

# Integrated Economics of Climate Change: Annual Update 2009/10

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This research programme was created with three inter-related objectives: analyse policy options; enhance climate modelling capacity and simulate policy scenarios. We are well on the path to achieving these and contributing to our intermediate outcome: that government will reduce New Zealand's vulnerability to climate change by confidently implementing adaptation and mitigation policies in a more informed policy environment. This year we have discussed our work with thirteen user groups including New Zealand government officials, industry representatives, non-profit groups, international policy makers and international scientists. We have published 8 pieces of written work including commissioned reports, a peer reviewed article, a book and a book chapter. We have achieved this despite our lead researcher, Suzi Kerr, taking a year of absence to teach environmental economics at Stanford University. We have therefore under-spent our grant this year and will use some of the saved funds for extra work in the remaining 16 months of the contract. We will also be able to draw on the new contacts, development of courses and graduate student advisees that have come out of her visit to extend and enrich our programme.

## 1. Analyse policy options

This year (1 July 2010) we have seen the implementation of the second stage of the emissions trading system (ETS) which now covers all major sectors other than agriculture. This research programme played a significant role in developing policy options, facilitating empirical modelling of impacts, providing technical input to contentious discussions on allocation, 'translating' technical material for those directly involved in the political process and facilitating dialogue. The second phase of implementation of the scheme ends one phase of our mitigation research with respect to the forestry, liquid fuels, stationary energy and industrial emissions sectors – we will now move into evaluation of the policy's effectiveness as well as research that will contribute to the first review of the system and policies complementary to the ETS. Some problems may arise with specific aspects of the regulation (especially the price cap without limitations on banking, and the very high levels of free allocation over a long time frame). We expect these to prompt demand for more policy input based on our research. We are also receiving increasing interest in work on New Zealand's experience with emissions trading from international policy makers particularly in Australia but also as far afield as the US, Italy, France and Brazil.

Our other major next step is providing input for deeper thinking on agricultural emissions both in order to clarify our understanding of what would be efficient in this sector and also to understand how policy could be designed to achieve a transition to an agricultural sector whose actions and investments fully reflect their greenhouse gas implications without under cost to individuals or communities. We have begun an associated 'Sustainable Land Management and Climate Change' (SLMACC) grant to develop thinking on how to enhance cooperation, to run a dialogue within the agricultural sector (involving farmers and those with a rural community perspective as well as technical specialists) and also develop tools for

effective communication in this area. This dialogue and communication effort will complement our ongoing technical work.

## 2. Enhance climate modelling capacity

Developing modelling capacity and the capacity of end users to interpret modelling results appropriately has been a major focus of our research effort to date. We were involved this year with CGE modelling, partial equilibrium land use modelling, and electricity sector modelling.

Our role in CGE modelling has been primarily as a facilitator, providing data that can be shared across models (such as the new input-output data for CGE modelling developed by Adolf Stroombergen and now used by all major models, or the land valuation data that Waikato, Landcare Research and Motu modellers all use), and encouraging collaborative modelling efforts and model inter-comparisons rather than competition between modellers. This year we have also developed a new set of general equilibrium analyses of mitigation scenarios. A long term effort, heavily in collaboration with Suzie Greenhalgh at Landcare Research has this year flowered in the creation of a new funded cross institution modelling team and also a Computable General Equilibrium (CGE) group organised by the New Zealand Association of Economists. This will allow us to reduce Motu's own efforts in this area so we can concentrate more on empirical understanding of land-use change and micro-simulation of policy. To this end, jointly with GNS, we have hired a new post-doctoral environmental economist (Levi Timar) with econometric skills that are rare in this field in New Zealand. Through his association with GNS, Levi will also be well placed to provide economic input on climate adaptation.

This year we have formally contracted five subcontractors, have worked on a GNS-led contract and have actively interacted with Landcare Research and MAF research staff. Within New Zealand we have been involved in the supervision of one PhD and two Masters' theses and have employed a student intern. Motu's core partial equilibrium land use model – Land Use in Rural New Zealand (LURNZ) is now recoded, upgraded and updated with a nearly complete set of new documentation. The new version is more robust, has greater spatial accuracy and explicit modelling of uncertainty and is more user friendly. MAF have implemented LURNZ in-house and we are having regular meetings with them as we develop it. The strength of the model is the richness of the data incorporated, the open source code and data (where not limited by others' confidentiality restrictions), and the careful documentation. It is not a projection tool but rather a tool for exploring the implications of different policy options or future scenarios. It produces a series of maps of land use change, emissions, and impacts on profitability as well as aggregate results.

