

Commodifying carbon to reduce deforestation: lessons from New Zealand

By Gary Cox and Leo Peskett

There has been a wealth of research and discussion around the implementation of REDD+ programmes (reducing emissions from deforestation and forest degradation) under the United Nations Framework Convention on Climate Change (UNFCCC) over the past three years. This is, at least in part, because carbon emissions from tropical deforestation and degradation contribute up to 18% of global carbon emissions (IPCC, 2007).

Another reason for the growing interest in REDD+ is, however, its potential to create new international incentive mechanisms, possibly linked to carbon markets, which would finance the reduction of emissions. Whilst this area does show great potential, there are also significant challenges in developing effective incentive systems that will achieve reductions efficiently while protecting forest dependent communities against new risks (Angelsen, 2009).

These challenges include how to measure and report emissions reductions accurately, how to ensure that these reductions are permanent and are not displaced to other areas, and the creation of the legal and institutional frameworks required to establish performance based incentive systems.

One of the major issues raised by REDD+ incentive systems, particularly in relation to carbon markets, surrounds who holds the property rights over the carbon 'credits' that are generated through REDD+ activities.

A carbon credit can be thought of as a new commodity, equivalent to one ton of carbon dioxide,

traded through carbon markets between countries that do have emissions reduction obligations (for whom it is cost effective to 'buy in' reductions from elsewhere) and those that do not (where emissions reductions projects could be cheap and the resulting credits could be sold).

The way in which carbon rights are established will be linked to existing legislation related to, for example, property rights to land on which emissions reductions activities take place, but may also be influenced by the creation of specific regulations. Only a few developed countries have such regulations, including Australia and New Zealand. Indonesia and Brazil are among the few developing countries that are developing such regulations.

This Background Note from the Overseas Development Institute (ODI) examines the experience of Aotearoa/New Zealand – Aotearoa being the Maori name for New Zealand – in establishing carbon rights linked to its emissions trading system (ETS). New Zealand has been used as an example of the implications of carbon rights legislation for the forest sector because of the government's controversial decision to retain the rights to carbon credits. This decision has been linked to the accelerated deforestation of plantation forests.

We look in detail at the data to see what actually caused the accelerated deforestation in this period, and the broader implications of the ways in which carbon rights have been established. We also highlight lessons for developing countries grappling with REDD+. The New Zealand experience of legislation on carbon rights suggests that there can be major and unintended consequences arising from the choices

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Table 1: Annual greenhouse gas emissions from New Zealand (Mt CO₂-e)

Sector category	1990 base year	2008	Proportion 2008	Change 1990-2008
1 Energy	23.04	33.84	45.3%	46.9%
2 Industrial processes	3.39	4.29	5.7%	26.8%
3 Solvent and product use	0.04	0.03	0.0%	-25.4%
4 Agriculture	31.87	34.83	46.6%	9.3%
5 Land use and land use change and forestry (LULUCF)	-31.07	-26.18	-35.1%	-15.7%
6 Waste	2.44	1.67	2.2%	-31.5%
Total (inc. LULUCF)	29.71	48.48	64.9%	63.2%
Total (exc. LULUCF)	60.77	74.66	100.0%	22.8%

Source: UNFCCC Data Interface (2010); New Zealand's Greenhouse Gas Inventory 1990-2008 (Ministry for the Environment, 2010).

made on the definition and ownership of rights to carbon credits.

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Forests in New Zealand

New Zealand is a developed economy that has been based, traditionally, on agricultural and forest product exports. Before the initial Maori settlement of the country around 800 years ago, most areas below the natural tree line were forested. European settlers arrived in large numbers after the Treaty of Waitangi between the Maori Chiefs and the British Crown in 1840. These settlers saw the forests as, at best, a timber source and, at worst, an obstacle to pastoral agriculture.

By the 1920s, most of the current 11.9 million hectares of agricultural land had been cleared, representing around 44% of the total land area of New Zealand.

