Agricultural Systems 135 (2015) 57–65

Contents lists available at ScienceDirect

Agricultural Systems

journal homepage: www.elsevier.com/locate/agsy

The financial implications of converting farmland to state-supported environmental plantings in the Darling Downs region, Queensland

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ARTICLE INFO

Article history:
Received 26 May 2014
Received in revised form 25 November 2014
Accepted 10 December 2014
Available online

Keywords:
Mixed species environmental plantings
Carbon sequestration
Pastures
Grain crops

ABSTRACT

Australia has one of the highest forest clearing rates in the world. Over the past 200 years, it has lost about 40% of total forest cover with consequent environmental problems such as soil and wind erosion, dryland salinity and biodiversity loss. The Australian Government has introduced a scheme to promote mixed species plantings for conservation and carbon sequestration benefits. This study first estimates the carbon sequestration amounts of these plantings using the Australian Government's Reforestation Modelling Tool and rules, and then compares the estimated returns with those from competing land uses in the Darling Downs region of Queensland, Australia. Costs and benefits data for all land uses were collected from different sources and discounted to produce net present values. With a standard discount rate, average carbon and commodity prices based on recent history and a low ($A1000/ha) direct seeding establishment cost, environmental plantings are more profitable than native pasture, grazing oats and forage sorghum land uses, but less profitable than grain sorghum and native pasture. Higher establishment costs would however favour the continuation of conventional agricultural activities, especially given the limited impact of revegetation schemes in Australia. A comparison of a policy of 25 years permanence (as in the Abbott Governments' Direct Action policy) with a policy of 100 years permanence, the 25 year permanence policy delivers 60% of the carbon sequestrated that would be sequestered over 100 years, but when cost components are included and compared with other land uses, it gives similar outcomes. Therefore, to be attractive to landholders, the restoration of native forests in agricultural areas, such as the Darling Downs, will likely require additional incentive payments (for environmental services and co-benefits) and reasonable contractual certainty.

1. Introduction

Globally, crop production requires large amount of energy (Hanjra and Qureshi, 2010) and therefore agriculture is a major source of greenhouse gas (GHG) emissions (Maraseni et al., 2009b). On-farm agricultural activities produce about 50% and 60% of all methane and nitrous oxide emissions, respectively (World Resources Institute, 2013). Furthermore, with more intensive and modernised farming systems, during the period 1990–2005, GHG emissions from agriculture increased by 14%, at an annual rate of 49 Mt CO_2e/yr (US-EPA, 2006). Australia has the highest per-capita emissions of greenhouse gases (GHG) at 24.3 tCO_2e/person. Its agricultural sector accounts for 15% of national GHG emissions and is the second largest source of emissions (DCCEE (Department of Climate Change and Energy Efficiency), 2012a). This proportion is significantly higher than the corresponding values for agricultural sectors in central and Eastern Europe (3%), the former Soviet Union (3%) and the USA (5.5%) (Smith et al., 2008).

In order to reduce GHG emissions, the Gillard Australian Government implemented Carbon Farming Initiatives (CFIs) (Department of Environment, 2013). Among other things (such as profitability, productivity and sustainability of farming system), CFIs allow farmers and land managers to earn credits by storing carbon or reducing greenhouse emissions from farm activities. These credits can then be sold to people and businesses wishing to offset their emissions. With this arrangement, the government expects agriculture to contribute to Australia's unconditional national target of a 5% reduction in GHG emissions by 2020 (Department of Environment, 2013). The CFI has the potential to provide incentives to the agricultural sector and to become actively involved in maximising activities which will promote on-farm carbon storage. This includes several activities including mixed species environmental plantings (MSEP) in ex-pasture and cropping lands. As of 20 February 2014, more than 100 CFI projects have been approved and >4.25 million Australian Carbon Credit Units have been issued to these projects (Department of Environment, 2014).

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http://dx.doi.org/10.1016/j.agsy.2014.12.004
0308-521X/

Mixed species environmental plantings (MSEPs), also referred to as 'carbon plantings', 'biodiversity plantings' or 'enrichment plantings' (Crossman et al., 2011; Eady et al., 2009), can include afforestation or reforestation activities. The species planted should be native to the local area, consisting of a mix of tree and understory species, but can be a single species if monocultures naturally occur in the region. Remuneration for plantings is then estimated using the Reforestation Management Tool (RMT), which draws on a range of biophysical data sources and the FullCAM model, to simulate the accumulated biomass and carbon sequestration for particular points in the landscape. This is a legal program tool and we set aside questions of accuracy and validity to use it in estimating likely payments for particular sites and in a particular region.

Over the past 200 years, about 40% of total forest cover has been lost in Australia (Bradshaw, 2012). Hence, in Australia, MSEPs have considerable potential to contribute carbon sequestration benefits, from 350 Mt CO_2-e/yr (Eady et al., 2009; Wentworth Group of Concerned Scientists, 2009) to 600 Mt CO2-e/yr (Burns et al., 2011), along with several other ancillary benefits, such as the enhancement of biodiversity, alleviation of dryland salinity, reduction of wind and/or water erosion (Baral et al., 2014; Bradshaw, 2012; Bradshaw et al., 2007), increasing agricultural crops pollination efficiency (Carvalheiro et al., 2011; Hoehn et al., 2008) and freshwater purification (Daily, 1997). Therefore, the motive behind the provision of MSEPs is not only for carbon benefits, but to restore some environmental services. The MSEPs is a 'no regret' option for government, but uptake is likely to be modest, based on historical experience of revegetation schemes.