Our LURNZ modelling focus this year has been on forestry. Forestry is a key area for response to the emissions trading system (the potential for sequestration is high) but there are some outstanding puzzles about human behaviour in this area. In particular forestry appears to respond slowly to profitability signals. The area of land in forestry is low when you consider its long-run profitability relative to the low levels of sheep/beef profitability on potential forestry land. Understanding forestry is also important in understanding how agriculture could respond to the cost of greenhouse gas emissions because they compete for land and because many farmers could offset their profit losses from emissions reduction by gaining credits for carbon sequestration. David Evison (Canterbury) has helped us create a

panel of data on forestry profitability. We have used work done for us last year by Tom Adams (Scion) – spatial mapping of forest age classes - to enable modelling of the evolution of land use (as forests are harvested) and spatial emissions and removals (and hence forestry credits and liabilities). Gabriel Fiuza, Lew Evans, Graham Guthrie have completed work on the effect of uncertainty and option values in forests. The fundamental puzzle is still unresolved but many more building blocks are now available.

Lew Evans has led a group at Victoria University who have built an option pricing model of electricity markets which will help interpret the impacts of the ETS on electricity prices and predict the impacts of climate change on electricity markets. It is derived using common finance technology: e.g. a diffusion process, and embedding of the delay option inherent in managing water where there is storage. It now includes choice between 'fuels': gas and water. Work has been continuing on the real option modelling of forward electricity prices. That work is progressing with some empirical work on the near horizon. It is a difficult economic problem, as was anticipated. The effect of climate change as it affects water availability and greenhouse gas emission mitigation policies relating to taxes/subsidies on fuels, on the production and price of electricity, and the volatility of these, have been examined within the context of the model described above. In that model, changes in the volatility, rate of mean reversion and average inflow have been explored, as has the effect of carbon prices. The focus has been on the implications of the effects for the performance of the electricity market, including the consumption of thermal fuel and spilling. Key scenarios are provided in the papers described above, and the model can be used to explore others. The approach compares these findings under competitive and monopoly markets.

### 3. Simulate Policy Scenarios

As well as modelling discussed above, we have produced two reports on impacts of climate change on agriculture. Both confirm that the most important effects of climate change on New Zealand are likely to be through trade not direct. Similarly land use change is likely to be a larger driver of pastoral production than climate change. A separate report by Adolf Stroombergen suggests potentially large effects on NZ because of the global effect of climate change transmitted through trade. These are likely to be positive according to the global models used but current global models have some significant shortcomings so these results are unlikely to be robust.

## 09/10 Outputs

### **Peer reviewed journal articles, books and book chapters**

- Betz, Regina, Stefan Seifert, Peter Cramton and Suzi Kerr. 'Auctioning greenhouse gas emissions permits in Australia' Australian Journal of Agricultural and Resource Economics, forthcoming.
- Meade, Richard, Glenn Boyle, Lewis Evans, Gabriela Fiuza and Andrea Lu. 2009. 'Forest Valuation under Carbon Pricing: A Real Options Approach,' VDM Verlag. ISBN 978-3-639-16124-3.
- Hendy, Joanna, Suzi Kerr and Troy Baisden. 2008. "Greenhouse Gas Emissions Charges and Credits on Agricultural Land: What can a Model Tell Us?" in Clean Development Mechanism and Law, Amicus Books series, ed. L Lakshmi. Hyderabad, India: The Icfai University Press, pp. 198-209.