Today, indigenous or natural forest comprises 6.3 million hectares and close to 80% of the total forest cover of New Zealand. There are 1.8 million hectares of plantation forest, mostly radiata pine. Though most plantation forests were state-controlled, the government pursued a privatisation strategy from 1988 to reduce public sector debt. Today, only 3% of the national plantation estate is owned by the state with a slightly higher proportion being passed to Maori ownership.

Separate 'forestry rights' were created through the Forestry Rights Registration Act 1983. The aim was to encourage investment in the plantation forestry sector by encouraging joint ventures via the registration of forestry rights against the land title. It had only modest success but paved the way for the forest carbon architecture in the Climate Change Response Act 2002. In 1993, the Forests Act 1949 was amended to end unsustainable harvesting of indigenous or natural forest. Since the early 1990s, exports of logs and chips from indigenous forests have been banned.

The emissions trading scheme and forest carbon rights

New Zealand has an unusual profile of greenhouse gas (GHG) emissions, more characteristic of Scandinavian countries in that land use and land use change and forestry (LULUCF) account for a substantial proportion of emissions. Table 1 shows the large reductions in emissions (the negative numbers under LULUCF) due to the absorption of carbon dioxide in New Zealand's forests.¹

A full chronology of New Zealand's climate change response is shown in Table 2. In 2002, the New Zealand Government enacted the Climate Change Response Act. This created the legal framework whereby the government would meet its obligations under the UNFCCC and the Kyoto Protocol, particularly in relation to its commitments to reduce greenhouse gas emissions. It was the government's view at the time that all of the benefits, liabilities and obligations under the Protocol would be retained by the state (Gould et al., 2008). This meant that the government retained both the credits and liabilities of carbon storage in relation to forests.

This intention to retain forest carbon rights was signalled to the forestry industry in late 2002 and was included in a forest industry consultation process in late 2005. In December 2006, the government released 'Sustainable Land Management and Climate Change: Options for a Plan of Action' (Ministry of Agriculture and Forestry, 2006b). This aimed to provide options for an integrated approach to climate change by reducing agricultural emissions, managing deforestation and establishing new forest sinks. It also included the establishment of an ETS.

The first major government initiative relating to forest carbon sequestration was the Permanent Forest Sink Initiative (PFSI) enacted in 2006. The aim was to establish permanent (i.e. non-harvested) commercial forests to act as 'carbon sinks' which absorb atmospheric carbon dioxide through the conversion of marginal, unproductive or erosion prone agricultural land to forestry. Under the initial proposals announced in 2004, the government would retain

Table 2: Chronology of New Zealand's climate change response

Year	Action
22 May 1998	New Zealand signs the Kyoto Protocol. Under the Kyoto Protocol, New Zealand's commitment was to maintain its 1990 emissions level of 60.77 Mt CO ₂ -e through the first commitment period (2008-2012). In 2008, total greenhouse gas emissions had increased by 23% to 74.66 Mt CO ₂ -e
2001	Climate Protection Bill introduced into Parliament
2002	Government indicates intention to retain forest carbon credits and liabilities in any future carbon trading regime
18 November 2002	Climate Change Response Act 2002 receives assent
19 December 2002	Ratification of Kyoto Protocol
2004	Initial proposals for the Permanent Forest Sink Initiative (PFSI)
2005-2008	On-going consultation with the forest industry around climate change policies and the Emissions Trading Scheme (ETS)
13 November 2006	Climate Change Response Amendment Act 2006 receives assent, establishing the legal mechanism for 'forest sink covenants'
December 2006	Government publishes: 'Sustainable Land Management and Climate Change: Options for a Plan of Action', which includes the establishment of an emissions trading scheme (ETS)
February - March 2007	Series of government-sponsored Hui (Maori assemblies) covering land management, forestry, energy and long-term climate change actions
Mid-2007	Government prepares proposals for an 'economy-wide' ETS, with proposals to devolve sink credits and liabilities to forest owners
20 September 2007	Government announces that it is not meeting its Kyoto targets
1 December 2007	Operational start-up of the Permanent Forest Sink Initiative to be complementary to the ETS
25 September 2008	ETS legislated through the Climate Change Response (Emissions Trading) Amendment Act 2008, which includes devolving of carbon rights to forest owners
1 January 2008	Date of entry of the forestry sector into the ETS, with first reporting period being 1 January 2008 to 31 December 2009
1 January 2010	Energy, fishing, industry and liquid fossil fuels sectors enter the ETS
26 March 2010	Government announces 'positive trend' in reversing previous deforestation
1 January 2013	Synthetic gases and waste sectors enter the ETS
1 January 2015	Agricultural sector enters the ETS

