post 1990 plantations)

Key points:

- The expansion of timber plantations could make a modest (1.4%) contribution to the emissions reduction attainable from rural land use in Queensland.
- There will be some limited incentives for timber plantation expansion under the CPRS.
- International rules may change to allow sequestration in harvested wood products to be recognised in future emissions accounting frameworks.
- The Queensland Government has committed to the sale of the state's plantation forests and the development of a Queensland Timber Plantation Strategy.

Timber plantations are commercial operations, primarily for harvesting. Queensland has approximately 250,000 hectares of commercial timber plantations located in south-east, central and northern Queensland. About 80 per cent (over 200,000 hectares) of this plantation estate is currently publicly owned and managed by Forestry Plantations Queensland (FPQ), a State-owned corporation. The other 20 per cent of the estate (around 50,000 hectares) is privately-owned and has been established by a small number of private companies over the last decade.

Over 75 per cent of Queensland's timber plantation estate comprises native and exotic softwood species harvested for use in housing and construction, poles for fencing and timber pulp. The other 25 per cent comprises native and exotic hardwood species managed for fibre product and sawlog outcomes. The Queensland forest and wood products value chain is estimated to contribute around $4 billion to Queensland's economy and provide 18,000 jobs.

Sequestration potential

The CSIRO report estimated that expansion of the timber plantation estate in Queensland could sequester an additional 2Mt CO_2-e per year. This relatively low figure is based on projections of timber plantation growth in Queensland from 2010 to 2050 under different carbon price scenarios.

The CSIRO report outlines projections for Queensland's timber plantation estate by 2050, which range from 370,000 hectares under a business as usual approach, up to approximately 620,000 hectares under a carbon price of $29.10 per tonne of CO_2.

The Queensland Government estimates that about one quarter of Queensland's timber plantation estate meets the Kyoto rules for reforestation and afforestation, being plantations established on land clear of forest on 31 December 1989. Kyoto compliant timber plantations are currently expanding at six per cent per year in Queensland.

Under current Kyoto Protocol and United Nations Framework Convention on Climate Change (UNFCCC) greenhouse reporting arrangements, reforestation and afforestation emissions are recorded at the time of harvest. The negotiations in the lead-up to the Council of the Parties (COP) 15 meeting in Copenhagen in 2009 include proposals to account for harvested wood products as an emissions sink. The Australian Government supports the sink proposal as it would provide benefits for timber plantation forestry development. For example, plantation timber used in construction stores carbon and is less energy intensive to produce than other building products. The introduction of a CPRS carbon price will make other construction materials, such as concrete and steel, more expensive relative to timber construction materials.

Timber plantations can apply to participate in the CPRS however there may be some risks to forest plantation owners from engaging in the scheme. The CPRS Green Paper identified that new plantation forests are likely to be more attractive options for inclusion due to the higher returns over a longer period of plantation growth. However, forest managers would be liable for any net emissions from harvesting, and would need to relinquish or purchase units when trees are harvested.

The benefits for plantation timber forests will depend on the flexibility of harvesting schedules and the price of future carbon versus log prices. CPRS participation is unlikely to be beneficial for single-rotation plantations as the obligations under the Scheme for emissions would exceed the credits received for sequestration.

Current and future initiatives

The Primary Industries Ministerial Council and the Natural Resource Management Ministerial Council, comprising Ministers from states and territories, are preparing a *National Climate Change and Commercial Forestry Action Plan 2009-2012* as part of the COAG Plan of Collaborative Action on Climate Change. The draft Action Plan includes mitigation actions to ensure that the forest and woods product industry plays a role in reducing Australia's emissions profile through participation in the CPRS. Other actions focus on supporting the development of more rigorous and comprehensive treatment of forest products and carbon cycles in the Kyoto Protocol accounting rules. As a member of the Ministerial Councils, Queensland will support implementation of the final Action Plan.

The Queensland Government's Statewide Forests Process (SFP) is the strategy for determining the long-term management of Queensland's State-owned forests. A major initiative of the SFP has been to establish 20,000 hectares of native hardwood timber plantations to provide a sustainable resource supply for the hardwood timber processing sector. Additional funding of $44.6 million over seven years was committed by the Queensland Government in 2008-2009 to assist FPQ to establish the remaining 8200 hectares of the new hardwood timber plantation estate.

The Queensland Government also supports the expansion of the timber plantation sector in Queensland through an annual investment in targeted forestry research and development, and ongoing policy work to identify and remove institutional impediments. The Queensland Government also actively engages with other levels of government in relation to policy development issues impacting on the timber plantation sector.

Expansion of the timber plantation estate in Queensland will be influenced by a number of factors including:

- a transition from State-owned native forest resources to plantation timber resources
- continued growth in the market demand for forest products
- availability and cost of suitable land in appropriate locations
- the relative attractiveness of the timber plantation sector to the investment market
- the price of carbon credits in the CPRS or voluntary offset markets.
- the treatment of harvested wood products under future international greenhouse gas emissions accounting rules.

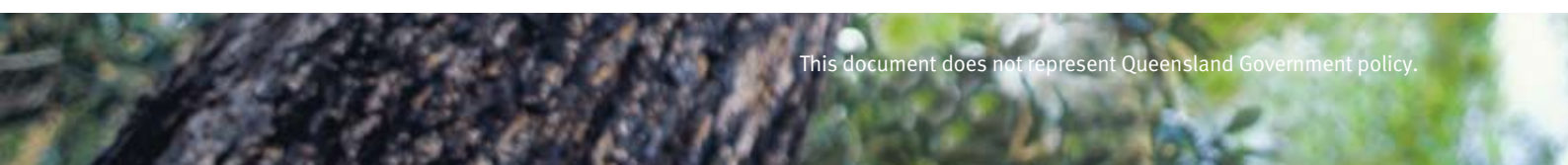
In June 2009, the Queensland Government announced its intention to sell FPQ, which will see the entire Queensland timber plantation estate move to private ownership. Following the sale of FPQ, the Queensland Government's role as the major industry plantation grower and supplier of timber products will cease. The government's role will be more focussed on facilitating development of the commercial timber plantation industry and providing an appropriate policy and regulatory setting.

A policy commitment to develop a Queensland Timber Plantations Strategy (QTPS) was included in the Queensland Government's 2007 climate change strategy, *ClimateSmart 2050*. The strategy will provide a range of policy, resourcing and industry development interventions aimed at building a sustainable and profitable timber plantation sector.

In addition, the Queensland Government is currently undertaking a review of Queensland's tree tenure legislation to ensure that State legislation supports investment in the plantation sector. This includes investment opportunities under the proposed CPRS and other voluntary carbon offset arrangements. The review will ensure that Queensland legislation governing land interests and timber plantations meets the requirements of the CPRS.

Recommendations

- Develop and implement the Queensland Timber Plantation Strategy.



Native forest management (Pre-1990 Eucalypts)

Key points:

- Changed native forest management, including a reduction in timber harvesting, could make a substantial (15%) contribution to emissions reductions and sequestration.
- There are significant measurement barriers to native forest management being included in carbon market frameworks.
- The Queensland Government has committed to the Statewide Forest Process to manage harvesting and increase protection of State-owned forests across Queensland.
- There are Codes of environmental practice for harvesting in State-owned and private forests, but these codes do not include management for carbon stocks.

Queensland has an estimated 52.8 million hectares of native forests, with 80 per cent of these forests occurring on State-owned land. Approximately three million hectares of declared State forests, timber reserves and State leasehold land are available for active timber forest production. In the 2008-2009 financial year, 239,000 cubic metres of log timber was harvested from State-controlled native hardwood and cypress forests for a range of products including sawlogs, construction timbers, poles, fencing and railway sleepers. It is estimated that between 200,000 and 250,000 cubic metres of log timber was harvested from freehold land over this period.

Sequestration potential

The CSIRO report estimated that 21Mt CO_2-e per year could be sequestered in eucalypt forests through changes to forest management.[18] The harvesting of native forests for timber and other products results in the long-term reduction in native forest carbon stocks.[19] Reduced harvesting and improved management of native forest ecosystems can significantly increase the carbon stock in native forests. This includes increased forest biomass and soil carbon sequestration. There is, however, a high level of uncertainty with existing forest carbon stocks and the prediction of carbon sequestration potential.

To establish a baseline for accurate accounting requires significant data collection and modelling of carbon stocks, including the effects of disturbances, such as fire and changing climate conditions.

The sequestration in native forests would sit within the category of forest management in Article 3.4 of the Kyoto Protocol. Forest management is recognised under the Protocol as "a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner."[20] Australia selected not to include Article 3.4 activities for the 2008 to 2012 commitment period due to the uncertainties with accounting frameworks and the potential liability for emissions from large forest fires and other uncontrollable natural events.

The Australian Government is currently pursuing, through the COP 15 climate negotiations, changes to the accounting rules to separate anthropogenic and non-anthropogenic activities. There are also possible changes to the accounting rules set for forest management.

Current and future initiatives

The Queensland Government is committed to a long-term reduction in harvesting in State-owned forests. Since the early 1990s there has been an ongoing process of retirement of native forest areas from timber production throughout Queensland. The first regions to be protected included the north Queensland rainforests from Townsville to Cooktown and Fraser Island/Cooloola.

In 1999, the Queensland Government signed the South East Queensland Forests Agreement with key stakeholders to provide a long-term timber resource certainty for the region's hardwood timber industry, and to establish a world-class conservation reserve system. As part of the Agreement, harvesting immediately ceased in approximately 425,000 hectares of State native forests, and by 31 December 2024 all native forest harvesting will cease across a further 800,000 hectares of State controlled native forests in south east Queensland.

In 2001 the Queensland Government initiated the Statewide Forests Process (SFP), a regional planning process focusing on long-term forest management and timber supply arrangements from all State-owned forests. The SFP is a consultative process, facilitated by the Queensland Government, with the aim of key timber industry and conservation stakeholders reaching agreement on forest outcomes. In the western hardwoods region, the government will supply a specified quantity of native hardwood sawlogs until 31 December 2025 from State-controlled native forests, and cease native hardwood harvesting in over one million hectares of State forests. The government is currently developing options for the cypress forests of southern and central Queensland to balance increased protection of cypress forests in conservation reserves and to provide certainty of supply to the timber industry.

