Expanding woodland regeneration on marginal pastures in Southern Queensland through the use of market-based instruments: a landowner's perspective on constraints with insights on resolutions from a case study of a New Zealand land-care initiative

Tek Narayan Maraseni[a] and Paul Dargusch[b]

[a]*Australian Centre for Sustainable Catchments-Condamine Alliance, University of Southern Queensland, Toowoomba, QLD 4350 Email: maraseni@usq.edu.au*
[b]*School of Natural and Rural Systems Management, University of Queensland, St Lucia Campus, Qld 4072 Email: p.dargusch@uq.edu.au*

Keywords: woodland regeneration, ecosystem services, market-based instruments

Abstract

Data collected during interviews with private landowners are used to identify important constraints on how market-based instruments can be used to expand woodland regeneration on marginal pastures in the Southern Queensland region of Australia. Landowners highlighted three types of constraints: (1) those related to the uncertainty over what rules will govern a mandatory carbon trading scheme in Australia; (2) those related to how landowners can measure and sell their carbon credits and; (3) those related to whether the initiative will be profitable for landowners. We then use case analysis of the 'Emissions Biodiversity Exchange Project for the 21st Century' (EBEX21) program of Landcare Research New Zealand to reveal ways in which similar constraints have been successfully addressed in the context of marginal pastures in New Zealand. The EBEX21 program demonstrates how a government policy initiative can provide support to landowners by: (1) informing landowners about carbon trading opportunities; (2) ensuring satisfactory regeneration of woodlands (including the use of appropriate practices for fire and livestock exclusion and pest and weed management); (3) helping landowners measure and verify their carbon credits and; (4) providing a transparent system (through carboNZero) for landowners to engage with potential buyers of carbon credits.

Introduction

This article discusses various issues affecting the expansion[1] of woodland regeneration as an ecosystem service that is funded by non-government sources through market-based instruments on marginal pastures in the Southern Queensland[2] region of Australia. In this context, we define woodland regeneration on marginal pastures as *the human induced regeneration (by methods such as direct seeding, exclusion of fire and/or exclusion of grazing[3]) of communities of woodland[4] tree species, typically endemic to the local region of the respective site, instigated after 1990, on pastures generally considered to be marginally economically viable for ongoing traditional agricultural livestock enterprises[5], that have been cleared of more than 70% of woodland tree cover (measured in terms of canopy cover) prior to 1990*.

Our premise is that Australian governments, whilst advocating the ecosystem service benefits of woodland regeneration on marginal pastures, are unlikely to provide substantial direct funding for the endeavour. Instead, we assume that Australian governments are likely to prefer to support the development of a policy environment that facilitates sustained and substantial funding for woodland regeneration on marginal pastures on privately owned land through the use of market-based instruments. We therefore place particular emphasis in this article on the perspectives of private landowners of marginal pastures and consider such landowners as critical actors in the expansion of woodland regeneration using market-based instruments.

We also adopt Boyd and Banzhaf's (2007 p. 619) definition of an ecosystem service as being: 'components of nature directly enjoyed, consumed, or used to yield human well-being' and we align our research with economic theory. Much of the wider body of literature on ecosystem services has focussed on quantifying the value of ecosystem services (Brauman *et al*., 2007; Kumar and Kumar, 2008). In the process, many such studies have stressed the importance of ecosystems services to the sustainability of the industrial, social and natural systems within which they feature (Boyd and Banzhaf, 2007). Most studies have argued that various changes need to be instigated to: account for these ecological services in traditional economic considerations and business performance measures (e.g. Dasgupta, 2008); create public policy settings within which ecosystem services can be supported (e.g. Egoh *et al*., 2007; Kroeger and Caseya, 2007); and invigorate market based systems capable of funding the sustained health of the ecological services (e.g. Turner and Daily, 2008).

Whilst a number of these articles have provided useful recommendations on aspects of the challenge of promoting ecosystem services using market-based instruments, none have investigated the constraints specifically relating to how market-based instruments could be used to expand woodland regeneration on marginal pastures in the context of Australian rural

[1] By 'expansion' we mean promotion, enhancement, advancement and development of the activity.
[2] We define the Southern Queensland region of Australia as that area covered by the following four Natural Resource Management regions as specified under the Australian Government's National Action Plan for Salinity and Water Quality and the Natural Heritage Trust: (1) South West; (2) Border Rivers Maranoa-Balonne; (3) Condamine and; (4) Burnett Mary (Australian Government, 2006). This region was selected for the study due to the importance of woodland regeneration as an ecosystem service in the region and because of its relevance to the geographical location and professional networks of the authors.
[3] Our definition of woodland regeneration does not include plantation-type tree planting.
[4] We assume a distinction between woodlands and forests consistent with the definition used by Boland *et al.* (2006) and focus on woodlands because of their relative prominence in marginal pastures in Queensland.
[5] We adopt the definition of marginal pastures used by Hodges and Goesch (2006).

settings. In making this statement, we acknowledge the significant work of Macleod, McIvor and McIntyre (McIntyre *et al.,* 2000; McIvor, 2002; Macleod and McIvor, 1998; 2005; 2006; 2008) that have dealt with the ecosystem benefits of woodlands in the Australian pastoral context but note that most of their work related more to the ecological economic of tradeoffs between grazing production and woodland conservation than to issues related to the expansion of woodland regeneration through the use of market-based instruments.

