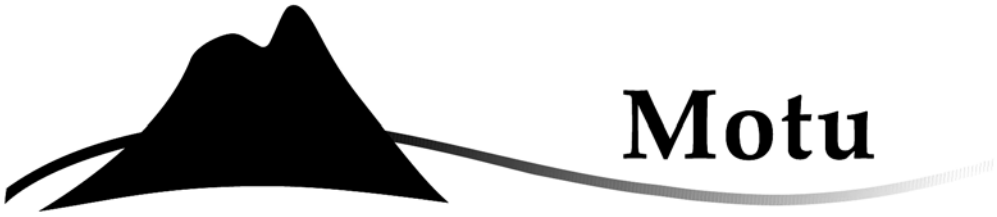

Indigenous Forests and Forest Sink Policy in New Zealand

Suzi Kerr

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Author contact details
Suzi Kerr
Motu Economic and Public Policy Research
PO Box 24390
Wellington
New Zealand
suzi.kerr@motu.org.nz

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Motu Economic and Public Policy Research
PO Box 24390
Wellington
New Zealand

Email info@motu.org.nz
Telephone +64-4-939 4250
Website www.motu.org.nz

Abstract

This paper tackles the complex issue of how to include regenerating indigenous forest in a domestic carbon credit system. The paper specifically addresses New Zealand conditions but most of the issues and conclusions are relevant in any developed country with indigenous regrowth. The paper begins by defining the constraints that any sink policy must meet. I begin by discussing environmental integrity, and in particular measurement and monitoring, "human-induced" change, and permanence. I then outline the international rules as they stand and how these could be translated into domestic rules.

JEL classification
Q23, Q28

Keywords
forest, climate, emissions trading, Māori, Kyoto

Contents

1 Introduction

Around 2.6 million hectares of land in New Zealand are estimated to be in the process of reversion to indigenous forest.[1] A significant percentage of this land is Māori-owned. Currently this land provides erosion control, biodiversity benefits and cultural benefits as well as having value as a firewood supply. It provides little or no financial return.

This land is found primarily in poorer rural parts of the country, East Cape, Northland, and Taranaki. The lack of economic return is a concern to the landowners and also to the wider community. These are regions the government has identified as especially deprived.[2] Although the land is currently reverting to native forest, with no economic return, if economic conditions change it may be cleared again and the environmental benefits may be lost.

The Kyoto Protocol, and concern about global climate change more generally, provides an opportunity for a modest return on this land. After 2008, land that was not in forest in 1990 could be eligible for payments as the forest regenerates and sequesters carbon. The government intends to ratify the Protocol but the domestic policies to implement it are still highly uncertain.

A high percentage of the reversion of New Zealand land to indigenous forest is occurring as a result of the economic reforms in the 1980s that lowered the return to agriculture on marginal land, as well as Cyclone Bola (1989), which damaged a lot of marginal land in the East Cape region. This means that a reasonable percentage was effectively not in forest in 1990. Just to give a ballpark figure, if all 2.6m hectares of regenerating land were eligible for carbon credits, carbon were sequestered at a rate of 5.5 tonnes of CO2 per hectare per annum and international carbon prices in the Kyoto trading regime were around $8.20 per tonne of CO2, indigenous forests could yield an annual income of up to $117m.[3] A considerable percentage of this could go to Māori.

[1] Ministry for the Environment 2000.
[2] See Dave Maré, Peter Mawson and Jason Timmins 2001.
[3] The estimate of 5.5 tonnes of CO2 per hectare is drawn from G. M. J. Hall 2001. One tonne of carbon is equivalent to 3.667 tonnes of carbon dioxide.

The carbon return to indigenous forest provides an extra land use option. It is unlikely to be valuable enough to displace plantation forestry or pastoral agriculture where these are feasible options. It is most relevant for marginal land that is unused at present or barely used.

This situation offers a valuable opportunity for Māori to gain a return on currently unused land, discourage clearing and hence promote cultural values, control erosion and floods and protect and enhance biodiversity. The erosion benefits are particularly salient in East Cape, where most marginal land is highly erodible. The challenges are to ensure that the domestic regulations are designed appropriately to maximise the benefit from this opportunity and to set up mechanisms that allow fair and efficient access to the opportunity.

The issues I discuss in this paper are also highly relevant to plantation forestry, which might also receive carbon payments, but I focus on indigenous forests here. Many of the conclusions I draw will be relevant, but there are some differences.

Māori land creates opportunities and challenges that are not present on non-Māori land and that require special thought. Māori have a strong desire to maintain control and ownership of their land and assets. This makes them suspicious of contracts to protect land in perpetuity. They are also concerned that if they protect the land it could become part of the Department of Conservation estate or locked up by local councils as Protected Natural Areas under the Resource Management Act. This requires care in contract design. Many Māori landowners are already protecting land under "Ngā Whenua Rahui" (similar to QEII Trust) in which land is covenanted for 25 years, and then there is a renewed kawenata (agreement) with landowners. They have found ways to provide effective protection using a mechanism that Māori trust. Domestic policy needs to allow for temporary sequestration and storage to allow these mechanisms to be used.

Māori land creates issues also in terms of the complexity of governance structures on multiply-owned land and limited ability to borrow, as well as low capacity to negotiate and administer contracts. To the extent that sequestering

carbon is technically a relatively non-challenging activity that requires little capital investment, it has an advantage relative to other land uses.