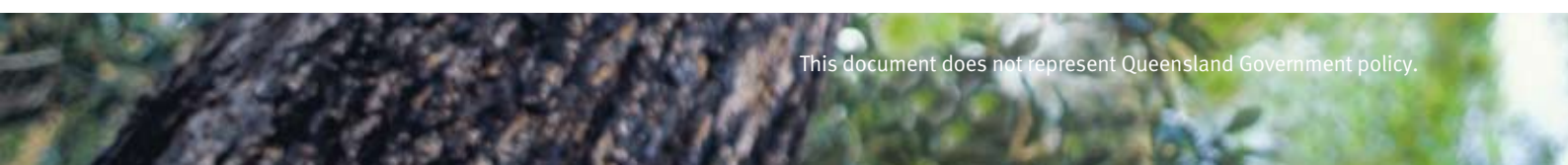
Timber production is managed on approved State controlled native forests in accordance with the Queensland Government's *Code of Practice for Native Forest Timber Production on State Lands 2007*. Native forest harvesting operations are subject to audit against this Code by Queensland Parks and Wildlife Service. The Code is designed to implement ecologically sustainable forest management on State lands including State forests, timber reserves and leasehold land. In addition, the *Vegetation Management Act 1999* requires that forest harvesting on freehold land or privately-owned native forests occurs in accordance with the *Code applying to a native forest practice on freehold land.*

Both of these Codes, which are subject to formal reviews, are principally concerned with the maintenance of the productive capacity and the protection of environmental values of native forests. Current government policy is that after one more harvesting, the majority of the available native forests within State controlled forests will be principally managed for conservation purposes and gazetted as national parks. The protection and restoration of native forests in conservation reserves will deliver ecosystem benefits, such as reduced disturbance and increased climate change resilience. Conversion of native forests to protected areas will also contribute to meeting the target of protecting 7.5 per cent of Queensland for national parks by 2020.

The Codes or other relevant Queensland legislation do not specifically require that harvested native forests are managed or restored to increase total carbon stocks over time. Achieving the carbon sequestration potential of native hardwood forests would require the increased preservation of native forests in the protected area system, and appropriate practices to increase carbon stock in State-owned and privately-owned forests. In addition, further research is required to determine the carbon stock potential of harvested native forests across the state.

Recommendations

- Progress the Statewide Forest Process and phase out native forest harvesting in State-owned forests.
- Include management actions to increase carbon stocks in native forests as part of the review of the *Code of Practice for Native Forest Timber Production on State Lands 2007* and the *Code applying to a native forest practice on freehold land.*
- Utilise existing data on native forest harvesting to improve accounting for forest management activities in different native forest types in Queensland.



Reducing emissions from land clearing (regrowth)

Key points:

- Managing the clearing of regrowth vegetation could make a moderate contribution (5%) to reducing Queensland's emissions profile.
- The rate of land clearing in Queensland has decreased substantially over the past 30 years, but still represents approximately 27 per cent of Queensland's total emissions.
- Emissions from deforestation will not be covered by the CPRS, and the Australian Government has committed to investigate incentive-based mechanisms.
- The Queensland Government is considering a number of options to further reduce emissions from land clearing.

Potential for reducing emissions

The CSIRO report estimated that emissions from clearing regrowth vegetation could be reduced by 7Mt CO_2-e per year, from a total regrowth clearing estimate in 2007 of 11Mt CO_2-e per year.

In 1990, Queensland had one of the highest rates of land clearing in the world, with emissions recorded at 86Mt CO_2-e per year. The reduction in financial incentives and removal of conditions from leases (which required the clearing of native vegetation) has led to a decrease in clearing rates.

In the mid 1990s Queensland introduced regulations to manage clearing on leasehold land and further extended the regulations to cover freehold land through the *Vegetation Management Act 1999*. In 2004, Queensland introduced a ban on broad-scale clearing of remnant vegetation in Queensland, supported by a $150 million adjustment package for landholders. The purpose of the *Vegetation Management Act 1999* is to protect biodiversity and manage clearing impacts on ecosystems, but also to reduce greenhouse gas emissions.

The phase out of broad-scale clearing of remnant vegetation in Queensland has accelerated the long-term downward trend in land clearing emissions. This reduction in emissions from land clearing has made a significant contribution to meeting Australia's international commitments under the Kyoto protocol. For 2007-2008, the rate of land clearing had reduced to 235,000 hectares in comparison with 375,000 hectares per year reported in the Statewide Landcover and Trees Study (SLATS) Report for 2006-2007.[21] Regrowth clearing rates over this period had reduced from 153,000 hectares in 2005-2006 to 106,000 hectares in 2006-2007. The full reduction in land clearing emissions will be provided in the updated Australian National Greenhouse Accounts for 2007-2008.

Current and future Initiatives

In 2009, the Queensland Government introduced a moratorium for clearing important regrowth vegetation. Prior to this, less than 240,000 hectares of an estimated 33 million hectares of regrowth vegetation was subject to regulations controlling clearing. New laws were introduced in October 2009 for the ongoing protection of high-value mature regrowth on freehold land, indigenous land, and agricultural and grazing leasehold land, as well as native regrowth vegetation along watercourses in priority reef catchments. The introduction of the new laws will protect a further one million hectares of regrowth vegetation, while a total of 2.3 million hectares will be subject to minimum standards and best land management practice. At this stage it is unclear to what extent the regulations will further reduce emissions from land clearing.

The Queensland Government is currently considering options to reduce land clearing emissions that are complementary to the CPRS. The CPRS White Paper 2008 confirmed that deforestation occurring after 1 January 1990 would not be included in the coverage of the CPRS. As clearing is exempt from the CPRS, businesses that clear are incurring an emissions liability, but are not paying for the market cost of those emissions. However, the White Paper committed the Australian Government to investigating incentive-based mechanisms, including offsets, to further reduce emissions from deforestation.

The Queensland Government's submission on the CPRS Green Paper strongly advocated that the Australian Government consider funding incentives outside the CPRS to encourage the retention of regrowth vegetation.

Other options to further reduce emissions from clearing could include the introduction of carbon offsets under the *Queensland Government Environmental Offsets Policy*. An offsets policy could enable clearing for a range of land uses, but require that another area of regrowth vegetation is protected from clearing through either a Nature Refuge Agreement or other mechanism.

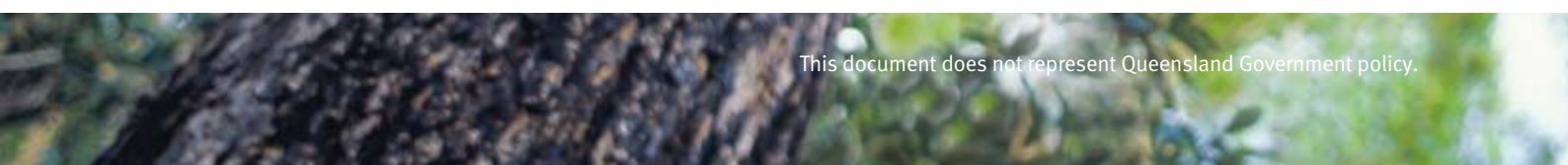
The Queensland Government has committed to streamlining the administration of the *Vegetation Management Act* and the approval process for applications. The Queensland Government has also committed to pursuing non-compliance with the regulations and any illegal clearing.

Several large fines have been issued for non-compliance by landowners who have cleared without appropriate permits. However, despite the considerable effort in detecting clearing, there is likely to be some level of non-compliance with State regulations, leading to increased clearing. Strengthening the compliance regime may further reduce rates of illegal clearing.

Recommendations

Develop options to reduce emissions including:

- an incentives package for discussion with Australian Government
- carbon offsets for clearing emissions under Queensland's environmental offsets policy
- reviewing penalties for non-compliance with the vegetation management regulations.



Achieving carbon savings from agricultural processes

Queensland's agricultural sector currently emits 26.3Mt CO_2-e per year, or 14.5 per cent of the state's emissions.[22] This does not include emissions from land clearing for agricultural purposes, which are discussed in the previous section.

Agricultural emissions and sinks are not proposed for inclusion in the CPRS in the initial term, with a decision to be made in 2013 about their inclusion from 2015.

The CSIRO report assessed that changed agricultural processes, including livestock, rangeland and cropping land management, and managed savanna burns could contribute 26Mt CO_2-e, or 19 per cent of the carbon savings that could be attained from rural land use. With the exception of managed savanna burns, these processes are generally more difficult to implement than forestry and bioenergy options. There are remaining uncertainties about the effectiveness, in the Australian context, of some agricultural management approaches in reducing emissions, and larger challenges in measuring carbon stock change in an accurate and affordable way.

A significant national research agenda is underway to address knowledge gaps in this area, including investment by the Australian Government of over $97 million in the Climate Change Research Program. Work is underway through the National Climate Change Research Strategy for Primary Industries (a partnership of the Australian and State Governments, RIRDC, CSIRO and industry groups) to coordinate research and development efforts in this area.

Each of the agricultural processes is considered below. While each process has been assessed separately by CSIRO, it is acknowledged that they occur as part of an integrated biophysical system at a farm level. There are, of course, complex interconnections between each process. For example, efforts to build soil carbon through rangeland management can deliver improved pasture that, in turn, can reduce emissions from livestock reliant on that pasture for feed.

Managed savanna burning

Key points

- Managed savanna burning could make a modest contribution (<1%) to the overall emissions reductions attainable from rural land use in Queensland.
- The process has relative ease of implementation, with established measurement tools and well understood management practices for reducing emissions.
- Managed savanna burns may deliver significant co-benefits in protecting biodiversity and in providing income and employment opportunities for Indigenous communities.
- These emissions savings are included in Australia's national accounts under Kyoto but will not be covered under the proposed CPRS, at least prior to 2013.
- Projects could be supported through direct government funding or attract investment through the voluntary offset market.
- Over the next three years, projects trialling traditional fire management practices in two Queensland sites, in Western Cape York and the Gulf of Carpentaria, will be established.
- Given the relative ease of implementation and possible co-benefits that this land use process may deliver, State Government investment may be warranted, subject to the success of the current trials.