We also acknowledge that a number of Australian government policy initiatives[6] have aimed to utilize market-based instruments to advance various ecosystem services in several parts of rural Australia and that the experiences of these initiatives provide valuable information for the development and implementation of new initiatives (e.g. Cockfield, 2005). But we assert that a weakness of the published analysis of these projects is that none have examined the issues affecting the success of market-based instruments from the perspective of rural landowners. This paper aims to contribute to this gap in the ecosystem services and market based instrument literature by exploring the issues that private landowners perceive as constraints on the expansion of woodland regeneration on marginal pastures in Southern Queensland through the use of market-based instruments (MBI). The MBIs are policy tools that encourage behaviour through market signals rather than through explicit directives (Whitten and Young, 2003). They are becoming more popular because of their effectiveness, efficiency and flexibility (Whitten *et al*., 2003)

There are several reasons why many stakeholders (e.g. land-owners, enterprise managers, investors and policy makers) should be interested in finding out more about such constraints and in promoting the development of woodland regeneration on marginal pastures. First, woodland regeneration is potentially a low-cost[7] land use option that stands to offer substantial benefits to the health of the natural ecology and sustainable economies of potentially vast areas of marginal pastures across Australia[8] (Crowley and Garnett, 1998; Smit and Olff, 1998; Bastin *et al.* 2003; Dorrough and Moxham, 2005; Fensham *et al*. 2005; Maraseni *et al.* 2005). The expansion of woodland regeneration is also a potentially substantial sink for the sequestration of greenhouse gases. For example, Burrows *et al*. (1997) showed that the carbon sink potential of regenerated woodlands could be around 42 million tonnes of carbon dioxide per year in the 60 million hectares of grazed woodlands in North-Eastern parts of Queensland and CRCGA (2006) estimated that regenerated woodlands could account for around 25% of the total estimated national net emissions of greenhouse gases for Australia.

We believe that any market-based instruments that are likely to prove successful in expanding woodland regeneration on marginal pastures in Southern Queensland will be closely linked to the opportunity to trade sequestered carbon. As such, the definition of woodland regeneration that we have adopted for this study seeks to comply with the guidelines for sinks and credits in carbon trading schemes specified under the Kyoto

[6] For example, the: National Water Initiative (Quiggin, 2007); Hunter River Salinity Trading Scheme (EPA, 2003); National Market-Based Instruments Pilot Project under the National Action Plan for Salinity and Water Quality (Econsearch, 2006); Environmental Service Scheme (Grieve and Uebel 2003; Parkes *et al*. 2003) and; Bush Tender, CarbonTender, PlainsTender, RiverTender and BushReturns (Bryan *et al.,* 2005).

[7] That is, low cost compared to traditional afforestation methods such as tree planting, if the woodland regeneration is induced by methods such as direct seeding, exclusion of fire and/or exclusion of grazing.

[8] Woodland regeneration is an initiative that is supported by numerous significant Australian government policies and regulations (e.g. the *Vegetation Management and other Legislation Amendment Act 2004*; the *National Action Plan for Salinity and Water Quality 2000* and; *Plantations for Australia: the 2020 Vision*).

Protocol[9] (as summarised in Hepburn, 2007). The main elements of these specifications include that Kyoto-compliant forests[10] (which includes woodlands) need to be: (1) a product of human induced afforestation methods enacted after 1990 and; (2) take place on land mostly cleared[11] of trees before 1990.

Considering carbon market for woodland regeneration, the potential types of non-government sources of funding for woodland regeneration are likely to include carbon traders, philanthropists and corporations[12]. These investors are likely to be motivated by a mix of reasons, including the desire to profit, reduce financial risk by engaging in carbon trading and the desire to contribute to and support the broader ecosystem service benefits of an activity like woodland regeneration (Aune *et al.,* 2005; Amalric 2006; Levinson, 2006; Coomes *et al.* 2008). In this study, we seek to learn from one particular policy initiative from outside Australia that has facilitated investment in forest and woodland regeneration on marginal pastures[13] - the 'Emissions Biodiversity Exchange Project for the 21st Century' (EBEX21) program of Landcare Research New Zealand (2008a). We also orientate our case analysis by elucidating how well a number of private landowners of marginal pastures in Southern Queensland understand the issues at-hand. From associated analysis we aim to answer the research question; '*What issues do private landowners perceive as constraints on the expansion of woodland regeneration in Southern Queensland using market-based instruments and what lessons can be learnt about how to address those constraints from the EBEX21 program of Landcare Research New Zealand?*'

Research Methodology

A two stage approach was used to address the research question. The first stage involved interviews with 14 private landowners of marginal pastures in Southern Queensland (the 'participants'; denoted in the Results section of this article as P1 to P14). The research method used in these interviews was phenomenography (as described by Marton, 1981). The purpose of the interviews was to elucidate the understandings of participants on what they perceived as the constraints on the expansion of woodland regeneration on marginal pastures in Southern Queensland through the use of market-based instruments. Importantly, we were not aiming to investigate how landowners make land-use decisions and have not included theoretical perspectives from the farm-use decision-making literature in this article. For this reason, we also did not collect detailed demographic information on participants but instead,

[9] Although the policy environment relating to emissions trading schemes at both national and global levels continues to evolve, the Kyoto Protocol remains the pre-eminent international reference point for what the rules will most likely be in any mandatory emissions trading scheme in Australia (Garnaut, 2008).

[10] The 'Sink' or the 'Land Use, Land Use Change and Forestry LULUCF)' activities cover two Articles (3.3 and 3.4) of the Kyoto Protocol. The eligible activities under Article 3.3 include direct human induced afforestation, reforestation and/or deforestation activities that started on or after 1 January 1990. Likewise, the eligible activities under Article 3.4 include revegetation, forest management, cropland management and grazing land management (UNFCCC, 1997).

[11] The Kyoto Protocol sets out a flexible definition of forests as those a minimum area of land of 0.05-1.0 hectare with tree crown cover of more than 10-30 percent with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ'. Consistent with these criteria, Australia defines forest as an area with a potential to reach a minimum of 20% crown cover, two metres in height and minimum area of 0.2 ha (BRS, 2005). A large proportion of woodlands in Southern Queensland will have canopy cover less than 20%. We believe that human induced regeneration activity could help to increase canopy cover over 20%, by which landholders will be eligible to get carbon credits.

[12] Gullison *et al.* (2007) suggested that these types of investors would be the likely investors in ecosystem services provided by forest related systems.

[13] That is, marginal pastures in the context of New Zealand land capability and agricultural systems.

we used some simple features, such as age and size of landholding, to describe the participants and ensure that they were able provide valuable information on the research question.