The purpose of this paper is to design feasible carbon sequestration, or "sink", policies that are likely to meet the constraints and achieve the goals of current and future international climate change rules. The paper begins by defining the underlying constraints that international climate change rules must meet. I discuss environmental integrity and in particular measurement and monitoring, "human-induced" change and permanence. I then outline the international rules as they stand and how these could be translated into domestic rules. This paper is written primarily for a non-economics audience so I have tried to make it as non-technical as possible.

2 Environmental constraints on policy design

The environmental constraints will eventually be defined in international and domestic regulations but are also intrinsic to the nature of the climate change problem we aim to address. Sequestration of carbon in "sinks" that create tradeable credits needs to have the same atmospheric effect as the emission reductions that the credits would replace. The amount of credits given for sink enhancement should depend only on the additional carbon that is removed from the atmosphere (or not put in) and when the carbon is removed.

2.1 Measurement of sinks

The basis for environmental integrity is accurate measurement of the carbon stored or added to sinks. At a global scale what is important is that measurement is unbiased so that the amount credited globally is accurate. Large errors in specific places are not important as long as they go in both directions and do not lead to global bias and too many (or too few) credits being created. Overall bias will lead atmospheric concentrations to be different than envisaged in the agreement.

Ensuring fairness across countries requires more accurate measurement so that each country's total sink credits accurately reflect the real sinks created. Again, as long as the national total is accurate, it does not matter if the methodology used to generate this is not accurate for each specific area within the

country. Current inventory methodologies are designed in this way. Errors are made but they average out over large areas so the national total is pretty accurate. These inventories are currently taken using a combination of remotely sensed and aerial imagery, plot sampling and models of carbon accumulation with limited differentiation of carbon storage across space.

The problem becomes more challenging if we want to measure carbon more accurately at a local level. Simply put, the smaller the area where we require accuracy, the more costly and difficult it is. The gains from accurate measurement are obvious: more equity across landowners and more accurately focused incentives to enhance carbon stocks. The costs of accurate measurement are high costs of monitoring and compliance. These have to be traded off against each other. When the carbon price is relatively low, the compliance costs are likely to dominate and less accurate methods are probably preferred. As carbon prices rise, more accurate methods will become worthwhile.

The sink credits need to be verified at regular intervals. Verification could involve varying degrees of accuracy. It may be that only the existence of the forest is monitored in some periods, rather than auditing the carbon content of those forests.

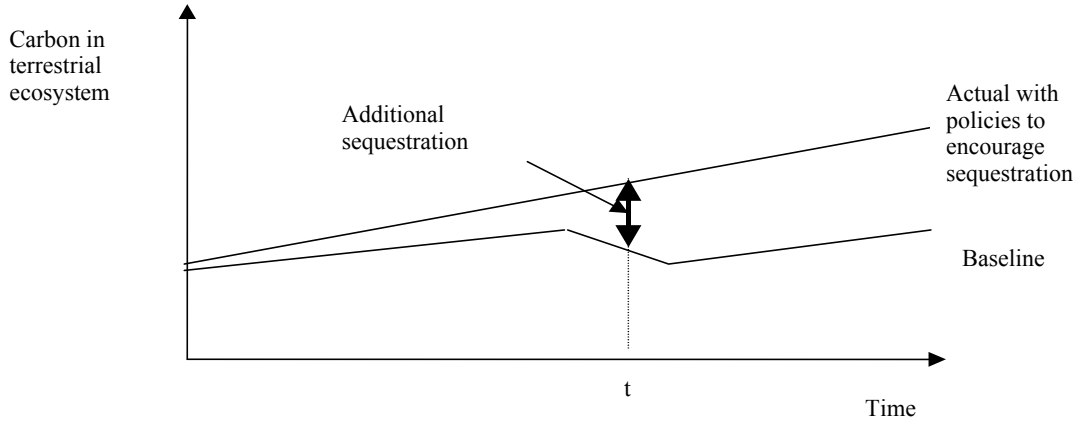
If involvement in the domestic program were voluntary and project monitoring stopped for any reason, for example the carbon price dropped and the project wasn't worth continuing, the buyer would have to pay all net accrued credits back. Voluntary involvement is discussed further below. Monitoring is a requirement of credit creation and maintenance because otherwise compliance cannot be established. Because sinks can be destroyed, monitoring must be ongoing. As long as no carbon release occurs and monitoring continues, the credits would remain valid.

2.2 Additionality: Human-induced change

The only real global environmental gains are increases in sinks relative to the level that would have been there otherwise. The ideal regulatory system would identify what would have happened without regulation and only reward activities that go beyond that. In practice this is extremely difficult to do as it requires predicting human behaviour that we will never observe.

Figure 1 shows an example of two scenarios. In the lower line, no effort is exerted to sequester carbon or protect regenerating forest. For reasons unrelated to climate change land is reverting to scrub and forest and the level of carbon in the terrestrial ecosystem is gradually rising. At some point it falls, possibly because of a fire or a change in land use when beef or lamb prices rise, but then it rises again.

Figure 1: Additional sequestration from human-induced activities



The higher line is a scenario where the land is actively being protected. Weeds are controlled, animals are kept off the land and the rate of sequestration is higher than under simple abandonment. In addition fires are suppressed, and land does not return to pastoral uses when the prices receivable from alternative land uses rise, therefore ensuring that the level of carbon does not fall. Overall the level of carbon is higher than it would have been. This should be rewarded to encourage more carbon sequestration.