Potential for reducing emissions

The CSIRO report assessed that carbon savings of 0.77Mt CO_2-e per year could be attained through the use of managed savanna burning practices in Queensland. CSIRO rated savanna burning favourably for ease of implementation as an emissions saving tool, as the fire management practices required to reduce emissions are well understood and the tools and technologies for measurement have been established.[23]

Savanna covers approximately 80 per cent of Queensland's land area and much of it is utilised as grazing land. It is the most fire prone of Queensland's landscapes, particularly in the tropical north, and emissions from savanna fires contribute approximately 0.7 per cent of Queensland's total emissions.[24] Wildfires that occur late in the dry season, when there is considerable build up of fuel, tend to be more intense and to occur over wider areas. While the impact that these fires have on the above and below ground carbon stocks is not yet completely understood, it is clear that they result in the release of the greenhouse gases nitrous oxide and methane into the atmosphere.

The emissions from savanna fires can be reduced through the use of strategic burns carried out early in the dry season when fuel loads are lower. Pattern burns across the landscape at this time can reduce the intensity and scope of burns, resulting in reductions in emissions.

Impacts and opportunities

Fire management is part of customary practice for many northern Indigenous people.[25] In regions of high fire frequency controlled burns may provide biodiversity benefits and help to improve pasture productivity.[26] They may also assist in preserving cultural sites and sources of traditional food for Indigenous communities that can also be threatened by intense widespread burns.[27]

The creation of a carbon market for fire management services has the potential to provide social and economic benefits for Indigenous communities in locations, such as Western Cape York and the southern Gulf of Carpentaria, where the emissions reduction opportunities are most pronounced. These communities have few other opportunities for engagement in the market economy.

The feasibility of reducing emissions through managed savanna burns and of attracting mainstream market investment has been demonstrated by the West Arnhem Land Fire Abatement (WALFA) project in the Northern Territory. The WALFA project is a commercial scale offset project of enhanced fire management over 28,000 square kilometres of Indigenous-owned land, involving partnerships between Aboriginal custodians, Indigenous organisations, Australian and Northern Territory Governments, and research institutions.

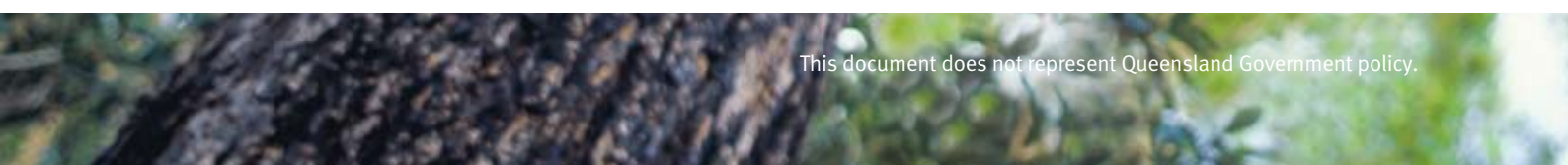
The project has achieved emissions reductions of around 100,000 tonnes per year[28] and has attracted funding ($1 million a year over 17 years) as a voluntary offset activity.[29] The project has created over 100 part-time jobs for Indigenous rangers and others, and has stimulated the formation of private enterprise Indigenous land management business.[30] Early evidence from the project shows that threatened plant communities are experiencing some recovery as a result of less frequent wildfire.[31]

The use of traditional fire practices to generate emissions offsets is still in its early stages and the activity is not without its risks and barriers. Should managed savanna burns be more widely included in carbon markets in the future, there will be a need to manage potential liabilities that arise from inadequate practices and increased emissions. Broader engagement by Indigenous communities in this carbon market opportunity may require significant initial investment in enterprise capacity building.

Current policy and investment context

While managed savanna burns reduce greenhouse gas emissions included in Australia's national accounts under Kyoto, the practice will not be covered by the proposed CPRS at least in the immediate term. However, the Australian Government has committed to facilitating the participation of Indigenous land managers in carbon markets, and to further investigating the potential for emissions reductions from savanna burning.[32]

To further investigate the carbon market issues associated with traditional fire management in northern Australia, the Australian Government has provided $10 million to the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) under the national 'Caring for our Country' Program.



Over the next three years NAILSMA will develop four landscape-scale savanna fire management projects, including two in Queensland (in the Gulf of Carpentaria and western Cape York) involving partnerships with the Carpentaria Land Council Aboriginal Corporation and the Balkanu Cape York Development Corporation. The projects will examine the possible opportunities to provide managed burns as a carbon offset service under the proposed CPRS and within the voluntary market. It will also investigate the options for establishing a legal framework for the creation of carbon credits for altered fire regimes.

To date there has been no direct Queensland Government investment in trialling Indigenous fire management practices as an emissions reduction tool. The State does have established expertise in the use of controlled burns in national parks as a tool for managing pests, supporting biodiversity and managing public safety risks. An additional $6.5 million has recently been committed through the ClimateQ strategy to improve this planned burn program to incorporate climate change projections.

Queensland has a number of strategic policy frameworks for which the NAILSMA projects may have relevance. 'Looking after Country Together' is a Queensland Government strategic policy framework aimed at improving Indigenous participation in natural resource management. The program includes a number of initiatives such as the Wild Rivers Rangers Program which provides funding for Aboriginal rangers in Cape York Peninsula and the Gulf of Carpentaria, and aims to encourage the development of local economies based on ecosystems services.

The Queensland Government's *Positive Dreaming, Solid Futures* Indigenous Employment and Training Strategy 2008-2011 is focused on achieving improved employment and training outcomes for Indigenous people. The Strategy aims to contribute to the national target of halving the gap in Indigenous employment outcomes within a decade. The Strategy has a particular emphasis on those individuals and communities that are locked into intergenerational unemployment. Managed savanna burning projects could provide an important contribution to the objectives of these strategic policy frameworks.

Future priorities

At a national level, there is a need for long-term research to understand the whole-of-system carbon stock effects of managed fire regimes (taking into account the influence on carbon stored in vegetation and soils) and to develop systems for measuring and validating these effects.

The key priority is establishing the policy settings which will determine whether it will be recognised as a legitimate offset activity. The outcomes of the NAILSMA project will be considered as part of the Federal Government work program for determining the treatment of agricultural emissions.

Given the relevance which this option has for Queensland's climate change, natural resources and Indigenous employment objectives, it is important that the Queensland Government is engaged with the Queensland trials for the NAILSMA projects. Queensland Government support for the establishment of business capabilities within these communities may be warranted if the projects demonstrate positive emissions reduction and socio-economic outcomes, and if national carbon markets develop for fire management services.

Recommendations

- Closely monitor the outcomes of the NAILSMA savanna burning trials in Queensland.
- Subject to the success of these trials in achieving emissions reduction and socio-economic benefits, invest in supporting enterprise development in the relevant communities.

Rangeland management

Key points

- Rangelands could make a sizeable contribution (13%) to the overall emissions reduction attainable from rural land use in Queensland due to the vast area they cover (160Mha).
- Sequestration potential is highly uncertain due to variability in the carbon balance of rangelands and difficulties in separating human-induced factors from natural effects.
- There is also little peer-reviewed evidence about the effectiveness of particular grazing methods in increasing carbon storage.
- Rangeland management is a voluntary activity under Kyoto Article 3.4 and Australia has not elected to include it in the national accounts. It will not be recognised as an eligible offset under the proposed Carbon Pollution Reduction Scheme, at least prior to 2013.
- A substantial, long-term national research effort will be required to support the inclusion of rangeland management practices in future carbon accounting frameworks.
- Any Queensland Government research investment on soil carbon in rangelands should be aligned with this national effort to develop a consistent data collection and modelling system.

Sequestration potential

Rangelands are the extensive permanent grazing lands, largely consisting of land either cleared of native vegetation or grazed by domestic livestock. They cover more than 70 per cent or 160Mha of Queensland's land area, and are found to the west of the high rainfall coastal areas.

Improved management of rangelands can increase the carbon balance in the soil and vegetation, in order to reverse losses from past agricultural activity. These management practices may include changes to grazing methods (such as varying livestock numbers and using rotational grazing approaches) and the restoration of native vegetation.

The CSIRO report estimated that carbon savings of 18Mt CO_2-e per year could be attained through improved rangeland management, but emphasised that this estimate is highly approximate. They rated rangeland rehabilitation as having the highest degree of difficulty for implementation within carbon markets.

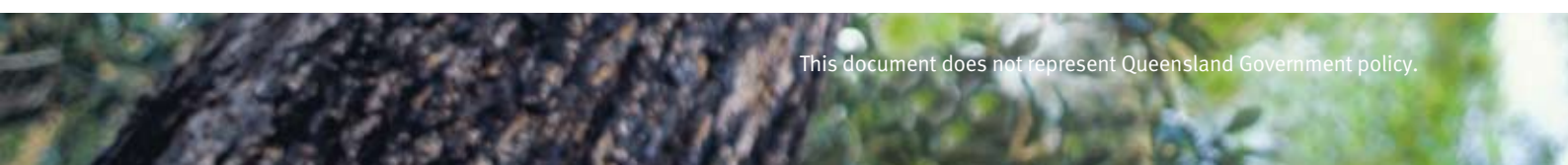
Impacts and opportunities

Managing rangelands to increase soil and vegetation carbon may provide pasture and livestock productivity benefits and support other environmental outcomes. Changed management practices can: result in increases in organic matter in soils; improve nutrient storage and supply; provide erosion control through improved soil binding; and increase soil moisture.[33] Increased vegetation cover on rangelands may contribute to greater biodiversity and create a connected network of forest for wildlife migration.[34]

Given the vast area of rangelands in Queensland, even relatively small increases in soil and vegetation carbon could make a significant impact on the state's emissions profile. The potential to restore soil carbon through rangeland management has been the focus of considerable public interest. Soil carbon has been promoted as an option for offsetting livestock emissions, including in lower rainfall areas where carbon forestry may not be feasible. It has attracted interest as an option that may involve lower levels of displacement of current grazing activity than carbon forestry.

