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Tackling greenhouse emissions from forestry & agriculture: what can we learn from New Zealand?*

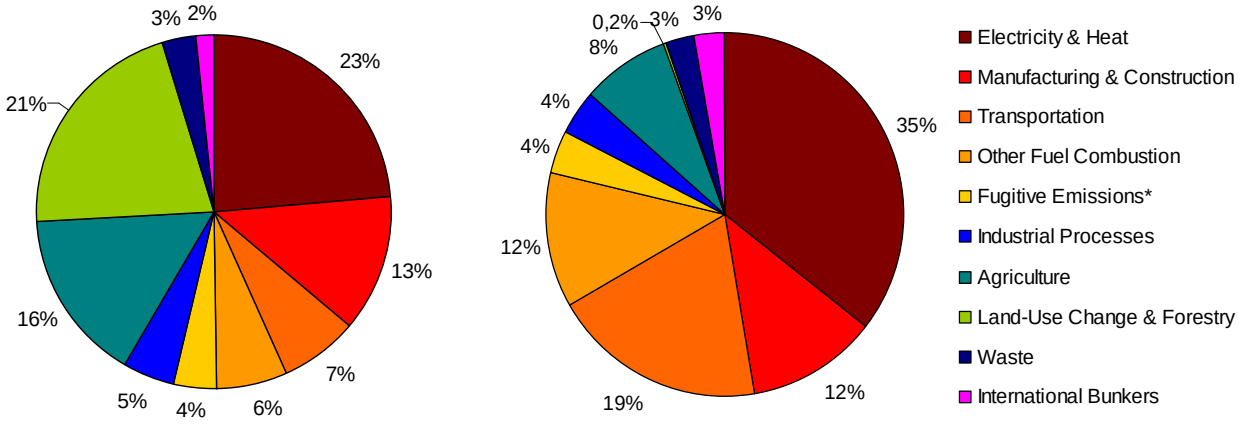
The combined emissions of the agriculture and forestry sectors make up about 25% of global greenhouse gas emissions. However their mitigation potential remains largely untapped. In this context, New Zealand is a valuable case study. Since it has high quality institutions but a "developing country" emissions profile, New Zealand is exploring innovative ways of constructing carbon markets for these tricky sectors.

Background: the big challenge of tackling GHG emissions in the forestry and agriculture sectors

Untapped mitigation potential & institutional challenges

Tackling greenhouse gas emissions from agriculture and forestry is a major global challenge. Globally, emissions from agriculture (13.8%) and land-use change and forestry (12.2 %) account for around 25% of all anthropogenic greenhouse emissions (WRI CAIT, 2010). But despite high and rising emissions levels, the mitigation potential of these activities remains relatively untapped compared to other sectors. For example, agriculture and forestry are not presently covered by the European Union Emissions Trading Scheme (EU ETS), which covers industrial and energy emissions in 30 European countries. Agriculture and forestry projects also make up less than 1% of emissions reductions currently expected from the offset mechanisms of the Kyoto Protocol, namely the Clean Development Mechanism and Joint Implementation (UNEP Risoe, 10-2010).

Figure 1. Emissions sources in developed (Annex I) vs. developing (non-Annex I) countries



Non-Annex I countries **Annex I countries** WRI CAIT 2006 data, * = N2O missing

This result is largely due to practical challenges posed by the specific nature of these sectors in terms of regulating emissions. For example, agriculture and forestry can be tricky to treat with economic instruments like other sectors because emissions can come from multiple small sources. This poses significant monitoring, reporting and verification (MRV) challenges.