Nine of the participants interviewed were male and five were female. All participants were aged between 40 and 60 years of age. At the time of interviewing (between December 2007 and March 2008) all participants owned farms that included at least 500ha of marginal pastures and all participants managed their marginal pastures for cattle and/or sheep grazing. Three participants (P1 to P3) owned farms in the South West region of Southern Queensland ; another three owned farms in the Border Rivers Maranoa-Balonne region (P4 to P6); another six owned farms in the Condamine region (P7 to P12) and; two owned farms in the Burnett Mary region (P13 and P14). Each of the 14 participants was known to one of the authors of this article as part of that author's work history and professional network. As such, making contact with each of the participants, verifying that they owned farms of the type specified above and obtaining their permission to be involved in the study was made somewhat easier. Participants took part in a single interview of between 30 and 90 minutes in length, conducted either in person or via telephone. At the start of the interview, participants were read our definition of woodland regeneration and a short discussion took place clarifying our intended meaning of the construct. The DAFF (2008) definition of 'market-based instruments' adopted in this study was also discussed. Participants were then asked one open-ended question: what constraints are there on the expansion of woodland regeneration in Southern Queensland using market-based instruments? Follow-up questions were used to encourage participants to elaborate on their comments (What do you mean by that? Can you explain further? Can you give an example?). Theoretical saturation (as described by Eisenhardt, 1989) was reached with the 14 participants. Other social science studies published in respected peer reviewed journals that have used similar research design and claimed to have reached theoretical saturation with a similar sample size include Lee *et al.* (2002), Jette *et al.* (2003) and Troiano (2003).

The second stage of our methodology involved a case study analysis of the 'Emissions Biodiversity Exchange Project for the 21st Century' (EBEX21) program of Landcare Research New Zealand (2008a). The purpose of this case study was to identify ways in which constraints similar to those highlighted by the participants involved in our study have been successfully addressed in the context of marginal pastures in New Zealand. Our method of case study analysis followed the principles of case analysis espoused in the business research paradigm (Dargusch, 2003) and in the publications by Pettigrew (1985), Eisenhardt (1989), Yin (1994), Remenyi *et al.* (1998), Marshall and Rossman (1999), Suddaby (2006) and Sigglekow (2007).

EBEX21 provides an information-rich case study of a market-based instrument being used to promote woodland regeneration on marginal pastures that has been operational for over six years and has had a good amount of rigorous research published on its performance (Carswell *et al.,* 2003; Trotter *et al.,* 2005; Carswell, 2006; MAF, 2006). , New Zealand and Australia have many cultural and political similarities, so insights from the case study are likely to have sound application to the context of Southern Queensland. However, we recognise some important differences between New Zealand and Southern Queensland, including that the biophysical and agricultural industry attributes differ and that those differences may influence important issues such as the nature of weed and pest management and geographical scales of woodland regeneration development. It is also important to acknowledge that whilst we consider that the notion of woodland regeneration promoted by EBEX21 is essentially the

same as the definition that we have adopted in this article (e.g. Trotter *et al.*, 2005), we could not find any EBEX21 documentation in which a specific definition was stipulated.

Results

Interviews with Participants

All participants expressed enthusiasm for the idea of expanding woodland regeneration on marginal pastures in Southern Queensland by using market-based instruments but all of the participants qualified their enthusiasm by explaining that the potential success of the concept was dependent on the resolution of a number of important constraints.

> I think it'd be a great thing to do in principle but there's so much to figure out about how you actually trade carbon that it's hard to say whether it would be realistic… (P4)

> I think there'd be no shortage of interest….Most farmers I know would be pretty keen on the idea …I don't know too many farmers that'd know too much about carbon trading and from what I hear it can get quite complicated and if you going to get serious about it, then that's the sort of details you need to know…(P9)

> It's a good idea and all but I think a number of things need to happen before it becomes a reality … (P14)

All participants explained that the type of market-based instruments most relevant to the expansion of woodland regeneration in Southern Queensland were those associated with emissions trading and specifically carbon trading. In this regard, participants almost exclusively referred to 'carbon trading' and 'carbon credits' and as such, in the results we present in this article, we use those terms and not 'emissions trading' or 'emissions offsets'. Importantly, none of the participants raised issues related to the opportunity of selling other aspects of the ecosystem services offered by regenerated woodlands, such as attracting philanthropic investment in biodiversity conservation. Some participants did recognise however, that woodland regeneration offered many benefits to the ecological health of their farms and pondered that if woodland regeneration could make them an equal or greater net income from their marginal pastures than their existing grazing enterprises, then there would be good reason to consider changing land uses.

> I'd love to lock a few paddocks up and get paid for it…I'm sure it would encourage a lot more wildlife and probably do the farm as a whole a lot of good … (P6)

> We're not far off passing the farm on to (our kinds), so it would be really good to use something like this to diversify income and improve the land and still make money from it … (P10)

Participants highlighted three types of constraints (Table 1): (1) those related to the uncertainty over what rules will govern a mandatory carbon trading scheme in Australia; (2) those related to how landowners can measure and sell their carbon credits and; (3) those related to whether the initiative will be sustainably profitable for landowners.

Types of Constraints	**Specific Issues Raised**
Those related to the uncertainty over what rules will govern a mandatory emissions trading scheme in Australia.	• Will woodland regeneration be permitted to be used as a source of carbon credits? • How will carbon credits from woodland regeneration need to be measured and verified? • What 'vintages' of carbon credits from woodland regeneration will be permitted to be traded? • Can woodlands be cleared after the particular vintage of carbon credits is sold?