However, the CSIRO report identified large scientific and measurement barriers to incorporating rangeland management in carbon trading frameworks. In order to be included, rangeland management would need to demonstrate removal of measurable amounts of carbon dioxide from the atmosphere in a way that is permanent and verifiable over long time scales. Challenges include:

- little published data about the impact of specific management practices on soil carbon levels and some mixed conclusions from the existing limited research
- a "vast" lack of baseline data on carbon stocks against which to measure the impacts of management changes
- difficulties in distinguishing the effects of managed change from natural fluctuations in carbon stocks



- a requirement to collect measurement data over long time periods (greater than 20 years) in order to determine the effectiveness of particular practices
- the need for landholders to persist with specific management practices over extended time periods in order to maintain the increased carbon stock
- a significant risk of fraudulent carbon offset claims given the challenges in accurate measurement
- the risk of soil carbon being carried 'off site' by erosion, making it difficult to monitor carbon stock improvements achieved by specific landholders.

New techniques for determining carbon stock levels are required and will involve a combination of modelling and direct measurement.

Should rangeland management be incorporated in a future carbon trading framework, the extent of potential financial benefit for landholders would vary considerably across the state. Temperate, high rainfall areas appear to have a higher potential to sequester carbon in response to changed grazing practices than low rainfall areas.[35] The opportunity costs (for example from reducing livestock stocking rates) and ongoing costs of maintaining and verifying an elevated level of ecosystem carbon are not well understood.[36]

The CPRS will provide rangeland managers with opportunities to generate carbon market returns from Kyoto compliant reforestation activity. There is some early evidence that, at least in some rangeland areas, trees can be incorporated into grazing lands in ways that can optimise returns for landholders.[37] This option is discussed in greater detail in the section on carbon forestry.

Management practices to improve pasture on rangelands can also reduce emissions from livestock. This is discussed in greater detail in the section on livestock.

Current policy and investment context

While grazing land management is included in the Kyoto climate change agreement as a voluntary activity under Article 3.4, Australia has not elected to include it in its national accounts. As with other agricultural processes, rangeland management will not be considered for inclusion in the CPRS prior to 2013. The CSIRO assessment provides a compelling picture of the barriers to inclusion in the near term.

Under the national Climate Change Research Program, the Australian Government has invested $20 million in addressing these barriers. The Soil Carbon Research Program will look at the creation of a nationally consistent system for collecting and analysing soil samples across the country. This will contribute to the baseline data necessary for the development of a consistent modeling approach to measuring soil carbon. The research will also investigate the effect of practices such as cell grazing and changed stocking rates on soil carbon, and will include sampling from the Toorak grazing trial in north-western Queensland. In addition the Australian Government is developing tools to assist landholders to affordably measure carbon stock changes from land use, utilising a mix of satellite mapping, soil data and modelling.

A range of research activity on soil and vegetation carbon in grazing lands has occurred in Queensland. The Queensland Government has some established capability in this area. In particular, the Queensland Herbarium and Queensland Climate Change Centre of Excellence have undertaken research in the area of carbon stock changes in grazing lands.[38]

Queensland has a number of sites which have been utilised for long-term primary industries research, such as the Brigalow Catchment Study and Southern Queensland Tree Strip Project, which could be utilised for obtaining data on the effect of specific management practices over time.

A key policy activity in the area of rangeland rehabilitation is the Delbessie Agreement (State Leasehold Land Strategy). The Agreement provides rural leaseholders with incentives to improve the long-term sustainability of leasehold land by offering longer tenure in return for management practices to address land degradation issues. Rural leasehold land accounts for more than half of the state's land areas and the Delbessie process has provided the Queensland Government with a practical basis to work with farmers on improving the condition of rangelands.

Future policy and investment priorities

The CSIRO report noted the impossibility of designing, within the next few years, a trading scheme involving soil or ecosystem carbon stocks in Australian rangelands that would effectively ensure carbon savings.[39]

The report highlighted that a "massive" research effort would be required over the next 20 to 30 years in order to establish the necessary information base.[40] Accurately and affordably measuring carbon stock changes in rangelands soil will require the development of an agreed national model for estimating carbon stocks, verified against measured data for different climatic regions and soils. The CSIRO report suggests that this will require the establishment of a national network of permanent monitoring sites across 250 grazing land types and decade long research trials to quantify the effects of specific practices.

The current round of national investment through the Soil Carbon Research Program will assist the Australian Government to determine how soil carbon should be treated in the CPRS from 2015. Given the enormity of this research task, it is important that any Queensland Government investment in soil carbon research is integrated with this national research effort. Investment should focus on testing management practices under Queensland conditions and on calibrating data on Queensland soils for inclusion in a national modelling approach.

Queensland has significant interests in improving knowledge of carbon stocks and flows across the rural landscape, particularly in relation to rangelands. It could play a strong role in a co-ordinated national research effort to resolve the measurement and verification barriers to a fuller inclusion of terrestrial carbon in the CPRS. Queensland should investigate approaches, such as supporting a Co-operative Research Centre (CRC) in the area of terrestrial carbon, to promote a coordinated research effort.

Recommendations

- Ensure that investment in soil carbon research contributes to the development of a consistent national approach to data collection and modelling.
- Investigate the benefits of hosting a Cooperative Research Centre on terrestrial carbon in Queensland, to promote stronger linkages between state, national and industry research.

Cropping lands (Soil carbon)

Key points

- Cropping lands could make a modest contribution (<1%) to the overall carbon savings attainable from rural land use in Queensland.
- Existing peer-reviewed research suggests that there may be little potential to increase carbon storage in much of Queensland's cropping soils, due to rainfall limitations and soil type.
- There is potential to achieve some carbon savings from the reduced application of nitrogen fertilisers.
- Cropland management is a voluntary activity under Kyoto and Australia has not elected to include it in its national accounts. It will not be recognised as an eligible offset under the proposed Carbon Pollution Reduction Scheme at least prior to 2013.
- A substantial national research effort is underway to collect data to inform a national approach to modelling soil carbon changes.

Sequestration potential

Queensland's cropping lands produce grains, cotton, sugarcane and intensive horticulture, and occupy 2.54Mha, or less than two per cent of the state's land area. There may be potential to achieve carbon savings from cropping land by building soil carbon and reducing emissions of the greenhouse gases methane and nitrous oxide that are associated with fertiliser application.

The CSIRO report assessed that carbon savings of 0.4Mt CO_2-e per year may be attainable. They rated cropping land management as having a moderate degree of difficulty for implementation as a carbon saving approach. This was based on given difficulties in accurately measuring soil carbon, and indications that management practices recognised for emissions trading purposes internationally may not be effective in Queensland conditions.

Management practices to increase soil carbon include minimising soil tillage, planting pasture (particularly legumes) for periods between crops, and applying manures and waste organic materials to the soil.

Queensland's cropping systems require the application of significant amounts of nitrogen based fertilisers which result in emissions of nitrous oxide, a greenhouse gas that has a global warming potential 298 times that of carbon dioxide. Management practices to reduce nitrous oxide and methane emissions include: monitoring nitrogen requirements more closely and tailoring application rounds more specifically to meet crop needs; applying other nutrients that assist the efficient use of nitrogen in the soil; and applying nitrogen at deeper soil levels.

Impacts and opportunities

Cropping land provides an important contribution to Queensland's food security and economy. The total volume of commodities from cropping, including first order processing, is forecast to be worth more than $4.915 billion in 2008-2009.[41] Adopting practices to increase soil carbon may offer other benefits for landholders including better soil conditions and enhanced productivity.[42] Practices aimed at increasing soil carbon can provide increased nutrients for plant growth, improve water and pesticide retention (thereby reducing run off into water ways), and reduce both erosion and the requirement for fertiliser application.

However the CSIRO report highlighted that there may be limited potential to realise financial incentives for these practices from carbon markets. As highlighted in the section on rangeland management, there are considerable scientific and measurement barriers to incorporating soil carbon in carbon trading frameworks.

There is evidence that cropping land management practices, such as no-till, that are accepted in international carbon trading frameworks, may provide little carbon stock improvement under Queensland conditions.[43] The rate at which carbon can be restored to soils is influenced by soil type and rainfall levels. The coarsely-textured sandy soils and lower rainfall levels that characterise much of Queensland's cropping areas present higher challenges to building soil carbon. Soils used for agricultural production in Australia require much higher carbon inputs than those in European and North American agricultural production systems.[44]

The cost of measuring soil carbon under current methodologies may be prohibitive relative to the small carbon returns that Queensland soils can generate. There is potential to develop more affordable modelling approaches, but this will need to be informed by data collected from an extensive network of monitoring sites reflecting the spectrum of terrestrial conditions and cropping activities. There are simpler measurement approaches possible in relation to emissions associated with fertiliser use, including auditing supply.

Current policy and investment context

The Australian Government has invested $20 million into research to support the development of a consistent data collection approach to soil carbon under the Climate Change Research Program. The Soil Carbon Research Program involves a range of research projects to investigate the effectiveness of management approaches (such as no-till) and undertake sampling in grazing and cropping land applications across the country. This will include a project undertaken with the Queensland Government (Departments of Environment and Resource Management, and Employment, Economic Development and Innovation) to undertake sampling of grain and sugar cropping systems across a number of soil types and rainfall levels in Queensland.

Queensland has some established science capacity in this area with the Natural Resource Sciences Unit in DERM specialising in soil chemistry. This includes studies of soil carbon and greenhouse gas emissions associated with cropland management. Primary Industries and Fisheries also have established expertise in researching and developing sustainable production practices in broadacre field crop industries.

The Queensland Government recently introduced the *Great Barrier Reef Protection Amendment Bill*. This new legislation will drive best practice improvements in fertiliser use on large sugar cane farms in priority catchments adjoining the Great Barrier Reef. While developed with the specific objective of improving water quality in the Great Barrier Reef, the initiative may deliver mitigation benefits associated with reduced fertiliser use.

Future policy and investment priorities

As with rangeland management, there is a need for further research to understand the efficacy of particular cropping practices in elevating soil carbon, and to collect data for calibration in a national modelling approach.

As outlined above, a significant research effort in this area is currently underway to inform a decision in 2013 about the treatment of agricultural emissions and sinks in Australia's emissions trading scheme. Given this sizable current research effort, the uncertainty about future inclusion in emissions trading frameworks, and the relatively minor carbon savings attainable in this area, it will be important to ensure that any Queensland Government investment in this area is coordinated with the national approach to data collection and modelling. Further investment in this area may be a lower relative priority in the short term.

Recommendations

- Ensure that any investment in soil carbon research contributes to the development of a consistent national approach to data collection and modelling.