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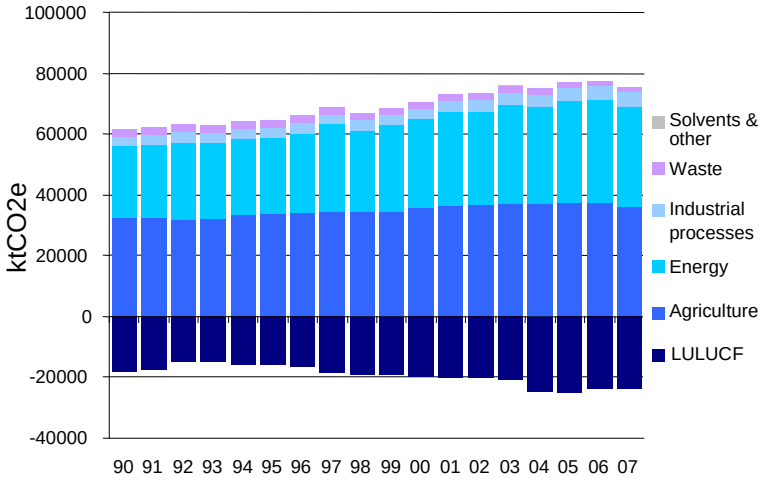
There are also greater scientific uncertainties in measuring emissions reductions in these sectors. Moreover, the question of the permanence of carbon sequestration in forests and soils is a critical credibility issue for any market-based mechanism. Meeting such challenges requires a certain degree of policy innovation and strong regulatory institutions. However it is precisely that which can be lacking in developing countries, where emissions from agriculture and deforestation are rising the fastest.

Why the New Zealand example is important

New Zealand is an interesting and potentially very valuable case study for policy makers in other nations because it is a developed country, with strong governmental institutions, yet it has an emissions profile similar to a developing country. For example, 50% of its annual emissions come from the country's proportionally large agriculture sector. Further, New Zealand currently offsets around 25% of its total annual emissions with net reductions from changes in land use, land use change and forestry practices (labelled "LULUCF" in the figure below). This latter figure is mostly due to afforestation, i.e. the planting of new forests.

Figure 2. New Zealand's emissions profile



New Zealand has thus become the site of innovative and valuable policy experiments regarding these two sectors and a possible model for developing countries to aspire to emulate as their institutional capacity develops. Indeed, if its policies are successful, then New Zealand could provide useful models for others to emulate.

Data source: New Zealand National GHG Inventory 2007

Innovative Economic Tools for Forest Carbon in New Zealand

The New Zealand Emissions Trading Scheme & Permanent Forest Sink Initiative

To provide economic incentives for domestic emitters to reduce emissions, the New Zealand Government launched a greenhouse gas emissions trading scheme in 2008: the New Zealand Emissions Trading Scheme (NZ ETS). Similar to other emissions trading markets, the NZ ETS places obligations on certain sectors, e.g. stationary energy, transport fuels, industrial processes, etc, to buy allowances to be entitled to emit greenhouse gases.

However, the NZ ETS is highly innovative in so far as it is the first emissions trading market in the world to try to include the forestry and agriculture sectors directly under the scheme. The intention is to extend economic incentives to reduce emissions and sequester carbon to these activities. Thus, a large portion of New Zealand's deforestation and afforestation (planting of new forests) activities began being covered by the NZ ETS on 1st January 2008.

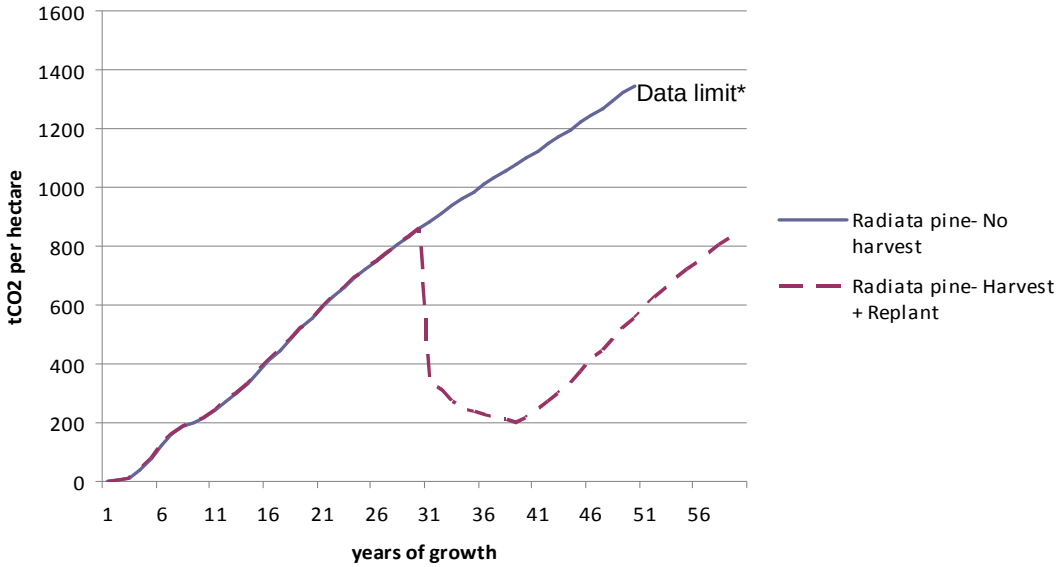
In addition, the Permanent Forestry Sink Initiative (PFSI) is another market-based mechanism which the New Zealand Government introduced prior to the NZ ETS. Like the NZ ETS, the PFSI offers land owners a chance to reap economic value from storing carbon in forests by planting new, permanent forests. As its name implies, the PFSI attempts to address the question of the long term "permanence" of forest carbon stocks in a different and arguably stricter way than the NZ ETS because permanence is a key issue for market-based mechanisms to enhance forest carbon stocks (further explained shortly).