Those related to how landowners can measure and sell their carbon credits.	• How much will it cost to measure and verify carbon credits from woodland regeneration, particularly given the large land areas potentially available? • Will individuals and organisations need to have some type of formal approval or certification to be able to verify carbon credit measurements? • How do sellers identify and engage with buyers of carbon credits? • Will professional legal advice need to be sought to complete a carbon credit sale?
Those related to whether the initiative will be sustainably profitable for landowners.	• How can the costs of inducing woodland regeneration on marginal pastures be sufficiently minimised given the large land areas potentially available? • How can the quality of pest and weed management required to achieve woodland regeneration on marginal pastures to appropriate ecological standards be maintained, whilst costs are sufficiently minimised? • What will be the price paid for carbon credits from woodland regeneration? • Does selling carbon credits from woodland regeneration restrict that land to be used only for woodland regeneration in perpetuity?

Table 1 Three Types of Constraints Identified by Participants on Using Market-Based Instruments to Expand Woodland Regeneration on Marginal Pastures in Southern Queensland

Participants highlighted a number of constraints relating to the uncertainty over what rules will govern a mandatory emissions trading scheme in Australia. These included issues related to; whether woodland regeneration would be permitted to be used as a source of carbon credits; how carbon credits from woodland regeneration will need to be measured and verified; whether carbon credits will be sold as 'vintages' and; whether woodlands could be cleared after the particular vintage of carbon credits is sold?

> It's hard to say anything until the rules of the mandatory scheme are set…Until then, any decision regarding measurement or verification or vintage is purely guess work and speculation … (P14)

> I suppose a lot depends on what they decide to put in the rules and whether they will allow this type of thing or not… (P12)

> I'm not even sure whether you could clear the land once you sold the credits…I think this would be a pretty important issue for a lot of farmers, the ones I know don't like having their hands tied too much… (P5)

Most participants also highlighted a number of constraints related to how landowners will be able to measure and sell their carbon credits. These included: whether the cost of measuring and verifying carbon credits from woodland regeneration will be financially viable given the large land areas potentially available; whether individuals or organisations need to have some type of formal approval or certification to be able to verify carbon credit measurements; how sellers will be able to identify and engage with buyers of carbon credits and; whether professional legal advice will need to be sought to complete a carbon credit sale.

> Well I've got no idea on how to measure carbon and it's hard to think of ways that you could do it cheaply if you're talking about these big properties … (P9)

> I can't see how you could get a consultant or someone like that to audit your measurements cheaply – they'd need days to measure trees and things like that on our property … (P1)

> Who buys these things? I've got know idea so how would I sell them…It's a lot different to livestock where you know your agents and you know what you need to do to sell your stock …(P4)

Participants also emphasised that the success of using carbon trading to expand woodland regeneration would depend on woodland regeneration being sustainably profitable. In this regard, participants questioned: whether the costs of inducing woodland regeneration on

marginal pastures could be sufficiently minimised given the large land areas potentially available; whether the quality of pest and weed management required to achieve woodland regeneration on marginal pastures to appropriate ecological standards could be maintained at sufficiently low cost; whether the price paid for carbon credits from woodland regeneration will be sufficiently high and; whether selling carbon credits from woodland regeneration would restrict that land to be used only for woodland regeneration in perpetuity.

> How would you manage the goats and dogs and all the other vermin?...and if you don't, it'd just be a breeding ground that'd kill the rest of your farm and your neighbour's and probably take all of your time trying to manage… (P7)

> I've tried fencing off a few smaller areas to get some regeneration going and in my experience it hasn't been easy… It typically involves more than just fencing… (P13)

> The success of this would be no different to the success of other types of farming. You need to produce a good product and you need to get a good price… I'm not completely sure how you would produce a good woodland but I suppose that would be a lot clearer when someone makes some rules… And I don't know anything about the price for carbon. We read about some pretty incredible prices being paid in Europe – around the $50 to $100 mark per tonne - but it's hard to see how those sorts of prices could be sustainable in Australia…. The ongoing success of the idea will depend on whether you can make money out of it in the long term… (P10)

Case Study – EBEX21 Program of Landcare Research New Zealand

The 'Emissions Biodiversity Exchange Project for the 21st Century' (EBEX21) program was started in 2001 by Landcare Research New Zealand. Landcare Research is an independent and not-for-profit Crown Research Institute involved in research relating to the conservation of natural and ecosystems, that was founded in 1992 from a reorganisation of Government funded research in New Zealand. The objective of the EBEX21 program is to expand the regeneration of woodlands and forests of endemic tree species on privately owned marginal pastures throughout New Zealand by facilitating the opportunity for landowners to achieve a financial return from woodland regeneration through the sale of carbon credits (Carswell *et al.,* 2003; Trotter *et al.,* 2005).

There were several reasons why Landcare Research instigated the EBEX21 program. As a signatory (in 1993) of the Convention on Biological Diversity, New Zealand is required to develop national strategies, plans or programs that enhance the conservation and sustainable use of its unique biodiversity. The EBEX21 program supports the pursuit of this obligation (Carswell, 2006). In addition, as a ratifying party of the Kyoto Protocol (in 2002), New Zealand must, by 2012, contain its national greenhouse gas emissions to a level equivalent to what they were in 1990. Recent data suggests that this will be an increasingly challenging concern for the New Zealand government considering that its national greenhouse gas emissions were estimated to be close to 22% above 1990 levels in 2006 and are projected, based on the assumption of a continuation of current government policy, to be 30% above 1990 levels by 2012 (Terry, 2007). There are over one million hectares of marginal pasture land in New Zealand (Eyles, 1985; Trotter *et al.,* 2005) and as such, the EBEX21 program has the potential to make a significant contribution to New Zealand's ability to meet these Kyoto Protocol targets.

In order to be eligible to enter into the EBEX21 program, the specified land must have had less than 30% tree cover (measured in terms of canopy cover) of tree species capable of reaching at least 5m in height as of 31st December 1989 (MAF, 2006). This is a requirement

for any subsequently regenerated woodland or forest to be compliant with the specifications for carbon credits under the Kyoto Protocol. Other eligibility factors are also considered, including: (1) those conditions affecting the likelihood that communities of endemic woodland species will regenerate (e.g. rainfall, distance to seed sources, altitude and evidence of woody colonisation) and; (2) whether the regenerated woodlands are protected by a covenant (e.g. through the Queen Elizabeth II Natural Trust and/or the Permanent Forest Sink Initiative (EBEX21, 2006; MAF, 2006).