Any policy has to include a "baseline" against which gains are measured. This lower line, "what would have happened otherwise" would be the ideal baseline if government wishes to maximise its revenue without compromising efficiency. We cannot ever observe the lower line, so need to set it somewhat arbitrarily when defining policy.[4] When making this choice we need to

[4] Suzi Kerr, Shuguang Liu, Alex Pfaff and R. Flint Hughes 2003 discuss the way baselines could be estimated for tropical forests. Suzi Kerr, Joanna Hendy and Alexander S.P. Pfaff 2003 discuss the implications of the uncertainty these baselines involve. Similar approaches could be implemented in New Zealand. This is the purpose of a major Motu project, details of which can be found at www.motu.org.nz/land_use_nz.htm.

consider the different costs of making the baseline too high or too low (see Section 3.3.3).

In the international rules, the baseline is defined so that any forests established after 1990 are "additional" while all forests established before 1990 are assumed to be maintained.[5] In New Zealand this is probably a "lower" baseline than would really happen because the area in both plantation and indigenous forests is continuing to increase for reasons unrelated to Kyoto. This expansion in forest area is a common historical experience in developed countries and even in more advanced developing countries. The issues relating to how these international rules should be translated into domestic policy are addressed further below (Section 3.3.3).

2.3 Timing and permanence of credits

One simple form of sink project is a permanent sink where forest is carefully protected and the land is convenanted forever. In this case it would be possible to estimate the total sequestration over the infinite life of the project. If projects were like this it would seem simple to issue credits equal to the total anticipated sequestration at the beginning of the project. No further action would be required.

This approach has several disadvantages, however. The greenhouse gas (GHG) benefits from land use change can be lost or reversed over time, unlike the GHG benefits from emissions reductions in other sectors. First, up-front credit allocation does not take account of unavoidable risk to the project. Fire, slips, earthquakes and even global climate change can cause loss of carbon storage. Initial estimates of the carbon to be stored could be incorrect. These problems could be dealt with through appropriate insurance, by the landowner or government as long as the land owner cannot unduly affect the risks.

Second however, and more importantly, the landowner may want to retain the ability to change their mind about their land use. Forever is a long time. If crop prices or technology change so that profitable land use options emerge, or

[5] This is the rule under Article 3.3 of the Kyoto Protocol. Under Article 3.4, existing forests can be rewarded if they sequester more carbon during each year of the commitment period than they were sequestering in 1990. Article 3.4 is unlikely to be applied in New Zealand in the first commitment period.

if the cultural values of successive owners have different emphasis, the landowner might desire to change the land use. They may want this to be possible without breaching a contract.

In any case, up-front allocation of credits puts all the risk of changes on the environment or the government (if they are unable to enforce landowner liability). It also violates the principle that increases in emissions should be offset by increases in sequestration in the same time period. Credits should be issued as the carbon is stored and not earlier.[6]

An effective permanence rule should be designed to reflect the following equivalences:

- One ton of permanent sequestration/storage from land-use activities is directly equivalent to one ton of avoided fossil fuel emissions (e.g. efficient lighting).
- The release of one ton of emissions from land-use activities (e.g. burning forest) is directly equivalent to one ton of emissions from fossil fuel.

The potential crediting systems for sinks should be compared in terms of how they affect atmospheric GHG levels at every point in time.[7] This principle of environmental integrity means that any risk from reversibility should be borne

[6] This issue is discussed in the context of the international negotiations in Suzi Kerr and Catherine R. Leining 2000, Suzi Kerr 2001 and Catherine Leining and Suzi Kerr 2001. K. M. Chomitz 1998 and 2000 and Colombia 2000 advocate a similar approach, as do many others.

[7] Some people have argued that the decay of emissions should mean that the amount of land-use carbon needed to offset a one-time emission would fall over time. If this were true, however, it would also be true of all other emission reductions. Therefore, all credits would convey not only the immediate right to emit an equivalent amount but also the right to continue to emit as the initial emissions were removed from the atmosphere. If we do not treat emission reduction credits this way, then we should not treat land-use credits this way either. This is a question about the timing of net changes in atmospheric CO2 and, at least within Annex I, Kyoto negotiators have chosen to treat emissions reductions and sinks as equivalent if they occur at the same time. The removal of atmospheric emissions through the global carbon cycle should be dealt with through appropriate choice of targets for different commitment periods aimed at achieving certain atmospheric concentrations at each point in time. Papers that propose and discuss issues relating to the appropriate international rules include L. Dobes, I. Enting and c. Mitchell 1998, P.M. Fearnside, D.A. Lashof, and P. Moura Costa 2000, J. P. MacLaren 2000, G. B. Marland, B. Schlamadinger, and P. Leiby 1997, M. Meinshausen and B. Hare 2000, P. Moura Costa and C. Wilson 2000, R. Schwarze and J-O. Niles 2000, B. Schlamadinger and G. Marland 2000, R. A. Sedjo and M. Toman 2001, R. A. Sedjo, G. Marland and K. Fruit 2001 and G.C. Van Kooten, A. Grainger, E. Ley, G. Marland, and B. Solberg 1997.

by the buyer and/or seller (as determined in the project contract), not by the environment.

A net increase in carbon stocks relative to the baseline during each crediting period would be awarded credits. These credits could be maintained in a registry, or sold or used by the buyer to achieve domestic compliance. During each crediting period, any net loss of previously credited carbon stocks would require payback of credits by the buyer or lessor (if the credits are leased not sold). Under a compliance system where credits are retired when project benefits are lost or reversed, environmental integrity can be maintained without requiring that credits be permanent or that forest be protected forever.

Why does it matter when GHGs are removed from the atmosphere given the long lifetime of CO_2? It is important for credibility (will the reductions ever actually occur) and efficiency under fixed targets (reductions today are worth more than reductions tomorrow with a binding cap today). We cannot borrow in an unrestricted way from banks on the basis of a simple promise to repay; nor should we borrow from the environment when our ability to repay is highly uncertain. As long as we base other climate regulation on caps on net emissions during a specified time period (as Kyoto does), net sink emissions should be treated equivalently so that the credits created are fungible (i.e. can be used interchangeably with credits released by emissions reductions).