Livestock (Reduce methane emissions)

Key points

- Improved livestock practices to reduce emissions could make a moderate contribution (5%) to reducing Queensland's emissions profile and could provide productivity benefits.
- Methane from livestock (enteric fermentation) is a significant proportion (79%) of agricultural greenhouse gas emissions in Queensland.
- The beef industry is the largest primary industries sector in Queensland, worth $3.4 billion in gross value of production and occupying 78 per cent of Queensland's land area.
- There is no single, high impact strategy currently available that could significantly reduce emissions in the next couple of decades, although gains of up to 20 per cent could be made through management approaches to improve pasture, feed and breeding.
- Achieving higher rates of emissions reductions will require significant research, which could take several decades to deliver.
- The feed improvement options available now, or likely to be available in the near future with additional research, are only suitable to intensive livestock industries, not the extensive grazing areas which constitute most of Queensland.
- Replacement of beef production with kangaroo harvesting could provide emissions reductions in some regions, but is considered unrealistic in the short term.
- To achieve the research breakthrough required to significantly reduce livestock methane emissions, there needs to be a very substantial increase in funding and concentration of effort.
- The potential to establish a research hub in Queensland for research into management practices suitable for open grazing systems should be investigated.

Potential for reducing emissions

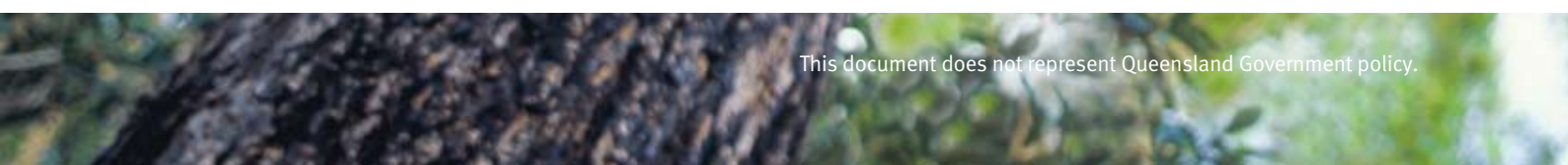
In 2007, livestock emissions contributed almost 80 per cent of agricultural emissions and over 11 per cent of Queensland's total emissions. Queensland contributes the largest share of the nation's livestock greenhouse gases.[45]

The CSIRO report estimated that efforts to reduce livestock emissions could contribute 7Mt CO_2-e per year, or five per cent of the carbon savings attainable from rural land use in Queensland. They indicated a moderate degree of difficulty in implementing the management changes required.

Currently there is no single, high impact strategy available that could significantly reduce livestock emissions in the next couple of decades, although some gains can be made through improved management practices and production efficiency.

In the short term, best management practices could reduce emissions by around 10 to 20 per cent. These practices include improved pasture management and feeding practices, improved reproductive performance and the use of dietary additives.

In the medium term, emissions could be reduced by around 20 to 40 per cent through additional research and development into areas such as: adding plant based compounds to feed; and developing vaccines and anti-microbials to constrain methane-producing microbes.



The largest gains of 40 to 80 per cent reductions, from rumen manipulation and genetic improvements, would not be available for several decades and would require significant research and development investments.

Nearly all of the options available now or in the near future are only suitable for intensive livestock enterprises, such as feedlots or dairies. The vast majority of enterprises in Queensland are based on extensive grazing systems.

If cattle were eliminated from the areas of Queensland in which commercial kangaroo harvesting is currently practiced, there would be a reduction of 5.5Mt CO_2-e per year, or about 25 per cent, in methane emissions but also a decline of around $1 billion in beef production value.

Impacts and opportunities

The beef industry currently dominates Queensland's primary industry sector. It is worth over $3.4 billion per annum in gross value of production, employs over 26,000 people directly, and supports more than 8000 people in the meat processing industry[46] - the majority of who are in the regional areas of the state. Many rural communities depend on the beef industry for their economic survival.

The Queensland beef industry consists of approximately 12 million head of cattle which are grazed on 14,000 properties covering 135Mha, or 78 per cent of Queensland's land area. There is currently no viable alternative economic land use for much of this land.

Most of the emissions from beef enterprises come from both methane and land clearing for pasture. As outlined in the section on land clearing, significant progress has been made on reducing emissions from this source, with Queensland land clearing figures declining by 43 per cent between 1990 and 2006.[47]

Strategies which reduce methane emissions intensity also increase productivity. A large proportion of the extensive grazing in Queensland is based on native pastures. In these areas, there are production, sequestration and biodiversity benefits from maintaining healthy pastures. The biodiversity benefits depend to some extent on the species, but severely degraded land is bad for sequestration, production and biodiversity.[48]

The scenario of replacing cattle production with kangaroo harvesting is described in the CSIRO report as "unrealistic and simplistic". The extent to which cattle could be replaced by kangaroo harvesting would depend on markets, economics, and social and political drivers. The change would require major investment into marketing, social science, production systems to understand sustainable levels of harvesting, and animal welfare issues.

Current policy and investment context

Current methodology for estimating methane emissions from livestock, as used in the National Greenhouse Accounts[49], is too coarse to account for the different factors at the farm level influencing methane emissions (such as diet quality). Therefore, it is unlikely to pick up reductions in emissions from improved management practices by individual farmers. It would, however, pick up changes relating to reducing cattle numbers.

The $26.8 million Reducing Emissions from Livestock Research Program, funded jointly by Meat and Livestock Australia (MLA) and the Australian Government, supports a range of projects by several research groups in Australia. Research topics include: breeding; use of feed additives; improved emissions measurement; use of viruses and microbes to suppress the production of methane; manure management; and management options for extensively grazed cattle in northern Australia. One of the projects under this program will, if successful, greatly enhance the ability to measure methane emissions from grazing ruminants.

Separate research has been undertaken by the University of Queensland and Queensland Government to investigate whether bacteria from kangaroos, which are largely methane free, can be implanted in cattle and sheep. This research holds considerable promise for significant reductions in methane production from these livestock. This pioneering research has already generated a large amount of public and stakeholder interest. However, funding for this work ended in June 2009 and it was not funded again under the DAFF-MLA research program.

Future policy and investment priorities

The research undertaken in Queensland to investigate the use of bacteria from kangaroos is innovative, internationally significant, and likely to lead to the most significant methane reductions from cattle, while also increasing productivity. However, it is complex, on-going work which will need significant, long-term support to achieve the desired outcomes.

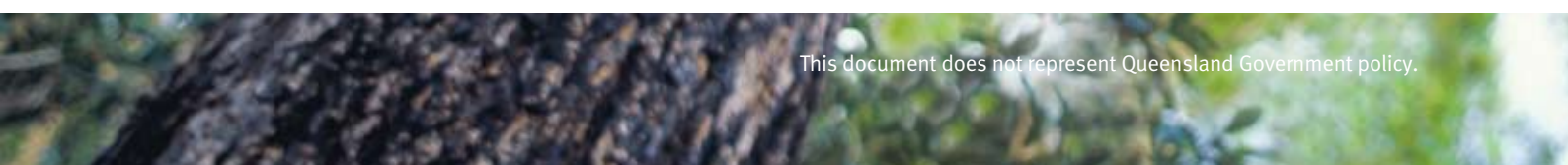
Even with further development, many of the options currently being investigated to reduce emissions will still require more research before practical and commercially viable products and options are available on-farm. They also need to be assessed in a whole-farm system, to ensure that emissions reductions at one point do not create additional emissions at another, and to maximise the cumulative benefit of options which work at different points of production.

Rumen manipulation research, which includes the kangaroo bacteria research, requires significant further investment for success. In addition, the research is more likely to succeed if there is a stronger collaborative effort across the livestock methane research groups within Australia and possibly internationally. A dedicated research group or facility will be more likely to attract the additional funding required over the long-term.

Queensland's beef industry, economy and rural communities have much to gain from the success of this research. The State Government and University of Queensland have already invested in developing world-class animal research facilities at Gatton. There may be opportunities to build on this established infrastructure, expertise and collaboration to develop a research hub from which the Queensland Government could play a leading role in rumen manipulation research globally.

Recommendations

- Investigate the potential to establish a research hub in Queensland to provide leading-edge research into livestock management approaches and technologies suitable to open grazing systems.



Achieving carbon savings from bioenergy

Bioenergy (including biofuels)

Key points

- Bioenergy, including biofuels, can make a moderate contribution (6%) to the overall emissions reduction attainable from rural land use in Queensland.
- The extent of carbon saving and other benefits provided by bioenergy and biofuels varies greatly depending on the feedstocks and conversion technology used.
- First generation biofuels such as ethanol produced from sugar and starch crops can compete with human and animal food sources. Any expansion of biofuels using first generation technologies beyond current policy targets could impact on domestic food and animal feed supplies, particularly during drought.
- Second generation biofuels can deliver higher carbon capture and other benefits, but require greater investment in research, development and demonstration.
- Queensland is playing a leading role in creating markets for biofuels by promoting consumer confidence and mandating a future production target for ethanol.
- Other policy drivers of bioenergy use include the national Renewable Energy Target and the CPRS.
- To achieve optimal sequestration and other environmental outcomes and avoid competition with food, the Queensland Government should prioritise further research investment against sustainability criteria and investigate the benefits of linking the biofuel targets to a sustainability standard.
- The role of biofuels in meeting Queensland's future transport fuel needs will be examined in the next Council Working Paper: Transforming Transport.

Sequestration potential

Bioenergy substitutes fossil fuels with plant or animal-based fuels, which have sequestered carbon over their lifespan, to produce electricity or liquid fuels (biofuels). Queensland's rural lands can be used to produce bio-energy feedstocks to deliver greenhouse gas savings.

'First generation' biofuels use existing technologies such as: the fermentation of sugar and starch crops to produce ethanol; or the use of tallow, and plant and animal oil to produce biodiesel. Generally, first generation biofuels use human and animal food sources such as grains and other crop products. Second and later generation biofuels offer greater promise as they would use non-edible crop waste or other non-food biomass such as wood waste, grasses and algae. However, second generation biofuels are yet to be commercially deployed.