Table 3: Classifying forest land in the New Zealand ETS

Forest land and deforestation
<p>Forest land is defined as an area of land of at least one hectare with forest species that has, or is likely to have:</p> <ul style="list-style-type: none"> • a crown cover of more than 30% on each hectare; and • an average crown-cover width of at least 30 metres. <p>Deforestation is defined as the conversion of forest land to land that is no longer forest land. That is, it involves clearing an area of forest land followed by a change to another land use, such as grazing. After deforestation, the deforested area is then classified as non-forest land.</p>
Pre-1990 forest land – 'non-Kyoto forests'
<p>An area of land is defined as pre-1990 forest land if it is forest land and:</p> <ul style="list-style-type: none"> • the area was forest land on 31 December 1989; and • the area was still forest land on 31 December 2007; and • the forest species on the forest land on 31 December 2007 consisted predominantly of exotic forest species (i.e. plantation forests).
Post-1989 forest land – 'Kyoto forests'
<p>An area of forest land is defined as post-1989 forest land if, at the time of application to join the ETS, the area satisfies the definition of forest land, and in addition:</p> <ul style="list-style-type: none"> • was not forest land on 31 December 1989; or • was forest land on 31 December 1989, but was deforested between 1 January 1990 and 31 December 2007; or • was pre-1990 forest land that was deforested on or after 1 January 2008, and the liability arising from the deforestation has been met; or • is ETS-exempt pre-1990 forest land that has been deforested, and the liability that would arise had the land not been exempt has been met.

Source: Ministry of Agriculture and Forestry (2010a).

both credits and liabilities for the first Kyoto Protocol commitment period.

In September 2007, the New Zealand Government publicly admitted that the country would miss its Kyoto commitment by 45.5 Mt CO₂-e by 2012. This prompted the Minister for Climate Change Issues to proceed with legislation to establish the ETS to tackle this imbalance. The system was to be structured as a cap-and-trade system that would eventually encompass all sectors of the New Zealand economy.

The first sector to be covered was forestry in January 2008. The carbon emissions unit – equal to one tonne of CO₂ either released into the atmosphere as emissions or removed from the atmosphere – was termed a New Zealand Unit (NZU), and could be traded internationally and be transferable with units derived through the flexibility mechanisms of the Kyoto Protocol.

The scheme came into being through the Climate Change Response (Emissions Trading) Amendment Act 2008, but diverged significantly from its original vision. Until mid-2007, the government's public stance was that foresters had no 'automatic right' to carbon credits. The ETS reversed this position, devolving the ownership of credits associated with forests established since 1990 to forest owners. In effect, the ETS 'de-nationalised' the rights to the carbon credits. The New Zealand ETS applied the Kyoto Protocol distinction between 'Kyoto forests', those planted after 31 December 1989, and 'non-Kyoto forests', those planted before 1 January 1990 (see Table 3).

As Table 3 shows, the rules on which types of forests must be part of the ETS and which can join voluntarily are very complex. In brief, participation in the ETS is voluntary for post-1989 forest owners, or 'Kyoto forests', who are eligible for 100% of both the carbon credits and liabilities generated under the ETS.