Any regulatory system for sink credits should have the following characteristics:

- As sequestration/avoided release occurs, credits are generated and can be sold or leased.
- Sink credits should be verified at least once per commitment period with mandatory payback of credits by the sink credit holder during the commitment period when credited carbon stocks are lost or monitoring ceases, whichever comes first.

3 International rules and domestic policy design

In this section I outline the international rules defined in Kyoto and discuss how these could be translated into domestic regulations. This is not

intended to be a definitive discussion of domestic sinks policy but aims to outline the key issues and offer a straw-man solution. Without this it is difficult to talk in a concrete way about projects. These regulations will constrain the way buyers and sellers can define project contracts. Looking at it more positively, however, if the rules are made as simple as possible they also define the many opportunities for different approaches possible within the minimal constraints of policy.

3.1 International rules

The international rules deal with the problems of monitoring, additionality and timing in the following ways. They still leave considerable flexibility in the domestic approach and even more flexibility in design of individual contracts.

The relevant article for New Zealand sequestration credits in the first commitment period is Article 3.3. This is the article that outlines how countries may claim credit for afforestation and reforestation activities on land that was not in forest on 31 December 1989 (i.e. "Kyoto Forests"). The credit is given for carbon sequestration that occurs on that land between 2008 and 2012. In addition, it mandates that countries take responsibility for deforestation anywhere in the country during the commitment period.[8]

Countries have some leeway in the definition of "forest" but have to be consistent once they have chosen a definition. The definition of a "forest" is critical for indigenous reversion, though less so for plantation forest, which probably fits most reasonable definitions. The government has chosen to define it as an area of a least 1 ha, with at least 30% canopy cover and able to reach a height of 5m at maturity.[9] Young stands, natural or plantation, that have the potential to become forest, are classified as forest. For NZ the critical issue is whether "scrub" is classified as forest. If scrub is classified as forest, areas that were in scrub in 1990 are not eligible for credit under Article 3.3 but are liable as net sources if the scrub is cleared. If scrub is not classified as forest, areas that are

[8] If a Kyoto Forest is cut before 2012, the carbon credits lost cannot be greater than those gained for sequestration during the period 2008–2012, i.e. there will be no punishment for reforesting land after 1990 but then cutting it down before 2012. This is relevant to some NZ plantation forests and also applies to regenerating native forests.
[9] New Zealand Climate Change Programme, 2002, p. 42.

in scrub during 2008–2012 would receive no credit for carbon sequestration from 2008–2012 because they would not be forest. They would need to be included under Article 3.4.

Article 3.4 relates to revegetation (establishment of vegetation that is not a potential forest), forest management, cropland management, and grazing land management. These are not the focus of the current paper.

3.1.1 Monitoring

At the international level, monitoring requirements are largely defined by IPCC best practice guidance and the definitions above. Land use change can be monitored using remote sensing or survey information. The rules require monitoring at a resolution no less than 1 ha, but actual monitoring (particularly back to 1990) may be constrained by data availability.

Currently carbon stocks and sequestration rates in different types of land use (above ground and below ground stocks) are modelled with the aim of being correct on average but not necessarily correct for specific plots. The science continues to improve but a high level of uncertainty remains. NZ is required to report at five-yearly intervals so will probably create inventories using remote sensing images each five years (i.e. in 2008 and then the end of each commitment period).

3.1.2 Additionality

The additionality issue has been addressed in Article 3.3 by defining Kyoto forests relative to land use in 1990. Forests already established in 1990 are assumed to stay in that land use in future (and are liable for emissions after 2008 if they do not). Implicitly the rules assume that no new land would have gone into forest after 1990 without climate change pressure. For New Zealand this is a "too low" baseline. Our area in forest was growing independent of climate change policy. The extra credits we will gain may be roughly compensated for by higher emissions reduction targets in future. In any case, NZ might not have agreed to its Kyoto target without this relatively generous sinks baseline.

3.1.3 Timing and permanence

The international rules provide credit only as carbon is sequestered, i.e. not in anticipation. Any reversal of sequestration, as well as removal of existing

forests, is accounted for by the requirement to report net sinks, which are defined as carbon sequestration from reforestation/afforestation net of loss of carbon through deforestation.

3.2 Potential domestic rules

If Kyoto comes into force, we need to design a domestic regulatory system that aids national compliance with our targets. We have considerable flexibility in regulatory design. In this paper I am primarily interested in the constraints that may be placed on private contracts to sequester carbon in exchange for credits.

Our aims when designing the domestic regulation can include the following:

- national compliance with Kyoto
- efficient incentives for sequestration
- minimising compliance costs—e.g. monitoring and reporting
- maximising flexibility in compliance to maximise efficiency and landowner/user control
- fairness in distribution of costs and benefits of the regulation
- simplicity
- maximising ancillary benefits.

New Zealand Kyoto forests are forecast to provide roughly enough credits to offset growth in CO_2 and methane emissions, making our overall target non-binding. With careful policy design they could contribute even beyond this if the response to regulation provides benefits greater than the costs. They could also assist with compliance in future commitment periods, from 2012 forward.

Efficient incentives could lead to planting or regeneration of additional Kyoto forests and could encourage landowners not to convert existing forest back to pastoral and other uses. Efficient incentives require first that carbon gains are measured with reasonable accuracy and second that the agent rewarded for carbon gains can directly or indirectly influence whether those gains are achieved. A perfectly efficient system would need to have comprehensive coverage of all forests.

