14. COMMODITISATION OF ECOSYSTEMS SERVICES AND OTHER NON-WOOD VALUES OF SMALL PLANTATIONS

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Forest plantations generate a number of favourable environmental and social benefits for the community, quite apart from the revenue from timber and other private benefits to growers. There has been much interest in whether the positive externalities of natural and plantation forestry – including carbon sequestration, salinity mitigation, biodiversity protection, and watershed and water quality protection – can be converted into market products for which forest owners receive payment. Various mechanisms for marketing ecosystem services have been trialled or suggested. Market-based instruments have advantages over subsidy and grant payments, but are not necessarily more socially efficient. Opportunities exist for marketing ecosystem services (particularly carbon credits). There are signs that these markets will develop in the future, providing the institutional framework is supportive.

INTRODUCTION

While some landholders are happy to plant trees for environmental objectives, others expect a positive financial return from their investment. Similarly, a target rate of return is sought by industrial foresters, e.g. anecdotal evidence suggests a rate of return of 7% is regarded as a satisfactory return for industrial forestry in Queensland. Sharp (2002) found that venture capital providers seek a return on forestry typically of the order of 12%. Financial analysis of forestry projects in north Queensland suggests that profitability is marginal if a discount rate of the order of 7% is adopted (Harrison *et al*. 2001) but non-market benefits can be substantial (Eono and Harrison 2002).

The creation of markets mechanisms for rewarding growers for non-wood forest benefits (NWFBs) provides a potential alternative to direct taxpayer support.[1] According to Killin and Brazenor (2003), 'It is increasingly apparent that any type of commercial plantation expansion in north Queensland will need to combine traditional timber-only returns with greenhouse and biodiversity bonuses, and returns from the emerging carbon credits market, to achieve a sufficiently high financial rate of return for forestry (7%)'.

Considerable attention has been given worldwide to the potential to create markets for the ecosystem services and non-marketed products provided by native forests and plantations. This could take the form of annual payments to growers for specific ecosystem service components, or it could involve the creation of some form of marketable certificate for the service. Landell-Mills and Porras (2002, cited in Pagiola *et al*. 2002) identified about 300 examples throughout the world of experiments with market-based approaches to providing incentives for conserving forests and their public good benefits. Pagiola *et al*. (2002) presented case studies of some of the more advanced experiments, with a focus on three particular ecological services, viz. watershed protection, biodiversity conservation and carbon sequestration.

[1] A *market mechanism* may be thought of as a system for rewarding the providers of ecological services, whereas a *market-based instrument* may be viewed more narrowly as the creation of a trading system for a particular item, e.g. a carbon or salinity credit.

The next section of this paper examines the rationale for creating market mechanisms to allow tree growers to capture a return from the public good benefits of their investments. Market based instruments are then placed within the context of the range of policy instruments available to achieve environmental objectives. The types of forest services for which markets normally do not exist but for which a commodity could be created are then discussed. Experiments and experiences with trading systems are reviewed. Opportunities for payments for ecosystems services of forestry (including small-scale plantations in north Queensland) are then examined. Concluding comments follow.

THE RATIONALE FOR PAYMENTS FOR FOREST EXTERNALITIES

Forest enterprises generate a number of benefits to the community above and beyond those to the tree growers, categorized in general terms as *ecosystem services*. Because the investor (farmer or company) cannot capture the value of these outputs, which are not traded in markets, the private return from forestry is less than the social return, and hence afforestation and reforestation take place at less than socially optimal levels. That is, a form of market failure takes place. This market failure may be particularly apparent for the long-rotation high-value native hardwoods, cf. shorter-rotation exotic conifers. If landholders are to incur private costs to provide benefits for the community, then social justice would suggest there should be some form of compensation from the beneficiaries. It is therefore logical to examine how growers can be remunerated for these positive social externalities.

If landholders can sell some form of ecosystem service credit for the social benefits they generate, then these services become a forest joint product rather than forestry externality (the externality is 'internalized'), and this may make the enterprise profitable from a private viewpoint (Binning *et al*. 2002). Hence there is interest in a number of countries in commodification of positive externalities of forests and creation of a revenue stream for tree growers.

