Land use, land use change and forestry (LULUCF) - a decision support tool for hill country farmers and forestry investors

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1. Introduction

New Zealand has significant climate change mitigation potential through afforestation. Carbon pricing will create a business opportunity for land owners and forestry investors. On the basis of a case study, we developed a decision support tool (DST) that can be used to assist:

- land purchase and land allocation decisions
- forest composition and management choices
- choice of carbon programme

Our work has also led to a number of more general conclusions concerning directions for land use, land use change and forestry (LULUCF) in New Zealand.

Fieldwork for our study took place over the period January-July 2008. We interacted with 3 regional councils: Greater Wellington; Horizons (Manawatu-Wanganui) and Hawke's Bay. We had meetings with land owners and developed the DST with reference to a particular hill farm property, East of Dannevirke.

The allocation of land between the competing uses of livestock farming and forestry is something of a perennial question. The “right” answer depends on the Nation's priorities of the time. For example, land settlement goals were in ascendency when soldiers returned from World Wars I & II. As a result, institutional and legislative settings favoured land development for livestock farming. Control of soil erosion within some of these same landscapes became central in the 1980's. Regional councils have continued to progress a broadened soil erosion and water quality agenda under the Resource Management Act 1991. Climate change has now become a priority, tipping the balance to afforestation because forest land has a greater carbon density than grassland.

Much of the sediment discharged from a hill farm during storm events comes from localized trouble spots. Horizon's http://horizons.govt.nz sustainable land use initiative is predicated on it being possible to afforest the “worst” 10-15% fraction of a hill farm with no significant impact on livestock production. A well-designed programme of afforestation can achieve substantial community water and soil benefit at negligible cost to the farm business. We refer to this kind of forestry as “strategic afforestation” distinguishing it from “plantation forestry” which is a stand alone tree growing business with no associated livestock.

Regional councils have a great deal of experience in strategic afforestation. Asset value impacts are not a concern because land is not being bought or sold. At the opposite end of the forest scale continuum, forestry companies have their own investment models to analyse the complexities of land purchase and carbon policy. Our case study property is representative of an in-between situation: the suggested area of forest is 155 hectares (60% of the farm). The forest is too small to be of interest to plantation foresters yet too large for do-it-yourself farmer management assisted by soil conservation grants. The farm is already marginally small to support a farming family. If the suggested forestry programme was to go ahead, the residual farm would probably become a lifestyle block. The farmer faces some hard choices.

We suggest our case study situation will not be uncommon in the hill country over the next 5-10 years. Is “downsizing” the farm businesses in favour of forestry profitable? We argue that carbon pricing will result in a new wave of afforestation but “new forests” may be quite different to those planted in previous waves of expansion since harvesting considerations are no longer paramount. Land values, however, will slow investor response in the short term.

Rephrasing, given reward for carbon, under what circumstances will forestry now be more profitable than the existing land use, sheep and beef farming? A priori such an analysis depends on: forest establishment and management costs; commodity prices: sheep, beef, logs; carbon; and the opportunity cost of the land. A second set of questions revolve around the kind of forestry that might be best-suited to particular situations.

1.1. Carbon programmes including emissions trading

We presume readers are broadly familiar with New Zealand’s Kyoto land use land use change and forestry (LULUCF) policies.
The Ministry of Agriculture and Forestry’s website: http://www.maf.govt.nz/sustainable-forestry/ describes

- The Afforestation Grant Scheme (AGS)
- The East Coast Forestry Project
- The Permanent Forest Sinks Initiative

The website deals with the Emissions Trading Scheme (ETS) separately. Linked documents include:

- A Guide to Forestry in the Emissions Trading Scheme,
- Draft Forestry Allocation Plan.