Compliance costs are a key issue here. Monitoring both land use and carbon and tracking large numbers of agents could be costly both to government and to the agents themselves. There will be tradeoffs between accuracy and comprehensive coverage on the one hand and costs of administering the regulation on the other. Strategic choice of the point of obligation, centralised monitoring and use of existing information (such as forest inventories), and voluntary participation of small players could reduce administrative/compliance costs with relatively small efficiency costs. If the system is non-comprehensive, the problem of leakage can arise, however.

Maximising flexibility is closely linked to efficiency but also related to minimising compliance costs. If a range of compliance options is available and carefully structured, landowners can choose the way that they comply and simultaneously make appropriate societal tradeoffs between efficiency and compliance costs.

Fairness in distribution of costs depends largely on whether high compliance costs are imposed on small agents and on how the baseline is set and hence the free credits are allocated. It also depends on the accuracy of measurement and reward. If baselines are variable, some agents are not included in the system, or credits are accurate on average but not in specific places, two agents who in reality create the same number of credits could receive quite different rewards. This is unfair and also has efficiency implications. Improving fairness may have to be traded off against reducing compliance costs. If agents can choose to forefeit gains or take risks in the accuracy of return in exchange for lower compliance costs they may not be upset about the differences in rewards that result.[10]

Subject to achieving environmental integrity, the rule should maintain maximum flexibility in how the credits are created and hence achieve maximum economic efficiency in climate mitigation. If two rules achieve the same ends both environmentally and economically and one is simpler than the other, the simpler rule would be preferred.

[10] Some small forest owners in New Zealand claim that they do not want to be involved, largely because of their perception of compliance costs.

3.3 Critical design elements for domestic regulation

Three key decisions need to be made. Where is the "point of obligation"? Who monitors and how? What is the baseline—who owns the credits?

3.3.1 Point of obligation

This could be the government, the land user or the landowner. The appropriate choice may vary between indigenous forest and plantation forest and by block size. As far as possible the obligation should be put on people/legal entities who jointly comprehensively cover all sequestration and deforestation (i.e. all forest and potential forest) in New Zealand and can influence sequestration on the land, either directly or through contracts with the land user. At the same time we need to minimise the number of agents required to report and choose those who can report with least cost (possibly because they already collect inventory information).

The government can indirectly influence sequestration by, for example, providing tax rebates for forestry, enhancing or restricting access to marginal land, and/or facilitating the process of covenanting land reverting to native forest. The government could expand the national parks or regional reserve system, or local government could use the Resource Management Act to influence local land use. These are relatively crude instruments. Government cannot send an effective price signal to efficiently reward sequestration if it maintains control.

The current land user (e.g. a forest concession holder) has almost complete control in the short run but it may be difficult to track them through time as contracts change. They may also have limited long-term control of the land or their control may be contractually limited to their current land use. Landowners have control of land use in the long term as their existing contracts with land users roll over. However, there is an unwieldy number of land owners.

One option would be to make the system voluntary or, alternatively, compulsory for large landowners/users but voluntary for smaller ones. Government would maintain the residual rights and obligations. This approach is commonly used in pollution control where there are some large sources and then a large number of very small sources. Rules are set for opt-in to the system.

Landowners/users who choose to include their pieces of land would need to meet monitoring requirements or subcontract those to government (see 3.3.2). They would be able to claim credits and would also be liable for emissions from deforestation. A baseline level of sequestration would need to be established—this could be as simple as the levels of carbon in Kyoto forests and the area of non-Kyoto forest at the date of entry.

Once a landowner/user opts to include a piece of land and receive credit they would need to keep reporting as long as they did not want to pay back all the credit received.[11] Voluntary participation by small players reduces compliance costs and encourages broadening of the system but also creates bias because opting in is a strategic act. Those who opt in will tend to be those who will gain from the system.[12] A similar problem that arises in monitoring is discussed below.

Wherever the point of obligation is placed, positive price signals encouraging more planting and more use of wood will be passed up and down the supply chain. A more comprehensive system with a greater percentage of the obligation placed on those who control land use will lead to more efficient price signals.[13]

3.3.2 Who monitors and how?

The lowest cost monitoring option would be for government to combine remotely-sensed maps of land use and cadastral maps of property boundaries to determine changes in land use and then use their carbon models based on a random sample of audited sites to estimate net carbon sequestration. This would be consistent with national-level reporting, and would be relatively unbiased. The disadvantage would be that it would be quite inaccurate, particularly for small areas and areas with unusual sequestration patterns (e.g. extremely fertile land or

[11] The government would probably not want to allow them to claim back net payments they had made for emissions if they opt out. This would exacerbate selection issues.

[12] Opt-in was allowed in the US Acid Rain program for controlling SO2 emissions from electric utilities. Juan Pablo Montero 1999 discusses the effect this had on environmental integrity.

[13] This needs to be compared with the case in CO2 emissions where many potential points of obligation are available: fossil fuel importers and producers, large energy users, consumers of energy-intensive products, or consumers of retail gasoline. This is because fossil fuel use is a near perfect proxy for CO2 emissions. As long as the obligation is comprehensive the efficient price signals will occur. Any agent who controls the use of fossil fuel or products with embodied fossil fuel at any point can indirectly control CO2 emissions. The choice here is to minimise compliance costs.

if the landowner has enhanced the forest). A way to address this would be to allow landowners to choose to have their carbon levels audited if they think it will provide a higher payment. They could then trade off the cost of the audit against the value of extra payments.