The CSIRO report assessed that bioenergy could offer an attainable emissions saving of 9Mt CO_2-e per year, comprising 1Mt CO_2-e per year from first generation and 8Mt CO_2-e per year from second generation biofuels. CSIRO assessed bioenergy as having a moderate 'ease of implementation' compared with other land use processes they considered.

As indicated by the CSIRO report, biofuels can generally deliver greenhouse emissions benefits compared with fossil fuels. The extent of this benefit depends, however, on feedstock production and the processing technology used. Unlike the forestry options, biofuels can offer carbon savings over time by using a biofuel feedstock that can be continually harvested and regrown.

However, when accounting for emissions reductions associated with biofuels, a full lifecycle assessment is needed. For example, a recent lifecycle analysis of biofuels internationally, which took into account land use change, such as converting forest savanna areas to biofuel feedstock cropping, found that in some cases, more greenhouse gases can be emitted by biofuel than petroleum fuel.[50] While the clearing of forest vegetation for biofuels feedstock has not been an issue in Australia, such studies highlight the need to take a whole-of-lifecycle view in supporting biofuel production for its sequestration benefits.

CSIRO data indicates that, on a lifecycle basis, E10 (10 per cent ethanol) offers a greenhouse gas saving over regular unleaded petrol of between three and five per cent and a five per cent diesel blend (B5) has a 1.5 to 4.1 per cent greenhouse gas saving over conventional diesel.

Impacts and opportunities

Globally, government support for biofuels has multiple drivers including support for domestic agricultural production, climate change, air quality and human health, and fuel security. These and other social and environmental considerations are discussed below.

Feedstock potential

Queensland has a number of areas of potential advantage in developing a future bioenergy industry. For example, there is potential for greater bioenergy generation building on the existing capacity in renewable energy generation fired from sugar cane pulp (bagasse). Biomass co-generation, primarily from bagasse, is the major renewable energy source in Queensland. 24 sugar mills located from the southern Queensland border to north of Cairns produce electricity from bagasse, generating 415 megawatts (MW) or almost half of Queensland's renewable energy capacity.

There is also considerable potential to grow a biofuels industry in Queensland. For ethanol production, there are abundant cellulose resources such as sugar biomass and surplus bagasse.[51] Other sources include sugar cane trash, energy cane, sweet sorghum and crop residues. By successfully deploying second generation technologies, Queensland could become a major ethanol supplier.

Queensland may also have the potential to produce large scale commercial quantity feedstocks for biodiesel in algae and *pongamia pinnata*.[52] Algae offers high carbon capture potential, can be grown in ponds or tanks on poor quality land, and also offers higher oil yields than other oil-seed crops. There is also the potential to establish algal farms to capture carbon emissions from large greenhouse-intensive industries, such as coal-fired power generators. *Pongamia pinnata* is a legume that can be cultivated on marginal land and produces inedible seeds from which oil can be extracted to produce biodiesel.

Fuel security

A key driver of government interest in biofuels internationally is their potential to provide domestic fuel security. As conventional oil supplies decline and oil prices become increasingly volatile, there are limited options to replace liquid fossil fuels.

The biofuels industry in Australia is small by international standards, currently comprising only 0.5 per cent of the country's petrol and diesel supply, and around 2.5 per cent in Queensland.[53]

Queensland currently produces about 100 mega litres (ML) of ethanol per year, but this is growing and there is currently capacity to produce up to 180ML per year. In contrast, Queensland's production capacity for biodiesel is about 190ML per year but only around one to two mega litres is expected to be produced over the next 12 months. The low level of actual production is primarily due to difficulties in securing economically viable feedstocks.

Already, there is a shortage of domestically sourced transport fuel in Queensland. Currently, around 20 per cent of Queensland's diesel supplies are imported. This proportion will only increase as Australia's oil production declines and demand for oil grows.

However, biofuels will never be a major source of Australia's transport fuel needs while current technologies and existing agricultural lands and feedstock crops are used.[54] Impediments to greater use of ethanol and biodiesel include the need to identify other economically viable alternative feedstocks and improve the economic viability of cellulose ethanol.[55]

Production value and employment

There is potential for biofuel production to add considerable value to the Queensland economy by replacing existing biofuel imports. For example, it is estimated that replacing five per cent of Queensland's unleaded petrol market with locally produced ethanol could provide $142 million in direct production value for the agricultural sector.[56] Expanding Queensland's biofuel industry could also: diversify landholders' income streams; add value to rural production industries; and expand regional employment opportunities, including in high value jobs such as biotechnology, engineering and agricultural science.[57]

The job creation effect of increased biofuel production is evident in a number of case studies across regional Queensland.[58] In Sarina, on the central Queensland coast, increased ethanol production created 389 direct jobs and 256 flow-on jobs in the construction stage, and 36 permanent jobs and 222 flow-on jobs from production. This added $7.7 million to household incomes in the region.[59] However, the type and size of regional employment opportunities will vary by location.

Air quality

Biofuels can deliver health benefits by reducing air pollutants emitted when they are burnt. In countries such as the United States this is a major driver of government support for ethanol.

Quantifying such benefits requires a full lifecycle analysis, from production through to tailpipe emissions. Initial estimates of avoided health costs range from $3.3 million to $90.4 million annually across Australia.[60]

The extent of these health benefits varies greatly across various biofuels, largely depending on the feedstock. Biodiesel offers clear air quality and health benefits[61], but the benefits of ethanol are increasingly less clear. Ethanol offers improved tailpipe emissions, but in some circumstances can produce other pollutants during the production cycle. Research indicates that substituting E10 for neat unleaded petrol results in higher costs associated with ambient air emissions in most production scenarios, but no research can be found that relates specifically to Australian biofuels production.[62]

Food security

The CSIRO report indicates that, to significantly scale-up biofuel production in the future, second generation technologies must be used. This position has arisen from increasing international concerns regarding diverting large amounts of grains out of food supplies to produce biofuels, and the food price increases that result.[63] In particular, there is international evidence that indicates that the significant expansion of biofuel production globally impacts on foods which rely on the same feedstock.[64]

Currently, there is limited competition for feedstocks between the biofuel and food industries in Australia. This is mainly because Australia's biofuel industry is still in its infancy.[65] In some commodity markets, food, fibre, livestock and biofuel producers are increasingly competing for the same commodity crops. For example, increasing the use of wheat or sorghum to expand the ethanol industry is likely to increase competition with grains for food and livestock feed.[66] Also, the inter-relationship between biofuel feedstock demand, food prices, and other factors such as high energy prices, competing land uses, drought and climate change, is yet to be thoroughly investigated.[67]

Second generation technologies have the potential to overcome the competition between biofuels and food. However, risks to food security remain as large-scale production of lignocellulosic feedstocks could indirectly compete for land, water and labour resources unless carefully managed.[68]

Environmental impacts

The environmental impacts of biofuels vary greatly depending on the feedstock and production method. Generally, biodiesel offers greater environmental benefits than ethanol, and second generation biofuels hold more promise than first generation biofuels.[69]

Environmental benefits of biofuels include their biodegradability and lower toxicity than fossil fuels. This makes them more suitable for use in sensitive environmental areas such as national parks and marine environments. Also, as indicated above, they can deliver improved air quality.

However, producing biofuels can negatively impact on the environment, for example contributing to soil erosion, reducing biodiversity, and decreasing water availability and quality.[70] Biofuel feedstocks can pose biosecurity risks, as many feedstocks favoured for biofuel production have similar traits to invasive weeds.[71]

Current initiatives

Queensland

Queensland is taking a leading role in developing bioenergy and biofuel resources.[72] For example, the Queensland Government is supporting bioenergy projects such as the Mackay Sugar Cogeneration Project with funding of $9 million to support the installation of efficient renewable electric generation.

The Queensland Government support for the biofuels sector has focused on ethanol and biodiesel, as Queensland has existing advantages in production capacity and existing distribution infrastructure. Strategies to support biofuels in Queensland include the following.

- The Queensland Ethanol Industry Action Plan 2005-2007, which successfully improved consumer confidence in ethanol in comparison to other Australian jurisdictions and supported the fuel industry to actively market ethanol blend fuels.[73]
- The Alternative Transport Sector Fuels Action Plan, which includes a mandated target of five per cent ethanol by December 2010 to support greater ethanol production capacity in Queensland. This target will be reviewed after three years.
- Funding biofuel research and development into cellulosic ethanol (QUT's Syngenta Centre for Sugar Cane Biofuels Development) and algae based biodiesel (James Cook University).
- Funding Boeing to develop regional aviation groups to investigate options for regional sources of biofuels for civil aviation.
- Requiring all government petrol vehicles to use ethanol-blended fuel wherever possible.

Commonwealth

The Australian Government's new Renewable Energy Target (RET) to generate 20 per cent of Australia's electricity supply from renewable sources by 2020 provides an incentive for bioenergy growth. The new RET, which is over four times larger than the previous Mandatory Renewable Energy Target, provides a guaranteed market for renewable energy generation through a mechanism of tradeable Renewable Energy Certificates. Queensland is well placed to take advantage of the expanded market for renewable energy generation under the RET given its existing bagasse-fired renewable energy generation and its associated substantial feedstock supplies. It is expected that almost half of the additional bioenergy generation resulting from the RET will occur in Queensland.[74]

Other support for bioenergy by the Australian Government includes: the Clean Energy Initiative which funds research, development and deployment of renewable technologies; and Renewables Australia which promotes the development, commercialisation and deployment of renewable technologies.

Australian Government support for the biofuels industry has largely been via fuel excise tax exemptions for biofuels, and capital, distribution, research and development grants. Importantly, the Australian Government's Second Generation Biofuels Research and Development Program has provided $15 million over four years for research, development and demonstration of new biofuel technologies and feedstocks.

Use of biofuels in the transport sector is regulated by the Australian Government through fuel quality standards. These currently impose limits on the maximum amount of ethanol content in petrol and determine the technical standards for biodiesel blends.

Under the CPRS, biofuels will be initially excluded. In the longer term, it is expected that the CPRS carbon price on fossil fuels will drive industry to invest in fuel substitution options, including biofuels.