To enter into the EBEX21 program, eligible landholders must sign a contract with Landcare Research. Under the terms of this contract, landholders must commit to undertake a number of key land management activities to an appropriate standard at their own cost. These management activities include fire prevention, weed and pest control and the exclusion of livestock from the regenerating woodland or forest. Once the landowner undertakes these activities and the land is protected from grazing and fire, pioneer shrub species such as *manuka* (*Leptospermum scoparium*) and *kanuka* (*Kunzea ericoides*) naturally populate the area and act as a nurse crop for endemic tree seedlings to establish. As the tree seedlings grow, the pioneer shrub species diminish. In the event that there are very few or no seedlings of endemic woodland and forest trees after five years of nurse crop, landholders are required to plant three groups of three or four endemic tree seedlings per hectare to act as sources of seed in due course. EBEX21 publications estimate that on average, one hectare of woodlands or forests regenerated in such a way are expected to sequester approximately three tonnes of carbon dioxide per year. Staff from the EBEX21 program provides all necessary assistance to landholders to measure and verify carbon credits to prepare them for sale (EBEX21, 2006).

To facilitate the sale of carbon credits from regenerated woodlands and forests, Landcare Research concurrently established the 'carbonNZero' program (Landcare Research New Zealand, 2008b). The carbonNZero program provides a number of services to organisations who would like to become certified as 'carbon neutral'. These services include tools and assistance for those organisations to calculate their current carbon emissions, resources to help those organisations reduce their emissions and the facilitation of the purchase of carbon credits by those organisations to offset their remaining emissions. The carbonNZero program currently includes a number of carbon neutral certified organisations including: Urgent Couriers; Mercury Energy; Braun Wheatley Partners; Youth Hostels Association; Air New Zealand; Canterbury University and; River Valley (EBEX21, 2004; EBEX21, 2007).

The carboNZero program buys carbon credits on behalf of such organisations from landowners engaged in the EBEX21 program. The price of EBEX21 program carbon credits paid by the carboNZero program in 2005 was US\$5/tCO_2e (Frame *et al*. 2005). It follows, that based on Frame *et al*. (2005) estimates that typical rates of carbon sequestration by woodlands and forests regenerated under the program are close to five tonnes of carbon dioxide per hectare per year, the average annual income to landowners paid through the EBEX21 program would be approximately US\$20 per hectare per year.

EBEX21 carbon credits are expected to comply with the rules being established by Ministry of Agriculture and Forestry on the Permanent Forest Sink Initiative (PFSI) (Landcare Research New Zealand, 2008a). The PFSI promotes forest[14] which is eligible for Kyoto

[14] For the purpose of Kyoto Protocol, New Zealand defines forest as having a land area of more than 1 ha with a canopy cover of more than 30% with a potential to reach height of 5 m at maturity in situ. In addition, the forest must be direct human induced —through planting, seeding and/or the human-induced promotion of natural seed sources (MAF, 2006)

market and thus the PFSI plays an important role to the New Zealand Emissions Trading System.

The EBEX21 program has been moderately successful in that 10 marginal pasture sites of between 500ha and 1000ha in size have been successfully included in the program since it was started. These sites have been successfully regenerated and the carbon credits have been sold to participants in the CarboNZero program. The program has also been very successful in getting carbon credit buyers to engage in the CarboNZero certification process, particularly in terms of the growth of the numbers of organisations seeking certification in the last 12 months.

Despite these achievements, a number of issues have been identified by various parties that act as constraints on the further expansion of the EBEX21 program. For example, the costs of silvicultural practices required for regenerating and maintaining woodlands (e.g. fencing) and the costs of measuring and verifying carbon credits remain significantly high. Indeed, these costs, particularly the costs of measuring and verifying carbon credits, account for most of the administrative costs subtracted from the gross carbon price paid by the CarboNZero carbon buyers (EBEX21, 2006). This is despite the efficient systems used by the EBEX21 program to assist landowners with these activities. Carswell *et al*. (2003) suggested that the costs of measuring and verifying carbon credits could be substantially reduced through economies of scale if larger land areas were included in the EBEX21 program but this principle would probably not apply to silvicultural costs. A number of commentators have also noted that the risk that woodlands and forests will not be included in post-Kyoto climate change policies remains a substantial source of uncertainty and deterrent for landowners contemplating joining the EBEX21 program (Burrows, 2002; MAF, 2006).

Discussion and Concluding Remarks

The participants agreed that woodland regeneration on marginal pastures in Southern Queensland is an activity worthy of public support and that market-based instruments could provide a substantial opportunity to support the initiative. The participants qualified this opinion by noting that the success of market-based instruments in this context was dependent on the resolution of a number of important constraints (listed in Table 1). Our case study of the EBEX21 program offered a number of useful insights to potentially resolve several of these constraints.

The main lesson of the EBEX21 case study is that successful development of market-based instruments to promote woodland regeneration may require a program that offers landholders support that will resolve the uncertainty and technical complexity that seems to underpin most of their concerns about using woodland regeneration on their marginal pastures to produce and sell carbon credits. Indeed, despite uncertainty over the post-Kyoto policy status of forests and woodlands as sources of carbon credits and despite details of mandatory emissions trading schemes not yet being specified, the EBEX21 program provides a vehicle of certainty for landowners in that it puts in place a ‘real’ system wherein landowners are enabled to grow, measure, verify and sell carbon credits. Moreover, the EBEX21 program is an example of a successful government initiative that does not involve government directly funding woodland regeneration, but rather uses market-based instruments and institutional support to better enable landowners to engage in the activity.