Market mechanisms provide an incentive for tree planting and forest protection. Since long payback period is an important impediment to farm forestry, some system of annuity payments allowing a return to be generated soon after planting and before commercial timber is produced may make forestry a considerably more attractive investment. As well as making plantations more *financially viable*, annual payments for ecosystem services can ease cash flow problems, i.e. make forestry investments *financially feasible* for cash-strapped landholders. Revenue from ecosystem services could also reduce financial uncertainty of plantation investments. Further, there may be an important psychological impact of the ecosystem credit scheme, in terms of signaling to landholders that government and traders in ecosystem credits support farm forestry, and that establishing plantations is an ethically correct action. As well, creation of ecosystem service credits could provide a feeling amongst non-industrial foresters of greater harvest security, as a result of a demonstrated financial commitment of government and industry to their enterprise.

The creation of markets for ecosystem services will involve establishment, operating and monitoring costs (i.e. *transactions costs*). In this context, Brand (2002) argued that Australian Federal and State governments are unable to provide sufficient support for developing markets for ecosystem services, and that a more promising option is to mobilize private capital. He observed that forestry investments, which can provide a cash flow from environmental services as well as long-run returns from timber, can be attractive to the private sector. It is probable, however, that government will have to play a major role in facilitation of any ecosystem service marketing systems.

Brand 2002 (p. 237) noted that 'The Kyoto Protocol rules, particularly the provisions of Article 3.3, are an important stimulus to this new financial mechanism [investing in carbon sequestration]. Article 3.3 requires national governments in industrialized Annex 1 countries to account for afforestation, reforestation, and deforestation events occurring since 1990.

The Bonn agreement in 2001 confirmed that projects eligible for credits against agreed national CO_2 emission targets would include those where a land use change from non-forest to forest had occurred'. He further noted that the accounting methodology adopted is the stock change approach, where forests that are growing are treated as a carbon sink and harvesting is treated as re-emission to the atmosphere.

Companies in some of the industries associated with environmental pollution are likely to show interest in purchase of credits for environmental services, e.g. fuel and energy companies such as Shell and BP Amoco with respect to carbon sequestration (van Bueren 2001). This may arise because the companies have emission caps placed on them by national governments, or may wish to gain experience in trading before any formal requirement is imposed upon them, or choose to invest in environmental credits to demonstrate good environmental citizenship. Should the Kyoto Protocol be ratified internationally, then mandatory constraints can be expected on net carbon emissions, and since vegetation sinks are recognized in this regard, industry will be required to reduce their emissions or purchase emission credits.[2]

MARKET-BASED INSTRUMENTS VERSUS OTHER POLICY OPTIONS FOR ENVIRONMENTAL PROTECTION

In practice, a variety of *environmental policy measures* or instruments have been applied by government at its various levels to overcome environmental problems, or bring about a 'socially efficient level of emissions'. Figure 1 provides a summary of the more common of these methods. Some of these methods use the authority of the government to command that polluters limit their emissions (command-and-control or CAC methods). Some facilitate operation of a market for abatement (market-based instruments, MBI), while some rely on development of improved technology to mitigate emissions or to repair damages. As well, governments can undertake direct action for environmental protection, at taxpayer expense. These policies may be compared on the basis of a number of criteria, including: efficiency and cost-effectiveness; fairness (equity); environmental justice; incentives for long-run improvement; information requirement, implementation cost and enforceability; and moral considerations.

In general, environmental economists advocate market-based instruments (MBIs) as alternatives to standards and CAC measures, which are unpopular with industry and lead to avoidance and high enforcement costs. The creation of marketable certificates creates private sector incentives for environmental protection, and allows those who can generate the benefits at lowest cost to do so, and those who would not be cost-effective in generating the service to purchase certificates from others (Field and Field 2002). Hence the service tends to be produced at lowest overall (economic) cost in a free and well-defined market.

Forestry is typically assisted by the MBI of abatement subsidies, and by direct government expenditure on plantations and conservation plantings. Traditionally, non-industrial forestry has been encouraged through various forms of subsidies and grants for tree planting. However, this imposes an obvious cost on the taxpayer and, further, subsidies appear not particularly effective for promoting tree growing unless they are set at a high level, and they are currently out of favour with Australian governments. Commoditisation of ecosystem services and trading of some form of transferable permit such as a carbon credit is an alternative to taxpayer-funded subsidies.

[2] Sinks are included in national allocation plans but at the time of writing it was still to be decided whether forestry sinks will be fully incorporated into the flexible mechanisms of the Kyoto - Joint Implementation, the Clean Development Mechanism, and emissions trading; for example, forestry sinks are currently excluded from the EU Emissions Trading Scheme. This may be resolved at the ninth session of the Conference of the Parties (CoP 9) of the United Nations Framework Convention on Climate Change.