Liabilities arise when forest land is deforested, requiring the forest owner to surrender NZUs to the national registry. Until 31 December 2012, ETS participants in the forestry sector can pay a fixed rate of \$25 per NZU as an alternative to surrendering units. Forest owners are, however, liable for emissions if they choose not to replant their forests after harvesting them.

Participation in the ETS is mandatory for pre-1990 forest land, or 'non-Kyoto' forests. Forest owners must choose between applying for an allocation of NZUs or, if eligible, an exemption from deforestation obligations. If an area of more than two hectares of pre-1990 forest was deforested after 1 January 2008, the landowner must automatically become a participant in the ETS and will be liable to surrender NZUs for the carbon emissions generated through deforestation.

At present, 5% of land in New Zealand is designated as Maori freehold land. Indigenous forests are the only remaining forests where substantial native forest logging occurs. Maori forest land is not exempt from the ETS, and the same rules apply, depending on the status of the forest. For the most part, Maori own predominantly pre-1990 forests, making their participation mandatory.

Any measures to reduce deforestation will inevitably affect the flexibility of Maori landowners to use their land. This is compounded by the restrictions they face on the sale of lands in multiple ownership and the desire of some to intensify agricultural production. However, there may be benefits to Maori in terms of attracting forest investment on the more marginal of their lands.

Government decisions on carbon rights and deforestation

There has been much discussion about the impact of the government's initial decision to retain forest carbon ownership on increasing rates of deforestation. There has certainly been a noticeable increase in deforestation during the time period between the announcement of the government intention to retain carbon rights and the subsequent decisions made by the forest industry.

Data from 2005 indicate that an estimated 7,000 hectares of forest harvested in that year would not be replanted. The official government report observed that a 'relatively new trend of not replanting forest after harvesting, and in a few cases converting immature forest to pasture, started on a larger scale in 2004' (Ministry of Agriculture and Forestry, 2005). The trend increased in the following year to 12,900 hectares, representing 33% of the annual area harvested.

As shown in Table 4, deforestation reached a peak in 2008 and then declined dramatically after the introduction of the ETS. What is less clear is whether the decisions over carbon rights directly caused the new trend in deforestation.

Table 4: Deforestation and land use conversion (hectares)

Year to 31 March	Area deforested
2005	7,000
2006	12,900
2007	13,600
2008	15,600
2009	1,800

Source: NEFD Surveys, Ministry of Agriculture and Forestry (2006a-2010b).

The deforestation witnessed in New Zealand over the period 1 April 2004 to 31 March 2008 appears to have had three main drivers:

- the ‘price signals’ sent to forest owners by the introduction of the ETS and the impact of phasing or lead-in periods, creating uncertainty and short-term decision-making on the part of forest owners
- the impact of the initial decision to ‘nationalise’ carbon rights, which removed the financial incentive for forest owners to retain trees that they had planted taking into account additional carbon revenues
- the attraction of alternative land uses to forestry in the context of the export-led agricultural and forestry sectors.

Uncertain price signals and phasing of policy decisions

Introducing a carbon price in an emissions trading scheme is supposed to be an incentive to plant forests and a disincentive to permanent deforestation. Through the ETS, the New Zealand Government wanted to implement a strong system of incentives to both plant new forests and to retain existing forest cover.

In the early stages, the government recognised forestry as one of the lower cost emissions abatement options. However, it also accepted that, if the ‘correct price signals’ were not in place, significant emissions could arise from the deforestation of pre-1990 forests. For the pre-1990 forests that were mandatory members of the ETS, the scheme would be a disincentive to deforestation. For the post-1989 forests that were voluntary members, it would be a positive incentive to retain existing forests and to plant new ones.