An alternative would be for landowners to report their own changes in land use. This could be randomly audited with remote sensing or ground truthing. If the total were inconsistent with the national-level reporting, adjustments could be made to all domestic credits (e.g. increasing or decreasing the quantity to account for bias). These reports of land use change could be translated into sequestration using government models, or alternatively landowners could pay for more accurate, certified audits if they chose.

Accepting estimates from land owners would create a bias in total carbon credits claimed because only those who have higher than average modeled sequestration would opt to provide alternative figures. Therefore, those who opt to provide their own estimates would always claim more credits than the government would have given them. The average credits provided on all other land may need to be adjusted downward to keep the domestic total and the internationally reported totals consistent. Land where landowners did not opt to provide their own carbon sequestration numbers will tend to be lower carbon producing land but may also include small land parcels. Owners of small parcels will not choose to provide alternative figures because the cost would outweigh any gains. Thus this system would create some inequity.

3.3.3 What is the baseline for domestic credits—i.e. who owns the credits?

The international rules set one baseline—all credits from post-1990 forests belong to New Zealand. The domestic baseline does not need to be the same. In this case there is no environmental impact—total international credits will be the same however it is done domestically.

Two tradeoffs are involved. The first is between economic efficiency, which generally biases toward primarily government ownership, and equity, which might lead some credits to be allocated to groups of landowners such as Māori. Equity and political feasibility might lead some credits to be allocated to land/forest owners. Second (at a finer level), if most credits are being claimed by

groups other than the landowner/user, when choosing the exact level of baseline there is a trade-off between our ability to freely allocate credits and efficiency in sequestration.

Figure 2: Baseline efficiency and equity tradeoffs

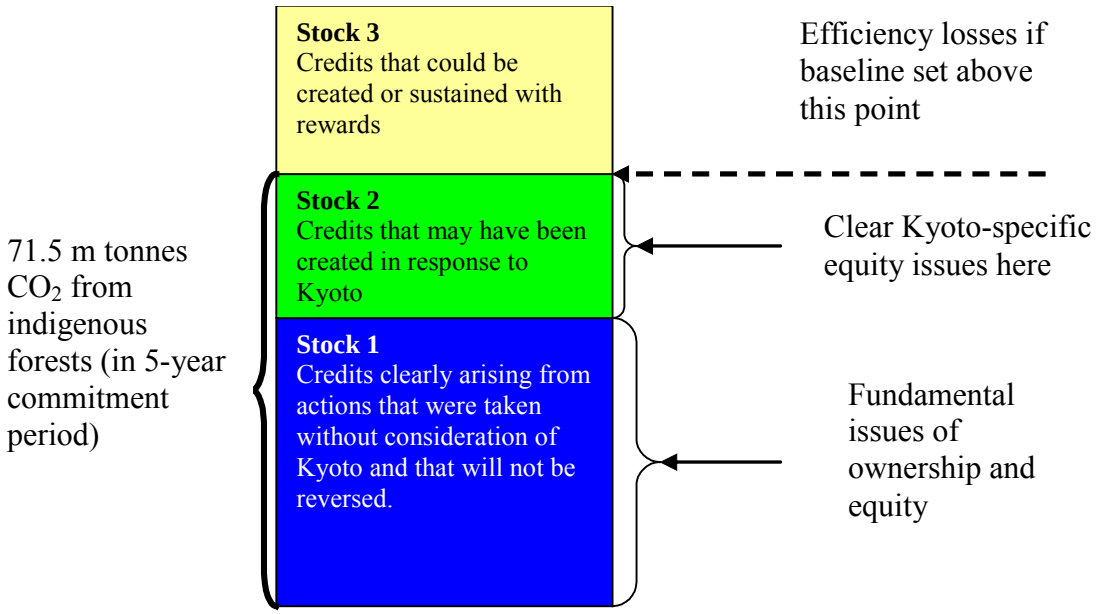


Figure 2 breaks the total amount of carbon credits into three stocks. Within the lowest stock, Stock 1, the issue is simply about who should benefit from this windfall gain to New Zealand. Within Stock 2, the equity issues are made a little more complex because landowners may have protected forest in response to expectations about Kyoto and might feel they have a strong argument for being rewarded even though there are no direct incentive effects. There may be indirect incentive effects through building trust that government will reward those who create benefit for New Zealand. Within Stock 3 there are clear efficiency arguments. By both equity and efficiency criteria, these should belong to those who control the land. The greatest challenge is to identify where the line falls between Stocks 2 and 3. I will discuss the issues relating to ownership of each of these stocks separately below.

Stock 1: Why is primary government ownership of carbon credits probably most economically efficient?

Allocation of the credits that arise solely because of historical activity does not affect the cost of producing extra output or the prices that landowners

face when making decisions; therefore it has no direct impact on economic activity. However great an incentive forest/landowners get, they cannot change their previous behaviour so the allocation of credits will have no impact on their earlier actions. They can't change their previous behaviour and it won't affect their future behaviour.

The benefit from government ownership of carbon credits arises from something called "revenue recycling". If the government can raise revenue without adverse impacts on economic activity and use that revenue to cut taxes that do create distortions and costs, New Zealand will gain. Income taxes, GST and corporate taxes cause inefficient changes in behaviour. For example, with higher income taxes (say 33%) it is less worthwhile for a worker to take on overtime work because she will receive only 67 cents out of each dollar of value she creates. Society would like her to work, and so would she if she received the full reward, but she might choose not to because of the tax.