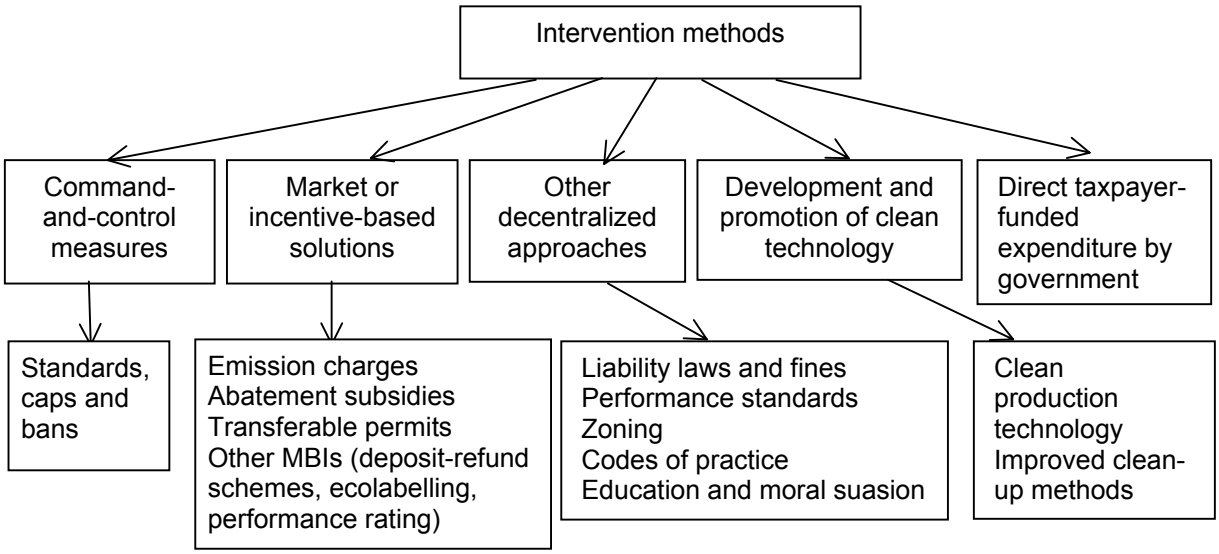

Figure 1. Policy instruments for environmental protection or to promote remedial action

The idea of introducing market mechanisms for payment for forestry ecosystem services is appealing in that the market rewards the service provider, and taxpayer subsidies are not needed. A difficulty in operating transferable permits for ecosystem services is the middleman cost of managing the market and the securing a profit for services. Added to this is the high transaction cost of estimating and validating the economic benefits of the services provided, and monitoring the service provision over time, and maintaining a trading system. Depending on the scale of forestry operation, and the complexity of the validation and monitoring system, the transaction costs could outweigh the value of the ecosystem service benefits provided, particularly for small-scale operators. A highly scientific validation and monitoring system would provide confidence in the environmental product for traders; a simple assessment and monitoring mechanism though somewhat imprecise may make the trading system more viable financially and more easily adopted by landholders. The simplest approach is to base payments on the area planted, and perhaps other factors such as land type, species planted, and the assurance of continuation of the land under forestry.[3]

Because costs of tradable permit mechanisms can be high, they are not necessarily the most socially-efficient means of rewarding tree growers for the environmental services generated. A similar effect can be achieved with subsidies or grants. The high woodland grant payments in the UK and assistance measures in Germany for non-industrial foresters are, at least in part, payments for ecosystem services. In the UK, landscape amenity is considered an important service of forestry, as reflected for example by the fact that higher grants are paid for stands of broadleaf species than for conifers (Hill 2000). Government support for farm forestry in the Black Forest region of Germany in part reflects social benefits of retaining an attractive rural landscape (supporting tourism) and stable rural population (reducing the drift to the cities).[4]

It may be argued that tradable permits are superior to subsidies or grants because the former are earned in markets while the latter are born by taxpayers. However, the distributional impacts require closer scrutiny. If a fuel company were to purchase carbon credits, the cost would be borne by motorists and shareholders. If an electricity generator were to purchase

[3] Sometimes harvesting is permitted only on condition of prompt replanting.