Before the ETS there was no price for the carbon either retained in forests or released upon harvesting or deforestation. This meant that before 2008 there was no incentive for forest owners to stop permanent clearing or to replant trees on forest land that was previously harvested. In addition, there was considerable uncertainty and robust public debate within the forestry industry (Manley, 2006-2010). Many landowners adopted a ‘wait-and-see’ approach, dependent on the direction of international negotiations and, fundamentally, the price of carbon.

This lack of clarity about the future regulatory framework led some forest owners to make short-term decisions, including deforestation, and to delay crucial decisions to plant new forests.

The New Zealand Institute of Forestry (2007) argued that a financially rational decision relating to the Permanent Forest Sink Initiative might be to keep land clear of trees in the reasonable expectation that the future value of carbon would increase, or that greater control of forest land would lead to

capital appreciation of other land suitable for wider uses. Some forest owners accelerated deforestation to avoid the ETS liability that would have followed its introduction, namely, the requirement to surrender NZUs if they cleared trees in pre-1990 forests. However, many forest owners simply ‘sat on their hands’ waiting to see what the new regulatory framework would mean for them.

Nationalisation of carbon credits

This uncertainty was compounded by the government’s initial decision to retain ownership of the carbon rights to forests. The Kyoto Forestry Association, representing forest owners who together have planted more than 200,000 hectares of forest since 1989, campaigned vigorously against the government retaining carbon credits, describing the policy as ‘de facto nationalisation of carbon credits that belong to forestry investors’ (Milner-White, 2007). They contended that these ‘Kyoto forests’ had been planted by landowners who expected to retain the long-term right to the carbon, and that carbon credits would be part of their future business plans. The consequent retention by the government of these credits was seen as a windfall tax and could have triggered some of the increased deforestation witnessed in the pre-implementation period, as the rational economic response was to harvest the timber, rather than to retain the carbon.

It took the government some considerable time to resolve these issues and give clear signals to the forestry industry. Even in mid-2007, when the government realised that it needed to act decisively on the implementation of an ETS to address the country’s burgeoning emissions, it was still not clear that forest carbon credits would be devolved to forest owners.

When the ETS legislation was eventually passed in September 2008, it resulted in a dramatic halt to the increased deforestation seen in the preceding years. In the language of economics, the carbon price had now been ‘internalised’ into the business decisions of the forest stewards. This corrected the ‘nationalisation’ of the carbon rights issue and brought much needed certainty into the regulatory framework of the industry.

Attraction of alternative land uses

This period of deforestation was linked to the relative attractiveness of other uses for forestry land – what economists term the ‘opportunity cost’.

The forestry and agriculture sectors in New Zealand are driven primarily by export markets. Therefore, the economic attraction of alternative land uses, notably dairy farming and beef and sheep production, plays a significant role in deforestation decisions by landowners. Clearly, switching to another form of land use would only occur if there are no incentives to keep the land as forest and if another use would make the

land more profitable. It appears that these conditions prevailed in New Zealand at the same time and as a consequence drove the high rates of deforestation.

This picture tallies with the findings of a series of Deforestation Intentions Surveys. In the 2007 survey (Manley, 2008) most of the proposed land conversion was to sheep and beef production (45%) and dairy farming (23%). Additional factors included a high exchange rate, increased shipping costs, and increasing international competition in the context of slowing domestic and international demand for timber products (Austin and Rivas Palma, 2009). This was compounded by better returns from alternative land uses.

The long-term prospects of forestry under the ETS may not be bleak. A higher price for carbon may induce landowners to both retain land as forest and to increase rates of new planting. In a recent research paper, Manley and Maclaren (2010) examine the potential long-term impact of carbon trading on forest management in New Zealand. They conclude that, in the long term, forest carbon may lead to a more profitable industry. They deduce that a carbon price of \$30 per tonne of CO₂ could transform the profitability of planting forests and have a positive impact on forest land prices. They also suggest that when the carbon price is high forest owners may elect not to harvest and instead opt for a no-harvest carbon forestry regime.