How do economic incentives to store CO_2 in new forests work in New Zealand?

This question is best answered with the help of an example. Thus, figure 3 gives an illustration of a New Zealand (Gisborne) radiata pine afforestation plantation. Assume that it is planted after 1989[1] and grown for harvesting under the NZ ETS or PFSI. Under the rules of the NZ ETS or PFSI, the forest owner can earn government-approved carbon credits for all of the CO_2 sequestration that occurred in this forest since 1 January 2008. The cumulative amount of carbon and therefore credits which could be earned per hectare as the forest grows is represented by the blue and dotted purple lines in the figure[2].

The credits earned can be monetised by being sold on the carbon market to buyers who want them as "emissions offsets" to comply with their own emissions limits under either the NZ ETS or the Kyoto Protocol. For example, these buyers could be other participants in the energy or industrial processes sectors covered by the NZ ETS, and who must therefore buy allowances (called "New Zealand Units" or "NZUs") to be legally allowed to emit[3]. Alternatively, the buyer could be an overseas "Annex I" country under the Kyoto Protocol looking to buy units to comply with its own international obligations under that treaty. Either way, by rewarding planters of new forests with the right to earn and profit from selling carbon credits, the NZ ETS and PFSI create economic incentives to plant new forests and hence store more carbon.

Figure 3. Carbon credits and obligations for post-1989 NZ ETS forests



Data: Carbon Volumes from NZ Ministry of Agriculture & Forestry Look-Up Tables in Regulations: Schedule 6, 2010
*data on carbon stock growth after 50 years is not available

What happens if forests are cut down or destroyed?

This question goes to the heart of why market based mechanisms for forest carbon are considered challenging to implement robustly. After all, if forest carbon can be used to earn marketable carbon credits and sold, how does one ensure that the carbon stays stored in the forest? This is often referred to as the "permanence" issue and it helps explain why potential buyers and sellers of carbon credits have shied away from forest carbon offsets under the Clean Development Mechanism.

The solution adopted in New Zealand is that under both the NZ ETS and PFSI land-owners face mandatory carbon liabilities if forests are deforested or otherwise destroyed. This therefore provides incentives to avoid deforesting existing forests. The rules also ensure that

[1] The rules for accounting for emissions from forests planted before 1990 and after 1989 are different under the Kyoto Protocol and hence this is also reflected in the rules of the NZ ETS and PFSI.

[2] However, in the case of harvesting, note that, unlike in the graphic, all carbon is assumed to be released, while the graphic represents the actual fact that some is still stored in the soil, roots, etc.

[3] The current price of an NZU (which is an allowance to emit 1 tonne of CO_2e) is around 18 NZD or 9 EUR.

owners of new forests which have earned carbon credits are forced to pay back the credits that they have earned if they subsequently cut down their forests.

However, the rules are actually quite different under the NZ ETS and PFSI.

Under the NZ ETS, harvesting of pre-1990 forests must legally be accompanied by the forest owner buying and surrendering an equivalent amount of NZUs to the Government for the associated emissions resulting from the harvesting of the forest. Also, owners of post-1989 forests – i.e. those who can earn carbon credits from the growth of their forests – must surrender an equivalent amount of carbon credits for cutting down forests on which they have already earned NZUs. Thus, in figure 3, if the forest owner had earned over 800 NZUs per hectare for the forest and then harvested it, he would have to surrender all 800+ NZUs per hectare of what he had harvested, even though some carbon remains in the soil, as shown in figure 3. Also, if the forest re-grows, the forest owner will once again be allowed earn NZUs for the new carbon is stored in the regrown forest.