[4] Of course, the forestry support arrangements in the UK and Germany may not be appropriate in Australia. Both countries have much higher populations and high industrialization, and it may be that urban people interface more with rural areas than in Australia.

carbon credits, the cost would be borne by electricity consumers. In other words, the members of society meeting the cost of the ecosystem service are not radically different to taxpayers in general.

An argument against subsidies and grants is that they create a 'dole-out mentality' and that landholders do not value plantations for which they have incurred little personal expense. In contrast, transferable credits allow landholders to earn revenue from their own endeavours. That is, the psychological impact of a market for ecosystem services could be important. As well, there might be greater certainty of the long-term continuation of the market, cf. the notoriously short life of most government forestry support programs in Australia. Further, transferable credits may be more efficient in terms of linking payments to the value of environmental benefits, cf. the often political targeting of forestry subsidy programs.

EXPERIMENTAL TRADING SYSTEMS FOR FOREST ECOLOGICAL SERVICES

The commodification of ecosystem services requires establishment of some form of product and market mechanism. According to Pagiola *et al*. (2002, p. ix-x), 'The sale of ecosystem services is a complex undertaking with a tremendous variety of market structures, payment schemes, and numbers and types of participants … Issues of property rights, pricing, and interaction between services, not to mention services that have yet to be described, remain problematic. The innovations in this area are still limited in scale, scope, and impact, and trading in environmental services remains a nascent activity'. Nevertheless, a number of promising examples can be found of trading in ecosystem services from forests, some of which are now briefly reviewed.

Trading Carbon Sequestered by Plantations

It is to be expected that emission trading schemes will develop in the future (for carbon and other greenhouse gases), and these may include forestry carbon sinks. Estimating the carbon sequestration value from plantations is a complex accounting issue. Questions arise as to whether to use carbon stock or flow estimates for accounting, and whether to include carbon in all parts of the tree (including canopy and roots) as well as soil carbon. It is desirable that net carbon sequestration be estimated, taking account of the previous land use and of the carbon costs of establishing and managing plantations, timber harvesting, transport and processing, and carbon leakage arising from milling and product decay (especially for short-life items such as newspapers). The analyses may also extend to the reduction in greenhouse gases from not producing the products which timber displaces.

Pioneering work on development of a system for trading sequestered carbon from plantations was undertaken in New South Wales. In 1999, State Forests of New South Wales (SFNSW) and the Sydney Futures Exchange signed a Memorandum of Understanding to jointly develop a market for trading of sequestered carbon, which was compatible with Article 3.3 of the Kyoto Protocol (Lamb 2000a). Under the *Carbon Rights Legislation Amendment Act 1998 (NSW)*, carbon sequestration is recognized as a right (a *profit á prende*), and there is separate ownership and trading entitlements to land, trees and carbon rights. A Carbon Accounting Standard was proposed to provide a standardized, transparent and defendable carbon product.[5] It was envisaged that pools would be formed of growers who achieved accreditation in their carbon management system (including SFNSW). The proposal included full and partial accreditation depending on accreditation competence, with the latter having

[5] The National Carbon Accounting System was established in 1999, and first reported in 2002. Australia's land-use change emissions have now been estimated for the period 1988-2001 (AGO 2003).

lower accreditation costs and allowing trade of 70% or 50% of the net tradeable mass of carbon.[6]

The Sydney Futures Exchange trading in carbon credits was proposed to commence in 2000, but failed to proceed. In this context, SFNSW was ahead of its time. According to Brand (2002, p. 242), 'At this point there is no officially sanctioned registry of carbon stocks anywhere in the world'. However, Brand (2002) noted that the NSW government in 2002 introduced a penalty of $A10-20/tonne for excess CO_2 emissions, and indicated that carbon sequestration credits could be used as offsets to this commitment, as well as releasing a detailed position paper on carbon credit accounting, registry and trading systems.

A drawback of the carbon credit trading proposal, identified by Lamb (2000a,b), is that the compliance requirements would be too expensive for individual small growers, a minimum forest area to support the transactions costs being of the order of 1000 ha. This might be overcome to some extent by a pooling process, with the carbon pool managed by a large firm, private consultant, industry association or grower cooperative, and sharing of the carbon credits amongst the pool. One example might be the joint venture plantings, such as those undertaken by government or by timber companies and landholders

Another Australian initiative for trading sequestered carbon is the Hancock Natural Resource Group's New Forest Program. This is designed to 'establish investment products that will assemble a portfolio of different forests with varying profiles of carbon sequestration, land and water rehabilitation benefits, timber production, and other returns' (Brand 2002, p. 237).