The EBEX21 program informs landowners about carbon trading opportunities and acts as an advocate for the use of market-based instruments to enhance and foster ecosystem services. This is an important form of support in that it helps to address landowners' carbon markets uncertainty and provides a reliable source of technical guidance that landowners can use to learn more about some of the more complicated aspects of carbon trading and woodland regeneration. Indeed, a number of participants in Southern Queensland considered the silviculture of woodland regeneration as a technically difficult task. It follows that the technical support offered by an organisation like the EBEX21 program on practices associated with fire and livestock exclusion, pest and weed management and appropriate seed sources, would be very useful to help Southern Queensland landowners ensure satisfactory regeneration and maintenance of woodlands on marginal pastures.

Likewise, the technical support offered by the EBEX21 program to landowners to help measure and verify carbon, could also help address those concerns reported by Southern Queensland participants about what they perceived as a complex task. Participants explained that they did not know how carbon should be measured or who would be approved to verify measurements. The EBEX21 program addresses these concerns for New Zealand growers by providing: a set of protocols for measurement and verification; expert technical support and carbon measurement tools that help landowners properly measure carbon credits; and a service wherein EBEX21 program staff act as the verifiers of carbon credit measurements.

The problem remains, however, of how the costs of carbon measurement and verification, and the costs of silvicultural practices can be sufficiently minimised. These cost issues were noted in our case study analysis as two important constraints on the further expansion of the EBEX21 program. That noted, carbon measurement and verification costs might be lower in Southern Queensland given that marginal pasture sites are likely to be larger than the 500 to 1000 hectare sites in the EBEX21 program. But whilst measurement and verification costs might be lessened as a result of economies of scale, the costs of silvicultural practices such as fencing and pest and weed management could be made more problematic by the larger sites and existing land conditions of marginal pastures in Southern Queensland.

A number of Southern Queensland participants explained that they were also unsure of how to sell carbon credits and whether the prices paid for carbon would justify the costs of woodland regeneration and carbon credit measurement and verification. Our case analysis showed how the EBEX21 program addressed these issues for New Zealand[15] landowners through the carboNZero program, which recruited carbon buyers, organised carbon credits produced through the EBEX21 program to be sold to carbon buyers and established a price for carbon credits from the EBEX21 program. These opportunities noted, the experience of the EBEX21 program also demonstrates that until the rules of mandatory emissions trading schemes are established and until the market pays prices for carbon sufficiently high to justify the costs of carbon measurement and verification, associated perceptions of risk and uncertainty by landowners will continue to limit the effectiveness of market-based instruments in the expansion of woodland regeneration on marginal pastures.

There are also a number of other issues not highlighted by our participants or our case analysis that we think are important considerations for future research. For example, there is

[15] In 2005, the price of EBEX21 carbon credits is US$4/t$CO_2$e. If the price of carbon credits increases to US$ 6/tCO_2e (US$30/ha), then EBEX21 woodland regeneration project would cross threshold and deliver a positive return (Frame *et al*. 2005). Considering the current international market price of afforestation and reforestation carbon credits it is easily achievable.

an opportunity to harness the same types of market and policy structures that have supported the rapid expansion of the Australian hardwood plantation estate over the last ten years through the so-called managed investment schemes (Dargusch, 2008). As such, there is an opportunity to research what types of features attract and motivate investors into managed investment schemes and what types of managed investment scheme models might be suitable to support the expansion of woodland regeneration.

There is also the opportunity to build on the issues discussed in this article and develop robust financial models that evaluate the comparative profitability of woodland regeneration under various market, silvicultural and spatial design considerations. Such models could also be used to investigate how woodland regeneration and grazing operations could be integrated into sustainable commercial enterprises whilst maintaining or improving the health of ecosystem services. Indeed such work could also build on the substantial research of McIntyre *et al*., (2000), McIvor (2002) and Macleod and McIvor (1998; 2005; 2006; 2008).

Acknowledgements

We would like to thank the Australian Centre for Sustainable Catchments, University of Southern Queensland and the University of Queensland for research and logistical support. We are also grateful to the Condamine Alliance for financial support.

References

Amalric, F 2006, 'Pension funds, corporate responsibility and sustainability' ' *Ecological Economics*, vol. 59. pp. 440-450.

Aune, JB, Alemu, AT and Gautam, KP 2005, 'Carbon sequestration in rural communities: is it worth the effort?' *Journal of Sustainable Forestry*. vol. 21(1).pp. 69–79.

Australian Government 2006, Natural resource management NRM funded projects, accessed 5 May 2008 http://www.nrm.gov.au/

Bastin, GN, Ludwig, JA, Eager, RW, Liedloff, AC, Andison, RT and Cobiac, M D 2003, 'Vegetation change in a semiarid tropical savannah, northern Australia' *Rangeland Journal*, vol. 25(1), pp. 3-19.

Boland, DJ, Brooker, MIH, Chippendale, GM, Hall, N, Hyland, BPM, Johnston, RD, Kleinig, DA, Mcdonald, MW and Turner, JD 2006, 'Forest Trees of Australia', 5th edn. CSIRO Publishing, Collingwood, 736 p.

Boyd, J and Banzhaf, S 2007, 'What are ecosystem services?' The need for standardized environmental accounting units', *Ecological Economics*, vol. 63. pp. 616-626.

Brauman, KA, Gretchen, CD, TKa'eo, D and Harold, AM 2007, 'The nature and value of ecosystem services: an overview highlighting hydrologic services', *Annual Review Environmental Resources*, vol. 32. pp. 67–98.

Bryan, B, Gatti, S, Cornnor, J, Garrod, M and King, D 2005, 'Catchment-care - developing an auction process for biodiversity and water quality gains', CSIRO Land and Water Client Report, CSIRO, Australia.

BRS (Bureau of Rural Science) 2005, 'National Plantation Inventory Australia: 2005 Updates', http://affashop.gov.au/PdfFiles/, accessed 10 September 2006

Burrows, W, Anderson, E, Back, P and Hoffman, M 1997, 'Regrowth and woody plant thickening/invasion impacts on the land use change and forestry inventory', Draft paper prepared for the IPCC Workshop on Biomass Burning, Land Use Change and Forestry. Rockhampton, Queensland.