Under the PFSI, however, once a forest has entered into the "system" and started earning credits, a covenant is signed between the Crown and land owner which ensures restrictions on harvesting for 99 years. To ensure collateral, this covenant is registered against the land title. This covenant thus gives the public authority significant powers for enforcement, including the right to enter the land to plant out the forest sink area (e.g. in the event the forest sink is not maintained). In reality many PFSI participants will not contemplate harvesting and will be motivated to maintain fully stocked stands so as to maximise sequestration and storage of carbon. Forests grown for conservation, biodiversity, and recreational purposes may be better suited to be registered under the PFSI than the NZ ETS.

Monitoring, Reporting and Verification (MRV)

Another of the great challenges seen by policy makers as a barrier to market-based measures for forest carbon is the perceived difficulties associated with measurement and enforcement in this sector. Emissions are potentially diffuse and precise measurement of carbon in different forest stands is potentially costly. New Zealand is trying to solve these problems as follows:

To keep track of changes in forested land participating in the NZ ETS, the New Zealand Ministry of Agriculture and Forestry (MAF) has developed a specialised mapping tool. It consists of satellite and high definition aerial photographic data forming part of an interactive interface which forest owners are required to use to submit their emissions returns. The online mapping tool requires forest owners to digitally map out the boundaries and characteristics (e.g. pre-1990 or post-1989, forest species, age, etc) of their different forest types using MAF's base imagery. This reporting and the underlying imagery is then tracked by MAF to verify that no anomalies occur between what is reported in the forest owners emissions returns and what is actually visible in the underlying satellite and photographic imagery.

In addition, a series of "Look-Up" tables has been developed which facilitates the cost-effective estimation of forest stocks in small stands, while larger stands will be able to use more precise measurement approaches, since the costs of error can be materially larger for larger stands.

Early evidence

Early market activity, registrations for forestry offset credits, survey evidence and recent land use changes in New Zealand, together provide early circumstantial evidence that the domestic carbon price signals delivered by both schemes appear to be having some incentivising effects in the forestry sector, although it is still too early in the learning phase with this new policy to judge the scheme's success definitively (Sartor et al, 2010).

New Zealand's approach to agriculture emissions: bringing farmers to the carbon market

Including agriculture emissions in an emissions trading scheme would also be a world's first, and New Zealand is attempting to do that, too. Like forestry, implementing market based mechanisms for agriculture emissions involves significant challenges, especially regarding measurement uncertainty, monitoring many diffuse emissions sources – not to mention gaining political acceptability. However, plans for agriculture's inclusion in the NZ ETS continue to develop. These developments are also of interest as they provide insights into the possible solutions to these challenges.

If agriculture joins the New Zealand Emissions Trading Scheme…

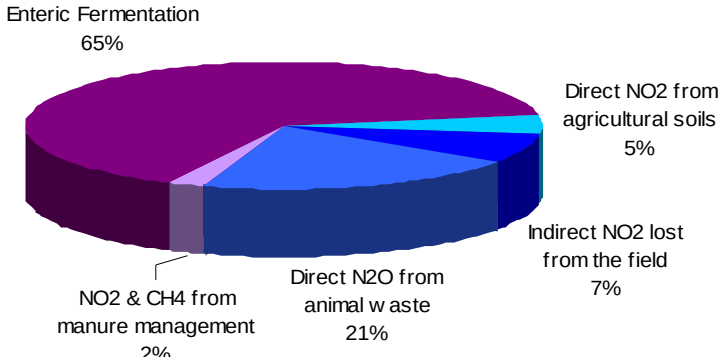
Which emissions sources?

There are two main greenhouse gases which are a problem in agriculture and they are emitted into the atmosphere by several different agricultural activities. In general, agriculture emissions consist of:

- methane (CH_4) emissions from the metabolic processes of livestock ("enteric fermentation")
- nitrous oxide (N_2O) emissions from interactions of animal livestock waste and nitrogen-based fertiliser use with the soil, and

Assuming agriculture activities do enter the NZ ETS in January 2015, the NZ ETS would attach an explicit economic cost of emitting to the vast majority of New Zealand's agricultural emissions (see Figure 4). Also, the sector will have mandatory emissions reporting obligations for these two broad categories of emissions from January 2012.

Figure 4. Breakdown of NZ's agriculture emissions



Source: MAF, NZ National Greenhouse Inventory 2007

Who would face obligations?