Future initiatives

Population growth and climate change pressures mean Queensland's land and water resources for food, fibre, energy production and environmental protection will be increasingly contested. Therefore, it is critical that a larger scale biofuel industry uses sustainable feedstocks and production technologies.[75]

Internationally, many jurisdictions have used policy instruments which have resulted in unintended social and environmental consequences. For example, there is evidence that the European Union's mandatory target for biofuel has resulted in developing countries converting forest land to crops such as palm oil. Similarly, the so-called 'Tortilla riots' in Mexico, where corn prices increased dramatically, have been attributed to the US diverting a significant proportion of their corn crop to ethanol production. Such perverse outcomes highlight the need for biofuel policies to include lifecycle greenhouse, environmental and social standards or criteria.[76]

In Australia, under New South Wales' mandatory ethanol target, only ethanol that meets a sustainability standard can be counted towards meeting the ethanol content requirement in the total petrol sales. The sustainability standard adopted by New South Wales is the *Principles and Criteria for Sustainable Biofuels*, developed by the international Roundtable on Sustainable Biofuels. This standard includes greenhouse gas mitigation, social and economic development, biodiversity and water considerations. The New South Wales ethanol mandate requires wholesalers to take reasonable steps to demonstrate that the ethanol used complies with the standard.

CSIRO and the Rural Industries Research and Development Corporation (RIRDC) have noted the potential market advantage of producing biofuel feedstock or neat fuel that can be certified as 'sustainably produced' and suggest its importance as an industry enabler.[77]

While Queensland's ethanol mandate will provide a critical boost to the biofuels industry, without sustainability criteria it will not ensure a 'green' biofuels industry in greenhouse, and other environmental and social, terms. There is potential for Queensland to adopt a similar approach to New South Wales and link its ethanol mandate to sustainability criteria.

That said, there are currently some concerns about the enforceability of the standard adopted by New South Wales. While the Queensland Government could adopt a standard as part of its mandate, it is important that it be fully developed, credible and enforceable.

To realise the potential of second generation biofuels, market development efforts will need to be balanced with greater investment in researching, developing and commercialising second and later generation technologies.[78]

The CSIRO report notes that research in biofuels technologies is developing rapidly in line with increasing international interest in their ability to reduce greenhouse gas emissions while providing greater energy security. To date, Australia's research investment in biofuels has been limited compared with overseas efforts.

In Queensland, clearly identifying research priorities in the biofuels sector is challenging due to the wide variety of possible biofuel feedstocks and production pathways, and the fledgling state of Queensland's biofuels industry. Queensland can build on international and national research efforts and focus its research investment on biofuels that are sustainable, suitable for Queensland conditions, and which can support larger-scale production capacity in the state.

Recommendations

- Investigate the benefits of linking Queensland's ethanol target to a sustainability standard.
- Develop emissions reduction and other sustainability criteria to guide future market support and research and development investment.

Biochar

Key points

- Biochar can make a modest contribution (3%) to the overall emissions reduction attainable from rural land use in Queensland.
- This assessment is based on the use of sugar cane waste, the most abundant feedstock in Queensland.
- Although the emissions reduction potential of biochar is small relative to some other land use processes, it can offer permanent and ongoing reductions, and a range of other benefits.
- Biochar is being considered for inclusion in the next international agreement on climate change and may attract carbon market investment in the future.
- There has been some recent investment to address remaining research gaps by the Australian and New South Wales Governments.
- There is opportunity for the Queensland Government to build on these investments and to lead the way in demonstrating an integrated application for biochar within the Queensland sugar industry.

Sequestration potential

Biochar is the solid charcoal-like by-product from bioenergy production. It is produced by heating organic matter at very high temperatures in a process known as pyrolysis, through which it is converted to a highly stable form of carbon. This stable form of carbon can then be added to soil where it may deliver agricultural productivity benefits and retain carbon over a long time span (in excess of 100 years).

Biochar can be produced from a wide range of feedstocks including most forms of agricultural and forestry waste. The most significant prospective feedstocks for biochar in Queensland include bagasse (12 million tonnes) and forestry residue (2.8 million tonnes).[79]

Biochar has the potential to reduce emissions in a number of ways: through the displacement of fossil fuels by the energy generated in its production process; by sequestering carbon that would otherwise be released into the atmosphere from decomposing biomass; and potentially through reducing emissions of greenhouse gases associated with fertiliser application.[80]

The CISRO report assessed that carbon capture of 4Mt CO_2-e per year could be attained from utilising Queensland's sugar cane trash and bagasse to produce biochar.

The CSIRO report ascribed a moderate level of 'readiness' for the use of biochar as an emissions mitigation tool in Queensland. While the technology is proven and it can be produced from almost any biomass, barriers include the need for further research (for example, on safe application rates to soils), a lack of production infrastructure, and the absence on an established system of quality control.

Impacts and opportunities

Biochar is not recognised as a carbon capture technology within the Kyoto climate change framework or the proposed Carbon Pollution Reduction Scheme. While this may change in the future, biochar development may not benefit from carbon market drivers in the short term.

Work to assess the potential profitability of biochar for farmers is currently under way (see below). It is possible that financial benefits from the other services that biochar can provide will be sufficient to make it economically viable, even in the absence of carbon market rewards.

Possible benefits include the generation of renewable energy, improved crop and pasture productivity, reduced requirements for fertilisers, and the diversion of biomass waste from landfill.

The extent of financial benefit attached to biochar production will be affected by returns from the renewable energy that is also produced from the pyrolysis process, and by the cost of feedstock. In some cases the costs of feedstock may be minimal or negative when waste products, which might otherwise attract a disposal fee, are utilised.[81]

Although biochar can be made from a wide range of feedstock, in some areas there may be competition with feedstock for biofuel and bioenergy production. In the longer term, this may require some assessment at a regional level about how best to optimise the available feedstocks for both biochar and bioenergy production.[82]

There is some evidence that biochar application to agricultural soils results in improved plant productivity. The CSIRO report notes that this might be of particular benefit for Queensland's soils that are acidic and low in organic carbon, including those that have been under long-term sugar cane cultivation. Improvements to soil health may reduce the need for the application of nitrogen based fertilisers which release potent greenhouse gases into the atmosphere.

Results from field trials appear to vary according to the particular properties of the biochar and the type of soil to which it is applied. Further research work is required to understand how this potential can be optimised in different applications and some of this research is currently underway (see below).

The Australian Government's Renewable Energy Target of 20 per cent of energy supply from renewables by 2020 will drive increased production of bioenergy in Queensland, largely from bagasse.[82] This may support the economic feasibility of biochar when it is integrated into the bioenergy production process.

The absence of any established quality control systems for the pyrolysis process could result in adverse air quality and human health outcomes. A system of quality control would need to be established to manage any significant scale-up in the production of biochar.

Current activity

There is uncertainty about how biochar will be treated in future carbon market frameworks. A number of countries are seeking consideration by the United Nations Convention on Climate Change for its inclusion in the next international agreement. It is possible that, in future, biochar producers or users may benefit from some form of carbon market reward for stabilising organic carbon, avoiding emissions from waste, or for increasing soil carbon stock through its application.

Despite high levels of public interest in biochar as a carbon capture technology, research and development investment has been relatively limited. Small scale commercialisation of biochar in Australia has been driven by private investment.

Recently the Australian Government provided funding of $1.4 million for biochar research. This research will include a lifecycle analysis, assessment of potential profitability for land owners, and an analysis of the risk factors associated with production and application to soils.

This research will provide information critical to the further development of a domestic biochar industry.[84] It will not, however, satisfy all of the information requirements for safe application rates in Queensland conditions or deliver a lifecycle analysis that is relevant to Queensland's most plentiful potential feedstock, sugar cane waste.

The New South Wales Government has been active in its support of biochar research and is currently funding research aimed at assessing the sequestration and agronomic benefits, and the ability to reduce the need for fertiliser application. This includes a small trial on sugar cropping systems in New South Wales, the results of which may be instructive for Queensland.

Future priorities

To date very limited research has been undertaken on biochar production and application under Queensland conditions.

Given the potential to integrate biochar in the bioenergy production process (which is expected to increase under the RET), and the range of cobenefits which biochar may offer in green waste disposal and crop production, some future investment is warranted.

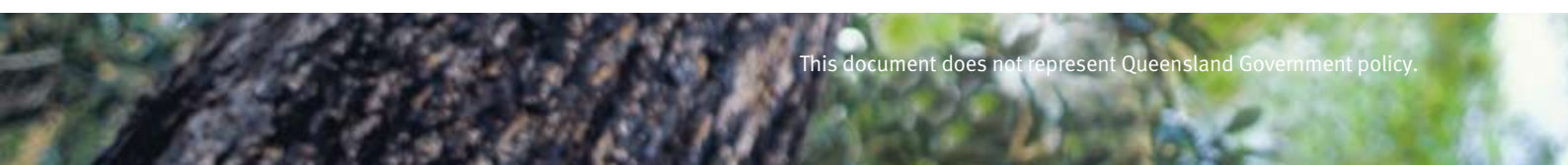
The CSIRO report notes the particular possibilities that may exist for biochar production in Queensland's sugar cane areas. With over 500,000 hectares, or 20 per cent of Queensland's total crop area, under cane production, there are large quantities of potential feedstock (cane trash) for biochar. This feedstock is located in close proximity to bioenergy production plants (in sugar mills) and to application sites (cane fields) which have depleted soils.

In particular CSIRO notes that the lower Burdekin area has potential for a viable biochar industry, where it could provide a disposal solution for nearly one million tonnes of cane trash.[85]

There may be scope for the government to support a small scale demonstration of the lifecycle benefits of biochar in the sugar industry, under a scenario in which a small biochar plant was attached to a local mill (thereby optimally located for feedstock, bioenergy generation and application to fields). The biochar product could be utilised for localised research on safe application rates and productivity benefits. CSIRO noted a high level of interest from farmers in this area in supporting soil productivity field trials.

Recommendations

- Support a biochar demonstration project in Queensland, based on the utilisation of sugar cane waste and located in an area with optimal access to feedstock and to crop applications.
- Investigate the feasibility of integrating the pyrolysis process for the project within an existing bioenergy production plant.



Summary and recommendations

Emerging markets for carbon offset services have the potential to bring considerable benefits to Queensland in reducing emissions, creating alternative income streams for rural landholders, and in assisting in landscape restoration. Harnessing these markets to best effect will require a considerable program of institutional and policy adjustment and further investigation. Given time and fiscal constraints there is a need to prioritise and sequence this program and to align it, as closely as possible, with the national program of policy reform aimed at reducing Australia's emissions.