Burrows, WH 2002, 'Seeing the woodland for the trees- An individual perspective of Queensland woodland studies, *Tropical Grasslands, vol.* 36, pp202-217.
Cacho, OJ, Wise, R and MacDicken, K 2004, 'Carbon monitoring costs and their effect on incentives to sequester carbon through forestry', *Mitigation and Adaptation Strategies for Global Change*. vol. 9 (3). pp 273 – 293.
Carswell, F 2006, 'Could biodiversity add value to New Zealand's Kyoto forest credits', *New Zealand Journal of Forestry*, vol (N/A), pp. 31-33.
Carswell, F, Frame, B, Matin, V and Turney, I 2003, 'Exchanging emissions for biodiversity: in pursuit of an integrated solution in New Zealand', *Ecological Management & Restoration*, vol. 4, pp. 85-93.
Cockfield, G 2005, 'Evaluating a Market-Based Incentive Scheme for Farm Forestry: A Case Study', PhD Thesis. *School and Geography, Planning and Architecture.* University of Queensland, Brisbane.
Coomes, OT, Grimard, F, Potvin, C and Sima, P 2008, 'The fate of the tropical forest: Carbon or cattle?' *Ecological Economics*, vol. 65. pp.207-212.
CRCGA (Cooperative Research Centre for Greenhouse Gas Accounting) 2006, Impact: woody thickening. http://www.greenhouse.crc.org.au/impact/woodythickening.cfm, accessed on 1 August 2007, Canberra, Australia.
Crowley, GM and Garnett, ST 1998, 'Vegetation change in the grasslands and grassy woodlands of the east-central Cape York Peninsula, Australia'. *Pacific Conservation Biology*, vol. 4, pp 132-148.
DAFF (Department of Agriculture Fisheries and Forestry) 2007, 'Market-based instruments: what are market-based instruments?' Department of Agriculture Fisheries and Forestry, Canberra
Dargusch, P 2008, 'Understandings of sustainable corporate governance by Australian managed investment schemes and some implications for small-scale forestry in Australia', *Small-scale Forestry* vol. 7. pp. 67-75.
Dasgupta, P 2008, 'Nature in Economics', *Environmental Resources Economics*, vol. 39. pp. 1–7.
Dorrough, J and Moxham, C 2005, 'Eucalypt establishment in agricultural landscapes and implications for landscape-scale restoration', *Biological Conservation*, vol. 123. pp 55-66.
EBEX21 2004, 'A national system for greenhouse has measurement, management, and mitigation', *EBEX21, Issue 4, May 2004.*
EBEX21 2006, 'Landowner eligibility for selling carbon credits', Landcare Research, New Zealand, available at URL: http://www.ebex21.co.nz/carbon_credits_sell.asp, accessed 12 August 2007.
EBEX21 2007, 'Newsletter on carbon credits from native forest regeneration', *EBEX21, Issue 11, January 2007.*
Dargusch, P 2003, Understanding the variables that affect Australian hardwood woodchip export performance – perceptions and lessons from the international business management research paradigm, New Zealand School of Forestry, accessed 16 May 2008, http://www.nzif.co.nz/articles/conf2003/Dargusch.pdf
Econosearch 2006, 'Adoption of new land management practices through conservation insurance National Market-based Instrument Pilot Program', Final report for MBI project 8, *EconSearch Pty Ltd, pp71* [Unley BC South Australia.
Egoh, B, Rouge, M, Reyers, B, Knight, AT, Cowling, RM, van Jaarsveld, AS and Welz, A 2007, 'Integrating ecosystem services into conservation assessments: A review', *Ecological Economics*, vol. 63. pp.714-721.

Eisenhardt, KM 1989 'Building Theories From Case Study Research' *Academy of Management Review*, vol 14. pp. 532-550.
EPA (Environment Protection Authority) 2003, 'Hunter river salinity trading scheme: working together to protect river quality and sustain economic development', Environment Protection Authority, New South Wales, Sydney.
Eyles, G 1985, 'The New Zealand land resource inventory erosion classification', Water and Soil Miscellaneous Publication 85, Water and Soil Directorate. Ministry of Works and Development, Wellington
Fensham, RJ, Fairfax, RJ and Archer, R 2005, 'Rainfall, land use and woody vegetation cover in semi-arid Australian savannah', *Journal of Ecology*, vol. 95, pp 596-606.
Frame, B, Gordon, R and Turney I 2005, 'The emissions/biodiversity exchange', A corporate sustainable development in New Zealand, Greenleaf Publishing, pp 231-141
Garnaut, R 2008, 'Climate change review: Interim report to the Commonwealth, State and Territory governments of Australia', Garnaut Review Secretariat, Melbourne, Victoria, Melbourne http://www.garnautreview.org.au, accessed 5 May 2008.
Grieve, A and Uebel, K 2003, 'The NSW Environmental Service Scheme - progress report on outcomes and experience developed during its implementation', New South Wales, Australia.
Gullison, RE, Frumhoff, PC, Canadell, JG, Field, CB, Nepstad, DC, Hayhoe, K, Avissar, R, Curran, LM, Friedlingstein, P, Jones, CD and Nobre, C 2007, 'Tropical Forests and Climate Policy', *Science, v*ol. 316. (5827), pp. 985 – 986.
Hepburn, C 2007 'Carbon Trading: A Review of the Kyoto Mechanisms'. *Annual Review of Environment and Resources* vol. 32 (1) pp. 375-393
Hodges, A and Goesch 2006, 'Australia farms: natural resource management in 2004-2005', ABARE research report 06.12, ABARE, Canberra.
Landcare Research New Zealand (2008a), 'Carbon Credits from forest regeneration projects' accessed 6 may 2008 http://www.ebex21.co.nz/ 2008
Landcare Research New Zealand (2008b) 'Welcome to the carboNZero programme', Lincoln, New Zealand accessed 6 May 2008, http://www.carbonzero.co.nz.
Jette, J, Grover, L and Keck, C 2003, 'A qualitative study of clinical decision making in recommending discharge placement from the acute care setting'. *Physical Therapy*, vol. 83(4). pp. 224–236.
Kroegera, T and Caseya, F 2007, 'An assessment of market-based approaches to providing ecosystem services on agricultural lands' *Ecological Economics*, vol. 64. pp.321-332
Kumar, M and Kumar, P 2008, 'Valuation of the ecosystem services: A psycho-cultural perspective' *Ecological Economics*, vol. 64. pp. 818-819.
Lee, D, Woo, J, Mackenzie, A 2002, 'The cultural context of adjusting to nursing home life: Chinese elders' perspectives', *Gerontologist*, vol. 42(3). pp. 667–675.
Levinson, J 2006, 'Why invest in rural Australia? Plantation forestry strengthening economic growth', in Proceedings of 2006 Australian Forest Growers Conference, Launceston, [Date of Conference, Publisher of proceedings, Place of publication].
MacLeod, ND and McIvor, JG 1998, 'Managing grazed landscapes: production and conservation tradeoffs in subtropical woodlands'. In: Gooday, J. (Ed.), Proceedings of Bio-Economics Workshop, 22 January, Armidale, NSW. Australian Bureau of Agricultural and Resources Economics, Canberra, pp. 51–63.
MacLeod, ND and McIvor, JG 2005, 'Reconciling economic and ecological conflicts in the use of grazing lands', *Ecological Economics* vol. 56(3). pp. 386–401.
MacLeod, ND and McIvor, JG 2006, 'Reconciling economic and ecological conflicts for sustained management of grazing lands', *Ecological Economics*, vol. 56. pp.386-401.