Possible lessons for REDD+ in developing countries

New Zealand has a well-developed carbon property rights regime and a very advanced governmental institutional and scientific infrastructure for monitoring and verifying forestry activities and changes to forest carbon. New Zealand also has a fairly clear, though by no means perfect, delineation of indigenous rights to land and tenure.

In developing countries, legal systems may be less well resourced, forest and land rights may be contentious and legal traditions may be very different. This has led some authors to question the transferability of the New Zealand experience (Climate Focus, 2010; Takacs, 2009). However, we argue that the New Zealand experience offers useful lessons for developing countries in terms of how effective incentives linked to carbon trading can be established in the forest sector.

1. Consider the impacts of assigning carbon rights to governments

The New Zealand experience shows that the behaviour of landowners and forest stewards can change immediately in the light of decisions to introduce carbon trading or a REDD+ regime. In this case, the landowners and forest stewards felt that the rights to

carbon sequestered in forests belonged to them. The short-term consequence was an increase in deforestation in reaction to an unexpected government 'tax take' linked to the nationalisation of carbon rights.

The lesson for other countries where governments are considering the nationalisation of carbon rights is the need for careful consideration of the implications of such a decision for different types of forests and land ownership categories. The decision-making process also needs to be carried out in consultation with landowners and other stakeholders so that the possible impacts are understood. These impacts could be severe, particularly in countries where rights over forests are contentious and where vulnerable groups that depend on forest resources, such as the forest dependent poor and indigenous communities, may lose out (Sunderlin, 2009).

From the perspective of investors, assigning carbon rights to governments may be a disincentive for external investment in REDD+, as investors may see their returns from projects reduced significantly.

2. Ensure certainty and care in sequencing decisions

A second factor contributing to the accelerated deforestation rate in New Zealand appears to have been the responses of forest managers to uncertainties around the future ETS regime, particularly any liabilities or additional costs. Rights to forest carbon in New Zealand were unclear for a lengthy period of time. The initial decision by the government to retain credits was not immediately followed by the implementation of an ETS and this appears to have accelerated deforestation rather than improving conservation or sustainable management.

As a result, regulatory regimes for REDD+ should be aware of the effects of phasing of different decisions on the incentives of forest stewards to plant more trees. Given the economic behaviour of forest stewards, there should, at the very least, be some form of benefit sharing in terms of forest carbon rights between forest owners and governments.

3. External economic conditions, combined with a lack of data, can reduce the impact of REDD+ incentives

External conditions, such as the local or international market for timber or even foreign exchange rates, can have a significant effect on REDD+ implementation, potentially dwarfing the incentives offered by REDD+ carbon trading schemes.

Even in a country like New Zealand with impressive data and the ability to conduct forestry surveys, it is not easy to disaggregate what drives deforestation. In many developing countries this will present even more of a challenge to planning an effective REDD+ regime.

Conclusion

Implementing REDD+ is a classic ‘wicked problem’ in that it is hard to solve because of incomplete, contradictory, and changing requirements that are often difficult to pinpoint. The very complex interdependencies mean that attempts to solve one aspect of the problem may reveal or even create problems elsewhere.

The New Zealand case study shows just how easy it is for unintended consequences to arise through a series of conditions applying at the same time – the uncertainties about the ownership of forest carbon, delayed implementation of the ETS and external economic drivers. The perverse outcome of increased deforestation appears to have been driven primarily by the initial government decision to ‘nationalise’ forest carbon, a decision that was subsequently reversed.

The key lesson for developing countries implementing REDD+ is that where national legislation on carbon rights is to be developed, the consequences for, and the subsequent behaviour of, different actors needs to be carefully thought through. Given the complex nature of land and forest law in many countries, often combined with far less complete information about the forest sector, these processes will need to be supported with efforts to improve data, more effective engagement with forest stewards in decision-making and careful sequencing of policy reforms.

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References

Endnotes:

- 1 The burning or decay of forests results in GHG emissions. The growing of new forests results in absorption of GHG emissions.