The above proposals place high priority on accountability. However, they are perhaps too complex for many situations, including application to smallholder forestry in developing countries. In contrast, Pagiola *et al*. (2002) envisaged a somewhat simpler carbon trading system, which would be workable in developing countries.

Marketing of Watershed Protection Values

Pagiola (2002) reviewed a formal, countrywide system of environmental service payments for water services of forests in Costa Rica. These services include reduction in sediment loads, regulating the timing of water flows, increasing flows (particularly in dry seasons), and improving water quality. It is noted that the services typically are enjoyed by people some distance from the forest that generate them, and land users in or near the forest typically do not receive any compensation for providing the services. In this initiative, payments were made to watershed land users by electricity companies at a rate of US$42/ha/year for reforestation and forest management activities. In the event, only 24,000 ha out of a target area of 200,000 ha was specifically financed from water services between 1997 and 2002.

Marketing of Salinity Mitigation Credits from Forestry

Reforestation is recognized to have high potential for amelioration of dryland salinity. Salinity credit trading has taken place in the Murray-Darling Basin in Australia, but this appears to have been between governments, and not as compensation to landholders for reforestation in the catchment. No case studies of trading in salinity credits are provided in the collection of papers by Pagiola *et al*. (2002).

Bioprospecting

Laird and Kate (2002) examined prospects for pharmaceutical biodiversity prospecting, pointing out cynically that this was a poorly understood area except for the recognition that 'many drugs have natural origins, and many sell very well' (p. 151). They concluded that biodiversity prospecting has the potential to provide considerable funding and non-monetary

[6] This has now been superseded by the rules governing the Kyoto Protocol, which will require compliance with the Marrakesh Accords and provisions arising from CoP 9.

support for forest conservation. However, it is probable that this finding would not carry over to plantation forests.

Payments for Allowing Public Recreation in Woodlots

A further mechanism for generating a cash flow for farm foresters is for government to provide payments for the provision of recreation services. For example, in the United Kingdom, farmers with existing natural stands of forest located near major urban areas are entitled to a Woodland Improvement Grant for works which will encourage informal public recreation in existing woodlands, such as construction of car parks, seating in picnic areas, construction of walking paths and signage, thinning to make views more pleasant, and making the wood safer for the public (Forestry Commission 1995). Smith (1994) commented on the role of managed landscapes of the UK and the financial compensation to landholders to provide recreation facilities such as camping sites, on their land. Similar arrangements have been provided in The Netherlands where woodland owners who allow public access are compensated for expenditure on items such as footpath maintenance and litter collection (Hummel 1991). It is questionable whether Australian governments would be prepared to make payments for recreation services of private forests, given the large areas gazetted as National Parks and the lack of culture of public access to private land.

Use of Thinnings and Harvest Residue as Biofuel

Fuelwood is an important product from forests in developing countries, and plantation timber is burnt for energy generation in some European countries, though biofuel use is limited in Australia. In a sense, this is a type of environmental service of forestry, in that fuelwood provides a sustainable primary energy source to displace some fossil fuel use. A promising application is in small-scale electricity generation. Biofuel energy generation is widely adopted in Europe; for example much of the plantation-grown timber in Denmark, along with cereal stubble, is used for urban heating networks. Biofuel electricity generation requires a relatively large and continuous wood supply, and considerable capital outlay is involved in setting up the generation plant and linking to transmission lines. Also, in Australia environmental groups oppose this energy source fearing the fuelwood will be extracted from native forests. More impetus could be given to use of biofuel if there is a substantial increase in the Australian government's mandatory renewable energy target (MRET).

Some Observations from Experimental Applications

A number of observations may be drawn from the examples of trading systems reviewed above.