At the time of writing, the ETS legislation (the Climate Change Response Act 2002) is under select committee review:


Our case study afforestation proposal would create a “post-1989 forest”. We assume entry to the ETS but our DST can also be used to explore the economics of the AGS; or a beginning with the AGS and cross-over to ETS after 10 years. Concerning choice of programme, we expect that for small-scale plantings, and depending on the bid amount, the AGS is to be preferred because of transaction cost considerations, whereas for the larger-scale plantings such as the case study farm, and again depending on the carbon price, the ETS is likely to be the better opportunity.

2. Decision Support Tool Description

The Decision Support Tool (DST) is a spreadsheet based tool, built within a workbook containing an instruction sheet (the first sheet), the DST (the second sheet) and several other sheets used to calculate the outputs given several inputs, including some which appear in the DST. The DST allows users to see the effects of critical variables on the viability of a carbon forestry enterprise, according to certain indicators (outputs), and determined by a range of input variables which the user can alter.

The DST can be downloaded from www.nzcee.org.nz and was developed by Charles Chrystall ChrystallC@landcareresearch.co.nz

DST outputs are: Land Expectation Value (LEV) per hectare; Internal Rate of Return (IRR); maximum debt; payback period, and a graph of net income flow. Outputs are given for one livestock farming scenario, and three carbon forestry scenarios: the ETS (scenario 1), the AGS (scenario 2) and the situation where AGS is taken to begin with but then transfer to the ETS is made after year 10 (scenario 3). LEV per hectare is given for the livestock scenario and all three forestry scenarios. The net income flow graph shows both the ETS and AGS situation, and by following the AGS line for 10 years and then following the ETS line thereafter it also shows the third scenario. Maximum debt and payback period are given for ETS and AGS, with scenario three’s situation corresponding to that of AGS regardless of inputs. IRR is given for ETS, and simply doesn’t make sense with a grant (scenarios 2 and 3) as no discount rate will bring the NPV to zero. IRR, maximum debt, and payback period are not relevant for the livestock farming scenario, as the DST is intended to analyse land-use change to forestry where livestock farming is currently the status quo.

DST inputs include management costs, carbon price, net stumpages, the afforestation grant, soil and water grant. A range of discount rates can be inputted to allow simultaneous comparison of LEVs.

With relevance to the case study farm, income to the forestry enterprise comprises of net carbon income (carbon price is considered net of audit costs), net stumpage income (net of harvest costs), the afforestation grant income (for scenarios 2 and 3), and possibly a soil and water grant. Carbon income for each year equals net carbon price multiplied by sequestered carbon. Costs to the enterprise comprise of fencing, weed suppression, planting and releasing, pruning (3 prunes), thinning, management, rates, pest control, insurance/protection, maintenance, and administration.

3. Discussion

3.1. A relatively biodiverse forest

Our DST allows users to ‘design a forest’. The composition decision requires consideration of the physical characteristics of the site particularly in relation to harvesting; the capabilities of the forest manager; the carbon sequestration characteristics of particular species; their compatibility within the context of the forest as a whole; and consideration of financial risk, including the desirability of having more than one income stream (logs and carbon), and more than one market.

For the case study property:

- Where harvesting is feasible, on south-facing sites we recommend Cupressus lusitanica (intended for local markets) and on all other sites, Pinus radiata (intended for export). We recommend exotics for harvest for 40% of the site.
- Where harvesting is not feasible, we suggest Pinus radiata and Eucalyptus fastigata mixes as a nurse crop for an eventual return to indigenous forest. We recommend (exotic) nurse-for-indigenous for 34% of the site.
- Where harvesting is not feasible and indigenous scrub species are already present, we suggest the forest manager simply encourages the transition that is already
Land-use change occurring. We recommend indigenous direct for 26% of the site.

Figure 1 shows carbon stock change on the site. The pattern is in marked contrast to the saw tooth characteristic of stand level production species. While there is a dip in total stock when the radiata component is harvested at around year 30, it is short-lived. Total carbon stock continues to climb to year 50 due to the nurse crop and indigenous component.