The CPRS will create a substantial market opportunity for reforestation services, or carbon forestry, commencing as early as 2011. Accordingly, a first order priority for Queensland is to focus its policy adjustment efforts on achieving optimal outcomes from this new market driver. A summary of the recommended program and policy actions and research investments in this area follows.

Immediate priorities

1. Support landholder engagement in carbon forestry

1.1 NRM organisations

Prioritise Queensland Government investment in NRM programs on biosequestration to support these groups in providing business services (for example brokerage arrangements, advice on market requirements, and property design) to landholders.

Include policies and targets in NRM plans that support the development of biosequestration projects that deliver natural resource and biodiversity conservation objectives.

1.2 On-line information.

Develop a web-based information service on carbon forestry opportunities, brokerage services, legislative requirements and forestry management.

2. Policy adjustment to balance sequestration and other outcomes from forestry

2.1 Regional Planning:

Integrate policies into statutory regional plans that promote carbon forestry and biosequestration and align with regional NRM plan objectives and targets.

2.2 Managing environmental impacts.

Review the adequacy of Queensland's existing regulatory policies and market mechanisms for managing the implications of large scale carbon forestry projects for biodiversity, vegetation and water resources.

2.3 Good quality agricultural land

Consider specific planning mechanisms to manage the risk of encroachment of large scale carbon forestry on good quality agricultural land.

2.4 Plantation timber

Develop the Queensland Timber Plantation Strategy to build a sustainable timber plantation sector.

2.5 Land clearing

Develop options to further reduce emissions including:

- an incentives package for discussion with Australian Government
- carbon offsets for clearing under Queensland's environmental offsets policy
- reviewing penalties for non-compliance with vegetation management regulations.

3. Information to guide immediate policy adjustments

3.1 To guide land use and NRM planning at a regional and local level

Undertake spatial mapping at a regional and local scale to determine areas environmentally suitable for carbon forestry.

Undertake economic modelling at a regional level to determine where carbon forestry will be suitable.

Priorities for mid to long-term

There are a range of other actions required to harness the potential for carbon savings from Queensland's rural landscape. These relate to: land use processes such as bioenergy for which there are complementary market drivers; agricultural processes which will be subject to the CPRS or other market drivers for emissions reductions in the near future; and vegetation management options such as native forest management, which are not included in the CPRS in the immediate term but can deliver significant emissions reductions.

4. Policy reform to further reduce emissions

4.1 Native forest harvesting

Include management actions to increase carbon stocks in native forests as part of the review of the *Code of Practice for Native Forest Timber Production on State Lands 2007* and the *Code applying to a native forest practice on freehold land*.

Progress the Statewide Forests Process and phase out native forest harvesting in State-owned forests.

4.2 Biofuels

Investigate the benefits of linking Queensland's ethanol target to a sustainability standard.

Develop emissions reduction and other sustainability criteria to guide future market support, and research and development investment.

4.3 Savanna burning

Monitor the outcomes of the savanna burning trials in Queensland, and consider funding to support enterprise development in relevant Indigenous communities.

5. Information to guide longer term policy adjustments (research and development)

5.1 Coordination

Investigate the benefits of hosting a Cooperative Research Centre on terrestrial carbon in Queensland, to promote stronger linkages between state, national and industry research.

Ensure that investment in soil carbon research contributes to the development of a consistent national approach to data collection and modelling.

5.2 Livestock emissions

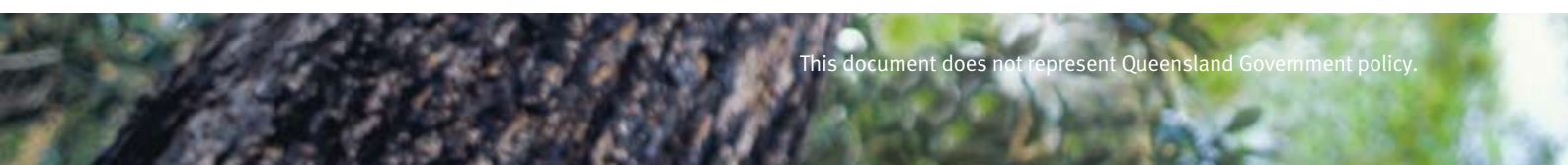
Investigate the potential to establish a research hub in Queensland to provide leading-edge research into livestock management approaches and technologies suitable to open grazing systems.

5.3 Biochar

Support a biochar demonstration project in Queensland, utilising sugar cane waste and production processes.

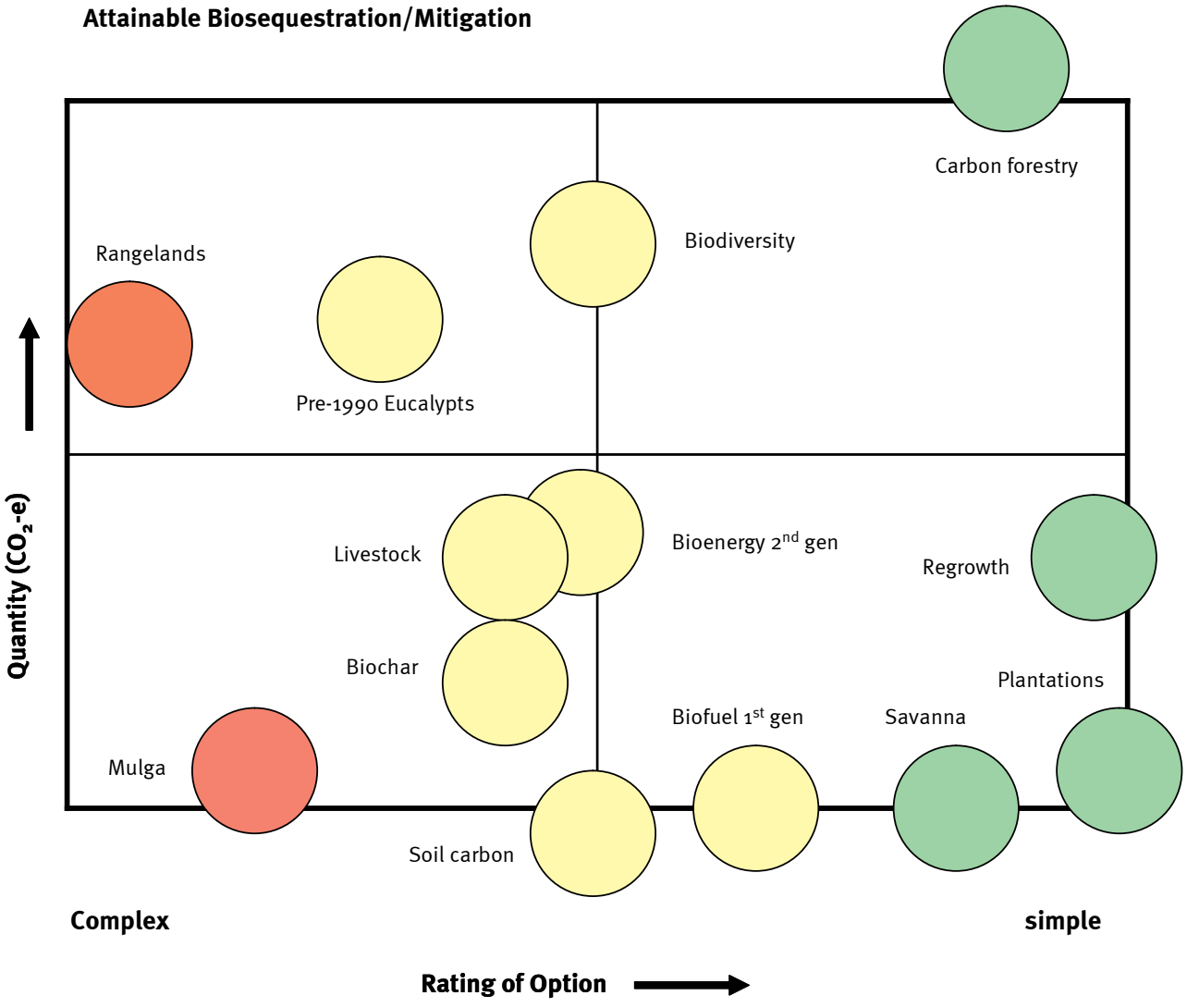
5.4 Native forest harvesting

Utilise existing data on native forest harvesting to improve accounting for different native forest types in Queensland.



Appendix 1

Figure 1: Qualitative assessment of the sequestration potential and relative difficulty for implementation of each of the land use processes



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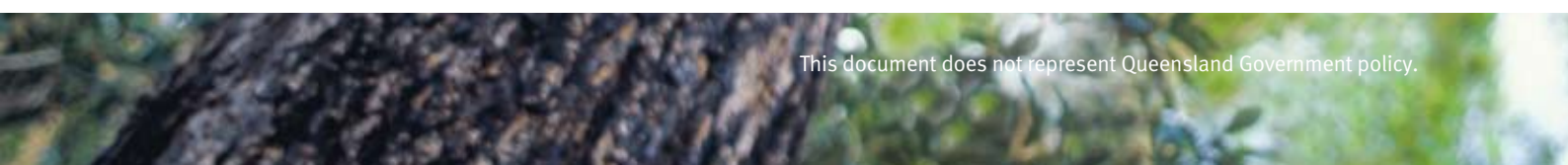

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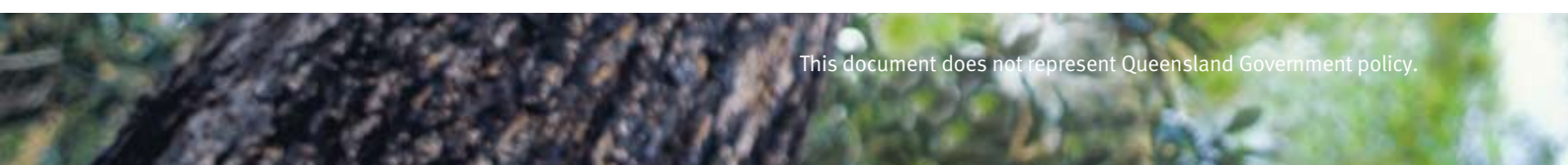

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