MacLeod, ND and McIvor, JG 2008, 'Quantifying production–environment tradeoffs for grazing land management — A case example from the Australian rangelands' *Ecological Economics*, vol. 65. pp.488-497.

MAF (Ministry Of Agriculture and Forestry) 2006, 'Permanent Forest Sink Initiative: A guide to eligible land', Ministry of Agriculture and Forestry', New Zealand, available at URL: www.maf.govt.nz/forestry/pfsi, accessed 8 August 2007.

Maraseni, TN, Cockfield, G and Apan, A 2005, 'Community based forest management systems in developing countries and eligibility for Clean Development Mechanism', *Journal of Forest and Livelihood* vol. 4, pp. 31-42.

Marshall, C and Rossman, G. 1999, 'Designing qualitative research', Sage, Thousand Oaks, CA

Marton, F 1981, 'Phenomenography—describing conceptions of the world around us' *Instructional Science vol.* 10(3). pp 177–200.

McIntyre, S, McIvor, JG and MacLeod, ND 2000, 'Principles for sustainable grazing in eucalypt woodlands: landscape-scale indicators and the search for thresholds'. In: Hale, P., Moloney, D., Sattler, P. (Eds.), Management for Sustainable Ecosystems. Centre for Conservation Biology, University of Queensland, pp. 92– 100.

McIvor, JG 2002, 'Soils'. In: McIntyre, S., McIvor, J.G., Heard, K.M. (Eds.), Managing & Conserving Grassy Woodlands. CSIRO Publishing, Melbourne, pp. 41–59.

Parkes, D, Newell, G and Cheal, D 2003 'Assessing the quality of native vegetation: the 'Habitat Hectare' Approach', *Ecological Management & Restoration,* vol 4 (Supplement), pp. 28-38.

Pettigrew, A 1985, 'The Awakening Giant: Continuity and Change at ICI', Blackwell, Oxford.

Quiggin, J 2007, 'Issues in Australian water policy', *Economic and Political Overview,* February 2007, 38-47.

Remenyi, D, Williams, B, Money, A and Swartz, E 1998, 'Doing Research in Business and Management: An Introduction to Process and Method', Sage, London,

Siggelkow, N 2007 'Persuasion with case studies'. *Academy of Management Journal*, vol. 50. pp. 20–24.

Smit, R and Olff, H 1998, 'Woody species colonisation in relation to habitat productivity', *Plant Ecology,* 139, 203-209.

Suddaby, R 2006, 'What grounded theory is not', *Academy of Management Journal, vol.49. pp* 643–642.

Terry, S 2007, 'Heat treatment', *New Zealand Listner*, 208, 1, available at URL: http://www.listener.co.nz/issue/3489/features/8462/heat_treatment, 15 August 2007.

Troiano, P 2003, 'College students and learning disability: elements of self-style'. *Journal of College Student Development* , vol 44(4). pp 404–419.

Trotter, C, Tate, K, Scott, N, Townsend, J, Wilde, H, Lambie, S, Marden, M and Pinkney, T 2005, 'Afforestation/reforestation of New Zealand marginal pasture lands by indigenous shrublands: the potential for Kyoto forest sinks', Annals of Forest Science, vol. 62. pp 865–871.

Turner, RK and Daily, GC 2008, 'The ecosystem services framework and natural capital conservation', *Environ Resources Economics*, vol. 39. pp. 25–35.

UNFCCC, 1997, 'The Kyoto Protocol to the United Nations Framework Convention on Climate Change', FCCC/CP/1997/L.7/Add.1. 10 December 1997: 24 pp.

Whitten, S and Young, M 2003, 'Market-based tools for environmental management: where do they fit and where to next' *This paper draws on the presentations made by Mike Young at the 2003 AARES Symposium.*, CSIRO Sustainable Ecosystems and CSIRO Land and Water, Canberra.

Whitten, S, Bueren, M and Collins, D 2003, 'An overview of market-based instruments and environmental policy in Australia' *This paper draws on the presentations made by Drew Collins and Martin van Bueren at the 2003 AARES Symposium.*, CSIRO Sustainable Ecosystems, Canberra.

Yin, RK 1994, 'Case Study Research, Design and Methods', Newbury Park, CA: Sage Publications.