The government needs to fund its activities. If it can receive revenue without causing distortion, as it could from carbon credits, it needs to raise less money from taxes and could lower them. This has potentially large economic efficiency benefits. In the US, C. L. Ballard, J. B. Shoven and J. Whalley (1985) estimate that each $1 of government revenue from taxes costs around $1.30 to raise. If indigenous forests can create 71.5m tonnes of carbon dioxide over 5 years and each of those tonnes is worth $8.20, then the government can get revenue of $585m and the efficiency gain from using that revenue to cut taxes could be as high as $175m.[14] The potential gains from government ownership of carbon credits from Kyoto plantation forests are an order of magnitude higher still.

A particular case may arise with potential Māori ownership of carbon credits. If Māori currently need to fund their community activities through government payments or through expensive fundraising within the community, there may be efficiency gains from providing them with a more direct revenue source. Revenue recycling gains of a sort may be achieved here too.

[14] The 71.5m tonnes of CO2 is based on the area of regenerating forest (Ministry for the Environment, 2000) and an estimate of average annual carbon sequestration from Hall, 2001.

The arguments against government ownership arise from concerns about how government uses extra revenue. If the government spends the money in unproductive ways rather than using it to cut taxes, these potential gains may not be realised.[15]

Stock 1: What is the most equitable way to allocate carbon credits?

These *efficiency* arguments do not mean that it is most *equitable* for government to claim all credits arising from previous activity, or that this is what they should do. In particular there may be a strong Māori claim for part of the credits, particularly those arising on Māori land.

The first equity argument depends on who bears the cost of the regulation and whether there is an equity argument on this basis for landowners or landusers to receive some of the credits. Landowners and forest owners as a group could win from inclusion of indigenous forests in a carbon credit system as long as they do not convert too much pre-1990 forest land back to other non-forest uses. With government ownership, if taxes are lowered, all New Zealand taxpayers will benefit. This may relate reasonably closely to fair compensation for the costs of Kyoto regulation of fossil-fuel emissions which will tend to be widely dispersed across all consumers. There is no obvious equity argument here.

The major arguments against government ownership derive from the problem that carbon is essentially an unowned property right. In a similar way to arguments over the ultimate ownership of fisheries when the ITQ system was created in 1986 (Te Ohu Kai Moana, 2000), it is not clear that government has the right to appropriate this new resource.

In some ways it is similar to the claim for the telecommunications spectrum. Carbon credits are not something that existed in the past so it's not immediately obvious that they belong to anyone in particular. It's also similar to the fisheries quota in some ways—while the fish always had value, during the time that anyone could fish there was no value in being able to fish, so that right did not clearly belong to anyone. This is not an economic issue, so I have no insight to provide on these arguments.

[15] For a New Zealand example of loss of efficiency gains through unproductive government expenditure see Davis and Fabling (2002).

The allocation of sink credits will have significant impacts on the distribution of wealth in New Zealand (as will the allocation of any other carbon credits). Because of this, allocation will be hotly contested, but this is primarily a political and equity argument, not an economic argument.

Stock 2: Rewards for early action

The basic economic arguments here are the same as for Stock 1 because these are actions that have already been taken. The equity issue is slightly different because some landowners and forest owners might have in good faith invested in forests with the idea that they will contribute not only profit but also carbon sequestration which will have environmental benefits. This was relatively unlikely in 1990 but becomes more likely in more recent years and is clearly true on land that is involved in the Emissions and Biodiversity Exchange (EBEX) run by Landcare Research. It is hard to separate Stocks 1 and 2 but errors have primarily distributional implications. If the government wants to reward this essentially altruistic (or optimistic) behaviour to encourage these people to do more in future it could find it compelling to give them some share of credits even if they are based on historical activities.

Stock 3: Ownership of "additional" carbon credits.

Even if government successfully claims ownership for Stock 1 and even 2, this does not mean that they should claim all credits. In particular, if landowners or forest owners create additional forests they should be rewarded for this by receiving any extra credits. The regulation should be designed to reward any activities that sequester carbon above the baseline. We would expect that with this regulatory system more forests will be planted (or indigenous forests be protected and allowed to regenerate). This is an efficiency issue central to regulatory design.

The real gain for New Zealand from here on out will come if land and forest owners plant and protect more forest than they would have without Kyoto. Forest areas may be expanding anyway but if they expand even more because of appropriate incentives, that will bring gains to NZ. The really additional gain to New Zealand only comes by them doing things from now to 2012 that they wouldn't have done otherwise. If this means the rewards per hectare of new forest

are small in the first commitment period because the trees grow slowly, that is because there is relatively little gain to NZ. We want to set up a system so that the person making decisions about forestry faces the same reward (incentive) as NZ as a whole when they make new decisions (about either planting or harvesting).

If the government is to successfully claim Stocks 1 and 2, it must face the difficult problem of setting a baseline that will encourage additional carbon sequestration but not reward historical sequestration. If the baseline is set too low, landowners and/or forest owners will receive a windfall and be rewarded for actions they have already taken and the government loses potential revenue.

In contrast, if the baseline is set too high people could actively protect and regenerate forest and receive no reward. This would decrease their incentive to do so. An opportunity for local environmental gain and to reduce greenhouse gas concentrations efficiently would be lost.

This problem is different for indigenous forests than for plantation forests. With plantation forests, once they are planted they are unlikely to be harvested before maturity, so we can predict sequestration between 2008 and 2012 fairly accurately. A baseline where forests planted after 2000 are rewarded would create relatively small windfall gains and be unlikely to lead to any incentive problems. As long as forests planted in the 90s never face a liability greater than the credits they create their owners will have no incentive to harvest early. In contrast, indigenous forests are not protected for profit in the absence of carbon credits. They could be cleared at any time if a different land use is preferred. This makes it harder to set a baseline without risking loss of appropriate incentives.