References:

- Angelsen, A. (ed.) (2009) *Realising REDD+: National Strategy and Policy Options*. Bogor Barat, Indonesia: Center for International Forestry Research.
- Austin D. and Rivas Palma, R. (2009) ‘Estimating and Projecting Flows of Greenhouse Gases for New Zealand Agriculture and Planted Forests’. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Cabinet Policy Committee (2007) ‘A New Zealand Emissions Trading Scheme: Key Messages and Strategic Issues’, POL(07)302. Wellington, New Zealand: Government of New Zealand.
- Climate Focus (2010, forthcoming) ‘Rights to REDD+: Local Communities and Carbon Rights’. London: Overseas Development Institute.
- Gould, K., Miller, M. and Wilder, M. (2008) ‘Legislative approaches to forest sinks in Australia and New Zealand: working models for other jurisdictions?’ in C. Streck, R. O’Sullivan, T. Janson-Smith and R. Tarasofsky (eds), *Climate Change and Forests: Emerging Policy and Market Opportunities*. London: Chatham House.
- Intergovernmental Panel on Climate Change (2007) *Fourth Assessment Report*. Geneva: IPCC.
- Manley, B. (2006) ‘2006 Deforestation Survey: Final Report’. Christchurch, New Zealand: University of Canterbury.
- Manley, B. (2008) ‘2007 Deforestation Survey: Final Report’. Christchurch, New Zealand: University of Canterbury.
- Manley, B. (2009) ‘2008 Deforestation Survey: Final Report’. Christchurch, New Zealand: University of Canterbury.
- Manley, B. (2010) ‘2009 Deforestation Survey: Final Report’. Christchurch, New Zealand: University of Canterbury.
- Manley, B. and Maclaren, P. (2010, forthcoming) ‘Potential Impact of Carbon Trading on Forest Management in New Zealand’, *Forest Policy and Economics* (in press).
- Milner-White, G. (2007) ‘The Legal Implications of Climate Change in New Zealand for the Forestry Industry’, *New Zealand Journal of Environmental Law* 11, p.141.
- Ministry of Agriculture and Forestry (2005) ‘A National Exotic Forest Description as at 1 April 2004’. Wellington, New Zealand: Ministry of Agriculture and Forestry.

- Ministry of Agriculture and Forestry (2006a) 'National Exotic Forest Description as at 1 April 2005'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry of Agriculture and Forestry (2006b) 'Sustainable Land Management and Climate Change: Options for a Plan of Action'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry of Agriculture and Forestry (2007) 'National Exotic Forest Description as at 1 April 2006'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry of Agriculture and Forestry (2008) 'National Exotic Forest Description as at 1 April 2007'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry of Agriculture and Forestry (2009) 'National Exotic Forest Description as at 1 April 2008'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry of Agriculture and Forestry (2010a) 'A Guide to Forestry in the Emissions Trading Scheme May 2010'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry of Agriculture and Forestry (2010b) 'National Exotic Forest Description as at 1 April 2009'. Wellington, New Zealand: Ministry of Agriculture and Forestry.
- Ministry for the Environment (2010) 'New Zealand's Greenhouse Gas Inventory 1990-2008'. Wellington, New Zealand: Government of New Zealand.
- New Zealand Institute of Forestry (2007) 'Submission on the Permanent Forest Sink Initiative Consultation to the Ministry of Agriculture and Forestry', 14 May.
- Sunderlin, W. D., Larson, A. M. and Cronkleton, P. (2009) 'Forest tenure rights and REDD+: from inertia to policy solutions', in A. Angelsen (2009) *Realising REDD+: National Strategy and Policy Options*. Bogor, Indonesia: CIFOR.
- Takacs, D. (2009) 'Forest Carbon – Law and Property Rights'. Arlington, VA: Conservation International.
- Useful resource:**
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