Our nurse crop recommendation could be contentious. One view is that “plant and leave” regimes are not sustainable. The counter-view is that planting trees for harvest on a site where access problems are so readily apparent simply sets up for future problems. In this sense, reward for carbon can be seen as creating a fundamentally new business opportunity.

3.2. ETS afforestation looks profitable

Recapping, our starting point was that prior to New Zealand’s signing of Kyoto, the public policy “driver” for afforestation of the hill country was soil conservation and water quality protection. Institutional and legislative arrangements involve the regional councils and the Resource Management Act 1991. In the Horizons region in particular, the “pitch” to land owners has been that “strategic afforestation” of, say 10-15% of a farm is a win-win proposition. On areas identified on a farm plan, forestry is at least as profitable as grazing and also delivers significant off-site benefit.

Carbon pricing strengthens the strategic afforestation proposition. Forestry should now be the preferred land use on a greater proportion of the farm. For our case study farm, and assuming a carbon price of only $20 per tonne, the forest is a financially attractive investment for 60% of the property. Harvesting cost and feasibility is no longer the dominant consideration. Good money can be made from trees that will never be harvested.

Our net income forecast shows that assuming entry to the ETS and sale of units as they are accrued, the project breaks even at year 7. The DST shows a capital requirement of less than $950/ha. Unusually for a forestry investment, profitability is not particularly sensitive to the discount rate assumption.

The 3 income peaks shown in the graph are generated by log sales. As with any other forestry investment, there is significant uncertainty around future log prices and the DST provides for users to make their own assumptions. There is a local sawmill near the case study property. With respect to carbon, the period that is critical to the result is 2012-2020 when sequestration is at a maximum. Carbon prices during the period to 2012 (CP1), when the ETS is presumed to be settling in, have a relatively small impact on net present value.

3.3. Ownership and management considerations

The forest we propose for the case study property is large by farm forestry standards and relatively complex in structure. It is not a feasible undertaking for a first-
time farmer-grower. Possible management arrangements include:

- A joint venture (JV) with an experienced forest manager
- Land purchase of the whole farm by a forest trust with subsequent subdivision and resale of areas better suited to agriculture.

Financial arrangements within a JV are a matter for negotiation between the land owner and the forest investor. We developed a version of the DST to explore a two part payment:

- An annual rental paid by the investor to the land owner calculated on the basis of the number of livestock displaced and a market-derived per stock unit agistment figure (example: 850 su*12 = $10,200), reviewed 5-yearly.
- A share of the carbon credits (example: 20% of the units)

This kind of approach should be attractive to the landowner since, if farmland becomes more valuable because food commodity prices increase in real terms, other things being equal, the rental will increase.

A forest of this size might not attract commercially-minded investors in any event because management cost per hectare could be relatively high. We do not know the extent that forest management costs are non-linear. We observe that NZ has few intermediate sized plantation forests and plenty of lifestyle blocks, and take this as evidence that there are economies of scale in forestry operations, and to the extent there are diseconomies of the livestock side of the farm business, land owners are prepared to absorb these.

On neighbouring farms, there is other land similarly suitable for afforestation. A total forest size of 1000 hectares might be attainable through land swaps and land purchase. The larger forest would improve the long-term sustainability of both the forestry (a greater % would be harvestable) and the farming (better quality land).

3.4. Policy risk

The possibility of policy change is a risk to long term investments such as forestry. A not-for-harvest forest has minimal economic value unless there is a carbon market. The nature of the post-2012 international agreement, and subsequent agreements, and the consequence for our domestic policy settings, is likewise uncertain.

Transaction costs are an additional consideration. The demand side of the NZ market will be made of large emitters. The parcels of units that would flow from a 155 hectare forest are small in comparison. We assume a net $20 carbon price and have not estimated the brokerage costs that might be involved in aggregating to a quantity of units that would of interest to a buyer.