Landholders have shown a reluctance to establish trees because of a loss of flexibility in land use choice and uncertainty or indeed scepticism about government schemes and their long-term surety. Hence, revegetation activities would need to have a clear financial advantage above conventional agricultural uses. Some studies (such as Crossman et al., 2011; Daryanto et al., 2013; Eady et al., 2009; Polglase et al., 2011) have assessed the economic potential of plantings at national or regional scales, but without using the Reforestation Modelling Tool, which will give a more accurate picture of likely payments. This study aims to estimate carbon sequestration potential of MSEPs using RMT and compare return from MSEPs with other competing land use systems in the Darling Down region, Queensland.

2. Revegetation policies and programmes

Following the United Nations Year of the Tree (1982), the Australian Government set up Greening Australia and the National Tree Program. The latter was succeeded by the One Billion Trees programme in 1989, which ultimately became the epitome of the failure of large-scale revegetation projects (REFs) and then Bushcare. Landcare (later Caring for Our Country) also funded local revegetation initiatives. In 1992 there was a National Forest Policy Statement which included a goal of encouraging farm forestry that would have both commercial and conservation benefits. It was expected that farm forestry could comprise up to 12% of an overall reforestation target of 3.3 m ha of plantations by 2020 (Centre for International Economics, 1997). Despite subsequent efforts to stimulate activity through the provision of information, advice and example plantations (Donaldson, 2001; Donaldson and Gorrie, 1996), farm forestry remained a minor part of the national estate (Wood et al., 2001).

In early 2014, there were several programmes (such as environmental plantings, managed regrowth, riparian plantations etc.) supporting revegetation, yet progress is limited. Incentives have included establishment subsidies, funding for group work (Landcare), funding for regional natural resource agencies to undertake work and small-scale conservation 'auctions', including within the national Environmental Stewardship programme. In the late 1990s, there was also some interest in promoting farm-based forestry through schemes that would 'bundle' the environmental services from plantations as to generate additional income for forest owners (see for example Binning et al., 2002; Buffier and The Allen Consulting Group, 2002; Hassall and Associates, 1999; State Forests of NSW and Commonwealth Bank, 1999; van Bueren, 2001), but with no major government scheme to purchase environmental services from forestry, such as the one that operates in Cost Rica (Pagiola et al., 2002) and no regulatory requirements for resource users to purchase environmental offsets, no such scheme eventuated.

Climate change may prove to be a game changer in delivering longer term incentives. It may have two types of impacts to environmental plantings: (1) direct impact, mainly due to changes in rainfall and temperature. It might be anticipated that climate change will further discourage the expansion of plantations, given the expected reduction in winter rainfall in Australia and generally higher temperatures, especially in inland areas (University of the Sunshine Coast and CLIMsystems Ltd, 2009), but it may also result in an incentive to establish plantations as other competing land uses could be less profitable due to the same reasons; and (2) indirect impact, mainly due to changes in government policy to tackle the issue of climate change. This study assesses the impact of the government policy, Carbon Farming Initiatives (CFIs), within the space of mixed-species environmental plantings provision.

3. Methodology

Planting trees produce several goods and services and remove carbon dioxide (CO_2) from the atmosphere and sequester the carbon in different pools. The Reforestation Modelling Tool (RMT) is the official software of the Australian Government for estimating carbon sequestration amounts in trees (above and below ground) and debris pools from mixed species environmental planting (MSEP) native to the local area for the purpose of Carbon Farming Initiatives (DCCEE (Department of Climate Change and Energy Efficiency), 2012b). The RMT can also estimate carbon emissions from trees and debris pools due to fire, but excludes crop, soil and harvested wood product carbon pools.

The Full Carbon Accounting Model (FullCAM; Richards, 2001; Richards and Evans, 2000) is another official model of the Australian Government. It is used to construct Australia's national greenhouse gas emissions account for the land sector for the purpose of national inventory and national communication to the UNFCCC. The RMT assesses the FullCAM model and uses the same data and parameter values as used in the National Inventory. The FullCAM has the capacity to estimate and predict all biomass, litter and soil carbon pools as well as changes in major greenhouse gases and nitrogen cycling in five systems; forest, agriculture, afforestation and reforestation, deforestation and mixed (e.g., agroforestry) systems. However, this model needs about 1200 different inputs to generate over 800 different outputs (Richards et al., 2005). By contrast, the RMT requires fewer inputs/data/information and provides a simple and user-friendly MSEP specific model.

3.1. Key attributes of RMT

The RMT accesses the Department of Environment's (FullCAM model) extensive climate, soil and vegetation databases to provide the base data for modelling reforestation projects (DCCEE (Department of Climate Change and Energy Efficiency), 2012b). Given co-ordinates (latitudes and longitudes or GPS points), the model is able to download the relevant Department datasets for the given co-ordinates.