To avoid the Government needing to monitor and verify emissions on tens of thousands of individual farms in New Zealand, the scheme would apply obligations for emissions at a more aggregated level of the supply chain. Thus, food processors and producers would be liable for emissions from livestock used for either slaughter, held for live animal exporting or trade, or for the sale of animal materials (such as the production of dairy, eggs, wool, etc). The obligations of the food processors would take into account, through simple calculative formulas, the associated greenhouse emissions from enteric fermentation and manure deposits during the lives of the animals used to produce the food in question. Also, to attach an economic cost on fertiliser emissions, fertiliser producers would also face obligations to purchase emissions allowances for the N_2O emissions that are expected to arise from the use of the fertiliser they sell.

How effective will be the incentives to reduce emissions?

Including agriculture emissions in the NZ ETS would mean that animal product processors and producers would have to pay for the emissions associated with the agricultural products they sell by buying emissions allowances on the NZ carbon market. This means that they would pass on the cost of emissions allowances to farmers. They would do so via the price they offer farmers for their products (for fertiliser sales) and in the price they are willing to buy livestock meat, dairy products, etc, from farmers (for livestock emissions). The pass-through of the emissions cost to farmers should create concrete commercial incentives for farmers to reduce emissions by:

- Reversing/slowing the rate of conversion of forest land to other types of farm production
- Changing the type and intensity of agricultural production
- Changing on-farm practices in ways that reduce emissions

The extent to which the NZ ETS would create incentives to reduce emissions in each of these 3 broad ways would depend on several factors. First of all, it would depend on the strength of the emissions allowance prices in the NZ carbon market. Secondly, it depends on the extent to which the rules regarding emissions reporting and verification can allow individual farmers' on-farm activities which reduce emissions to be factored into the obligations which participants face under the scheme. In fact, there is an ongoing investigation in New Zealand into options to devolve obligations directly to certain farmers to allow them to take on-farm practices, soil types, etc, into account in order to make the scheme more effective. Finally, the effectiveness of the ETS for agriculture would depend on the extent to which farmers can be educated and persuaded to change their practices and attitudes to the scheme in general.

The learning continues…

Preliminary lessons from the New Zealand experience show that the difficult challenges centre on the desire to allow for farm-level obligations to improve efficiency and make use of available abatement technologies, but to also ensure a stable and reliable monitoring, reporting and verification (MRV) framework. Given New Zealand's strong and transparent institutions, and the rate of development of measurement science, a robust and cost-effective MRV system which would allow recognition of additional farm-level abatement could soon become possible – at least partially (e.g. soil type and perhaps verifiable manure management system changes). Offering farms a choice between complex and simple emissions reporting options will need to be carefully managed to limit perverse incentives (see Sartor et al, 2010). In addition, the political viability of including New Zealand's historically sceptical agricultural sector under emissions pricing by the scheduled 2015 start date remains an open question. Policy makers in other countries with significant agriculture emissions would do well to pay attention to New Zealand's brave and important experiment.

To find out more…

CDC Climat Research Reports

- Sartor, O., Deheza, M., Belton, M., (2010): **"Good Shepherd or Black Sheep? Tackling forestry and agriculture in New Zealand's new carbon market"**, CDC Climat Research, Climate Report No. 26. Available at: http://www.cdcclimat.com/

Further Resources

- Karpas, E., Kerr, S., (2010): "Preliminary Evidence on Responses to the Forestry ETS", Motu Economic and Public Policy Research, Working Paper: http://www.motu.org.nz/publications/
- New Zealand Ministry of Agriculture and Forestry Agriculture Technical Advisory Group, (2009): "Point of obligation designs and allocation methodologies for agriculture and the New Zealand Emissions Trading Scheme", 2009. Available on Ministry website: http://www.maf.govt.nz/
- New Zealand Ministry of Agriculture and Forestry, (2010): "An introduction to forestry in the ETS": http://www.maf.govt.nz/sustainable-forestry/2010-introduction-to-foresry-in-ets.pdf
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- New Zealand Ministry for the Environment, MfE (2007): "New Zealand's Fourth National Communication under the UNFCCC": http://www.mfe.govt.nz/publications/climate/
- UNEP Risoe: http://cdmpipeline.org/
- World Resources Institute, Climate Analysis Indicators Tool (WRI CAIT): http://www.wri.org/project/cait