3.5. Land prices

The strategic afforestation proposition (10-15% of farm) sidesteps the question of the asset value impacts since land is not being bought or sold. The following graph shows recent trends in farm prices and farm incomes. Since the 1990’s, when rates of afforestation were last “high”, land values have increased 4-5 fold. Over the past 5 years the increase in land values has not been matched by increased returns from sheep and beef farming. Why are farmers apparently willing to accept declining rates of return on the land asset? A possible explanation is the expansion of the dairy industry has had spill-over effects to the hill country. Excess liquidity has generated a bubble in land prices.

At some unknown set of land and commodity prices, forestry investors will again purchase farm properties. For the forest investor, land is “just another cost”. Notwithstanding recent experience of the conversion of forest land to dairying and intensive sheep and beef farming in the Central North Island and Canterbury, historically, land use change from planted forest back to farmland has been rare. Conversion back to farmland can typically only be considered at the end of the rotation. Carbon pricing introduces a further reason why a forestry investor is unlikely to change land use. It makes no sense for the forest investor to pay for land on the basis of what it might earn in some future more intensive land use if ETS carbon liability would make such a conversion prohibitively expensive.

To the extent a correction in land values may be occurring at the present time, there is no early mover advantage for would-be forestry investors. Decisions to be taken concerning the domestic policy for agricultural emissions could result in further downward pressure on land prices. Additionally, it is as yet unclear the price of carbon that will be delivered by the ETS.
4. **Business as usual or a new kind of forestry?**

Climate change policy makers see afforestation as a “mid-price range” climate change mitigation option. On a per tonne of carbon basis, some energy efficiency actions should be cheaper. On the other hand, mitigation in agriculture is generally expected to be more expensive. Policy makers’ expectation is that: New Zealand will have an ETS; it will include LULUCF; and the market will generate a carbon price in the $20-$50 range. In recent years, rates of afforestation have been low because of unfavourable log prices and a bubble in the rural land prices. Land prices are now softening and may come back further as agriculture begins to face a cost of carbon.

As land prices decline, and the ETS becomes operational, we expect a new wave of afforestation. We argue that “new forests” will be different to earlier waves of afforestation reflecting the type of land likely to become available and that trees need no longer be harvested to contribute to cash flow. Compared to afforestation of the late 1980’s and early 1990’s, we forecast relatively small individual forests with a relatively low % harvestable and a significant indigenous component in the mix. For such a forest, our case study shows that the present value (PV) of the income stream from (forest) carbon over a 50-year period is significantly larger that the PV of the income from log sales.

We have presented our arguments to two groups expert in land use. Three areas of risk were identified (our responses in italics):

- **Risk 1:** “New forests” could become a liability in the long term once carbon income has ceased.
  - Forest managers should certainly plan for an eventual transition. Critical mass needed to ensure sophisticated management of the carbon and log harvest income streams, to enable land purchase, amalgamation subdivision, and the eventual transition to permanent forest. A portfolio of upwards of 10,000 hectares may be necessary. A Trust ownership vehicle has advantages http://www.reforest.org.nz

- **Risk 2:** The carbon income stream is highly uncertain.
  - There is no reason to think that carbon prices will be any more variable than log prices. We certainly need reconfirmation of the ETS and confidence in the policy settings beyond 2012. Carbon prices might well be volatile in the short term but provided there is scale, the price risk can be managed through a portfolio approach. A futures instrument can reduce the capital requirements for afforestation http://www.reforest.org.nz

- **Risk 3:** Separate top-up payments will needed for other land use change externalities such as water quality (sediment), nitrogen loading; and biodiversity.
  - Difficult sites such as the case study situation might well merit additional support from the regional council and Horizons has indicated it is prepared to consider involvement for sediment control reasons. A case by case approach is needed. The Lake Taupo Protection Trust provides such a model for nitrogen pollution. http://www.laketaupoprotecttrust.org.nz

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