- Trading in forest ecosystem services is still in its infancy.
- Major administrative issues have to be overcome. As noted by Brand (2002, p. 244), a key impediment to commercialization of environmental services is the lack of definition, accreditation and registration of these goods and services.
- Clear evidence of demand is necessary to set up markets, which should be recognized as demand driven rather than supply driven.
- Transaction costs can be high, including setup, assessment, validation and monitoring costs.
- The revenue generated from trading may be sufficient to make a difference in terms of plantation viability. Two Australian examples of potential values and prices of ecosystem services may be cited. Brand (2002) reported that financial modeling by Hancock Natural Resources Group (HNRG) indicates an increase in after-tax rate of return on forestry investments from 10.6% to 12% from inclusion of carbon credits, based on a price of US$5 per tonne of CO_2 equivalent. Wilson Land Management Services and Ivey ATP Agricultural Consulting and Management Services (2002, cited by Venn in press) estimated that the net present value (NPV) of off-site salinity costs

avoided by establishing 6,310 ha of plantations within the catchment was $427/ha at a discount rate of 8%.

- Managing forests for joint products can lead to differences in silviculture. It may be necessary to extend the harvest age, and take other measures to achieve joint products at some sacrifice to wood production.
- Future prospects are promising, particularly for trading in carbon credits. Brand (2002, p. 244) noted that 'There is widespread optimism that carbon sequestration may be the first of these international environmental commodities…'. Once these markets are functioning and the price signals and forward price curves are established, we will see institutional capital take a lead role in providing services such as carbon sequestration, watershed management, and biodiversity enhancement.'

POTENTIAL FOR MARKETING NON-WOOD FOREST/PLANTATION VALUES IN NORTH QUEENSLAND

There are a number of products and services of plantation forestry in north Queensland which potentially could be made into commodities, such that growers could receive a return from them. These include:

- carbon sequestration;
- watershed protection (protection of water quality, soil erosion control, sediment control, flood mitigation, maintenance of dry-season flows, protection of marine habitat) ;
- salinity mitigation (watertable management) ;
- biodiversity conservation or enhancement;
- bioprospecting;
- forest recreation (landscape amenity, access roads, walking tracks, seating) ;
- wildlife habitat; and
- biofuel production (especially from thin-to-waste timber and harvest residues).

The values of these services and products will vary with the type of forest, type of potential purchaser, community attitudes and government policy. Plantations produce carbon, and add to watershed protection and salinity mitigation, while native forests have greater biodiversity conservation and bioprospecting values.

The impetus for trading in carbon credits arises from international factors – e.g. concern over global warming – and consequent international accords such as the Kyoto Protocol and its flexible mechanisms. In the case of other environmental services, the externalities are mainly confined to the local region, hence there is less international pressure for control mechanisms and less impetus to develop trading systems. However, there is perhaps stronger justification for domestic beneficiaries to compensate landholders for providing the services.

Tradable Credits from Carbon Sequestration

In Queensland, the large firms which generate greenhouse gases are likely to be the ones interested in purchasing greenhouse gas credits, and having cash flows sufficiently high to be able to do so. These include electricity generators (since most generation is by coal-fired plants) and fuel companies (since motor vehicle emissions contribute to CO_2 and other undesirable emissions). A system of renewable energy certificates (RECs) is now operating in Australia. In the case of local positive off-site impacts, such as watershed protection, the benefits are felt at a local government level (e.g. local government manage domestic water supplies), but often local government would have difficulty funding payments for ecosystem services.

It is probable that in the case of farmers in north Queensland, with only a small area of forest, the cost associated with a system of tradeable carbon credits would outweigh the benefits. Harrison *et al*. (2003) noted that in a sample of 72 participants in the Community Rainforest Reforestation Program, 34% had planted less than 3 ha, and 24% between 3 and 10 ha, the median area being 3.5 ha and the maximum 45 ha. New large industrial growers, such as the companies planting eucalypts in south-east and central Queensland, may have plantations of sufficient scale to enable trading in carbon credits.[7] It may be that grower associations (such as the North Queensland Timber Co-operative) or brokers could aggregate the contributions of small-scale growers in some form of group accreditation so as to make trading feasible.

The most notable effort towards placing real dollars on ecosystem services of forestry in north Queensland has been the Greenhouse Gap Abatement Program (GGAP) initiative, arranged by the Douglas Shire Council and Mossman Central sugar mill. The Australian Greenhouse Office agreed to funding of $1.7M to facilitate the planting of about 3000 ha of forests, along with other energy projects. It was considered likely that one of the large fuel companies would be prepared to purchase the carbon credits from this program. The GGAP project offered the prospect of payments for carbon sequestration, although the federal government funding was mainly designed for operational activities (or 'making it happen') and it is probable that the carbon credits would have gone proportionally to the Federal governments and the private sector investment companies, who may have then passed on some of the payments to individual tree growers. More fundamentally, it is difficult to envisage how such an area of plantations could be established, compatible with the preference in the region for native species, when the highly generous Community Rainforest Reforestation Program achieved a planted area of only about 2000 ha over six years. Depressed sugar prices and the relatively small catchment area have resulted in financial difficulties for the Mossman Central sugar mill, and the GGAP initiative (which includes an ethanol plant at the mill) may not proceed.