Covenants complicate this issue. If a permanent covenant was placed on the land before 1990 it is unlikely that it will be cleared, so sequestration will not need to be rewarded. If a temporary covenant was placed on the land, particularly after 1990, it is unclear how likely the land is to be cleared and how the baseline should be set. With a temporary covenant the land may be cleared when it ends. In addition, equity issues arise because those who placed covenants on land after 1990 are more likely to have been responding to climate change and maybe even acting in expectation of later credit. Although they cannot change their behaviour

now, they may claim the rights to carbon credits from that land with some justification.

In no case does the setting of the domestic baseline affect international greenhouse gas environmental integrity. The international rules that define the carbon credits NZ receives are fixed.

3.3.3.a Key points on baselines for indigenous forest

Indigenous forests must be included in the regulatory framework if landowners are to receive credit for additional forest they allow to regenerate.

Economic efficiency generally argues for government ownership. This might be less true in the case of indigenous forests because:

- Māori may use the revenue from credits to replace other funding demands on government or their people, leading to "revenue recycling" benefits
- It is very difficult to define a baseline for indigenous forests that separates actions that would have occurred without Kyoto from those induced by Kyoto because indigenous scrub/forest could be cleared at any time.

Indigenous forests are a resource with considerable value even at moderate carbon prices (maybe $585m). Ownership of the carbon credits from these forests is not yet established. Māori could probably argue for at least partial ownership of these credits on Treaty/equity grounds.

3.3.4 Special issues pre-2008

Even if the Kyoto Protocol comes into force, there will be no formal Kyoto credit for carbon before 2008. Two scenarios are possible. First, voluntary action by companies and individuals could create some demand for credits in the way they are being created now under EBEX. Second, government could create an "early action" programme to provide domestic credit for pre-2008 activities.

Companies and individuals have paid for carbon credits since the mid-1990s. They have been motivated by a number of factors including positive publicity, concern about biodiversity, erosion of cultural values associated with forests, and an attempt to influence the future course of government regulation.

These trades also have provided a chance to experiment and learn how to set up such contracts by actually doing it. Many of the actors involved either as buyers or facilitators have been non-profit environmental groups. This has been a thin market with very few trades and generally low prices but very high dispersion of prices. It mostly depends on goodwill. This market could easily continue until 2008 and may strengthen as Kyoto comes closer and becomes more certain.

The government is free to set up domestic regulation to encourage sink enhancement and protection at any time. The key issues are who would pay for these credits and what the net effect on New Zealanders' welfare would be. One argument in favour of "early action" is that people are myopic or unduly risk averse so they will not make investment decisions in forests that appropriately reflect potential future returns from credits post-2008. This argues that government is better able to make investment decisions than the individuals directly involved. This would be true if government has better information about its intentions or the international political situation. A second argument is that we need to engage in learning by doing before 2008 so that we have an effective regulation in place to take advantages of opportunities after 2008. In general, when a new technology or opportunity arises it takes time to be adopted because people may not know about its potential, and there may be uncertainty about how profitable it would be. Costs tend to fall over time. If this process can be hastened effectively through demonstration projects that would have benefits.

The arguments against early action are essentially that it imposes costs. If the government simply creates a fund that can be used to reward sequestration there are costs to taxpayers. The benefits would have to clearly justify this. If the government goes further and creates a full carbon regulatory system before 2008 (as some countries in Europe are going to) emitting sectors will bear costs. Output and employment would fall in some sectors and the costs of some consumer goods would rise. There would also be direct administrative costs of creating the system, though some of these would be offset by lower costs in 2008 if the early action system mimicked the system that would be used after 2008.

In New Zealand we are in the unusual situation where if we placed a total cap on net emissions at 1990 levels between now and 2008 this would be more or less non-binding. Total emissions are very similar to total sequestration.

A capped domestic trading system would have a zero carbon price and no real effect. To be effective we would have to start selling credits to other countries (as part of their own early action programmes) or impose a more stringent cap than we will face under Kyoto.

4 Conclusion

Creating an effective domestic policy to encourage indigenous regrowth for its carbon benefits is complex. We have stressed three major issues. On measurement and monitoring of carbon, the existence of forest needs to be monitored as long as the credits are valid. Carbon can be directly measured on-site or modelled. The smaller the project is, the more expensive monitoring would be per hectare to achieve accuracy. The cheapest and nationally most accurate option would be to have government take responsibility for measuring carbon and use a national model. This would, however, have drawbacks in terms of the incentives individual landowners and users face. The appropriate resolution of the tradeoff between compliance costs and efficiency of incentives should depend on the value of the carbon and hence will change over time.

The ownership of sequestration credits is the second big issue. Essentially this is a tradeoff between having all New Zealanders benefit from this new highly valuable resource and providing incentives for landowners/users to enhance the resource by making sure they gain additional benefit created through their actions.

The third issue is the lack of permanence of sink credits. I argue that this is a perceived problem rather than a real one. Careful policy design can allow temporary sequestration credits, which leave the landowner controlling the future use of their land (this is particularly important for Māori), while protecting the government against liability if the land is later cleared.

Another key point that is highly relevant to Māori is whether regenerating indigenous forests (scrub) should be included as forest. This provides an opportunity for gain if forests regenerate but creates a liability if they are cut. The balance is probably positive so that it would be beneficial to include it. A second key point is that ownership of the carbon credits associated with this scrub is not yet established. A strong case needs to be made especially for those credits

arising on Māori land. This case should be distinguished from ownership of credits arising from plantation forests.

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