Watershed Protection and Related Benefits

Given the high levels and intensity of precipitation, watershed protection is of high priority in north Queensland. Establishing plantations on degraded farm land would contribute to erosion control. Prevention of transport of sediment and agrochemicals to the Great Barrier Reef would be a further benefit. Development of a system of marketing watershed protection credits would be difficult; presumably, local governments would need to promote this policy. It may be that governments would opt for a system of standards or best management practice (BMP) rather than tradable permits.

Water Quality Protection

Drinking water quality does not appear to be an issue in north Queensland, with the relatively low population and water storages located within the protected rainforest area. Of greater concern is water quantity, exemplified by recent shortages of town water on the southern Atherton Tableland, although forestry has limited ability to increase water yield.

Salinity Mitigation

Dryland and irrigation land salinity does not appear to be a pressing problem, in part due to the very high rainfall and the soil types in much of north Queensland, although it may become an issue around the Burdekin Dam.

[7] Most of the DPI-Forestry plantations are not Kyoto compliant because they were established before the baseline year of 1990; only post-1990 plantations established on previously cleared land are acceptable.

Biodiversity Protection and Bioprospecting
Research is being devoted to bioprospecting in north Queensland, but from natural forests, not plantations.

Wildlife Habitat
Surveys of landholders indicate that plantations do provide habitat for macrofauna (mainly lizards and birds), although the habitat contribution is small in relation to the World Heritage rainforests, and it is unlikely that any support for tradeable permits would be provided for this reason.

Forest Recreation
It is unlikely in the present political climate that payments would be made for landscape amenity benefits of farm forestry. High landscape amenity is provided in the region by the large area of protected rainforests, including nearly one million hectares in the Wet Tropics of Queensland World Heritage Area.

Biofuel Production
Currently in north Queensland, logging residue is burnt on site or left on site. An opportunity exists for electricity generation utilizing biofuel from thin-to-waste and harvest residues, for which technology is currently available. However, the likely low market value would not have a strong incentive effect, though this situation could change with an increase in the MRET target. Opportunity exists for linking bioenergy generation with the current cogeneration of sugar mills.

Negative Externalities of Plantation Forestry in North Queensland
It is notable that farm forestry in north Queensland also generates some negative externalities, such as provision of habitat for feral animal pests and native pest species which cause crop damage. These problems are dealt with by standards (e.g. a requirement to control feral pigs) and cull quotas (e.g. for cockatoos). Both species could be turned into resources for hunting and domestic or export sale, although this does not seem compatible with current government environmental culture.[8]

CONCLUDING COMMENTS
Traditionally, farm forestry has been supported by subsidies and grants. Transferable credits are an alternative market-based instrument, which converts the ecosystem services of forests into a market commodity. The marketing of forest ecosystem services and other products and services has potential to improve the financial viability of small-scale timber plantations, and hence encourage accelerated planting and generate substantial public good benefits. To date, such commoditisation has been largely experimental throughout the world, though viable models have been devised. In north Queensland, opportunities exist for marketing forest ecosystem services (particularly carbon credits) and for creating markets for plantation waste. It can be expected that these markets will develop in the future, providing the institutional framework is supportive. Should market mechanisms become available for what are currently externalities, farm forestry will have less of an image of a non-viable enterprise, and more investment funds are likely to become available, although lack of economies of size may be a limiting factor.

The political climate for greenhouse gas emission reduction through plantation forestry is strong in Australia, which has argued for vegetation carbon sinks during international negotiations. On the other hand, limited support can be expected for marketing of other ecosystem services of farm forestry. In Europe, access to the countryside tends to be regarded as a birthright of the urban population. In contrast, some countries including

[8] Substantial ‘wild boar’ export takes place from Australia, but little from the Queensland Wet Tropics.

Australia have a stronger exclusion attitude to farm land, supported by trespass laws, and concerns over bushfire risk. Whereas pioneering work on trading of credits for carbon sequestration has been carried out in Australia, progress is likely to be slow on developing tradable permits for other plantation ecosystem services.

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