### **Commissioned reports and non-peer reviewed published articles**

- Baisden, WT, ED Keller, L Timar, D Smeaton, A. Clark, A Ausseil, W Power, Wei Zhang  
'New Zealand's Pasture Production in 2020 and 2050' GNS Science Consultancy  
Report 2010/154 June 2010
- Kerr, Suzi. 2009. "Comments to select committee," invited independent specialist advice on  
the Climate Change Response (Moderated Emissions Trading) Amendment Bill.
- Meade, Richard, Gabriel Fiuza and Andrea Lu. 2008. "Forest and Forest Land Valuation:  
How to value forests and forest land to include carbon costs and benefits" Report  
prepared for the New Zealand Ministry of Agriculture and Forestry.  
[www.iscr.org.nz/n465.html](http://www.iscr.org.nz/n465.html) pp: 1-61
- Kerr, Suzi and Wei Zhang. 2009. "Allocation of New Zealand Units within Agriculture in the  
New Zealand Emissions Trading System," Motu Working Paper 09-16.
- Todd, Maribeth and Suzi Kerr. 2009. "How Does Changing Land Cover and Land Use in New  
Zealand relate to Land Use Capability and Slope?" Motu Working Paper 09-17.

### **Presentations (to researchers)**

- Fiuza, Gabriel. 2010. "Can market power in the electricity market translate into market power  
in the hedge market?" 85th Annual Conference of the Western Economic Association  
International, Portland, USA, June 29-July 3.
- Fiuza, Gabriel. 2009. 'A methodology for valuing the impact of an emissions trading scheme  
on forest and forest land value.' NZARES conference, Nelson, 27-28 August.
- Kerr, Suzi. 2009. 'How can agriculture be included in an emissions trading system? Some  
thoughts from New Zealand' Proceedings of the *Agriculture, Greenhouse and  
Emissions Trading Conference*, Australian Farm Institute, Maroochydore, May.
- Kerr, Suzi. 2010. 'Emissions trading for forestry and agriculture: policy design and integrated  
simulations in New Zealand' UC Berkeley Agricultural and Resource Economics  
seminar, February.
- Kerr, Suzi. 2010. 'Global Policies as a Framework for Effective Local Action to Reduce  
Deforestation: Insights from Costa Rica and Indonesia' Bay Area Tropical Forests  
Network, California, 4 March.
- Kerr, Suzi, William Power, Levente Timar and Wei Zhang. 2010. "Emissions Trading for  
Forestry and Agriculture: Policy Design and Integrated Simulations in New Zealand"  
Poster presentation.  
Analysis, Integration and Modelling of Earth Systems Open Science Conference, Edinburgh,  
May; and  
AIMES (IGBP) Young Scholars' network workshop: Transitioning to Sustainable  
Communities, Ithaca, New York, USA, July.
- Power, William. 2009. 'Potential Scrub Change and its Spatial Allocation under the New  
Zealand Emission Trading System' NZARES conference, Nelson, 27-28 August.
- Sinclair, Stewart, Suzi Kerr and Wei Zhang. 2009. 'Estimating a Marginal Abatement Cost  
Curve of Greenhouse Gas Emissions within the New Zealand Agriculture and  
Forestry Sector' NZARES conference, Nelson, 27- 28 August.
- Stroombergen, Adolf. 2009 'General Equilibrium Impacts of Biofuels from Forestry'  
Presentation to NZ Forest Owners Assoc., 25 November.
- Stroombergen, Adolf. 2010 'Economy-Wide Impacts of Biofuels from Forestry' Presentation  
to the Bioenergy Association of New Zealand, 9 February.
- van Benthem, Arthur and Suzi Kerr. 2010. 'Effective international policy to reduce emissions  
from deforestation' Paper presented at the Analysis, Integration and Modelling of  
Earth Systems Open Science Conference, Edinburgh, May.
- van Benthem, Arthur and Suzi Kerr. 2010. 'The complementarity between equity and  
efficiency in climate mitigation: Designing more effective international policy to  
reduce emissions from deforestation and degradation.' Program on Energy and  
Sustainable Development, Stanford University, June.

Zhang, Wei. 2009. 'Scrub Reversion under Emission Trading System in New Zealand.' 27th Conference of the International Association of Agricultural Economists, Beijing, China, August.

### **Data sharing**

Todd, Maribeth. 2009. "Land Use New Zealand (LUNZ) Map with 1996 Land Cover and Ownership Information," Restricted derived dataset. Details online at <http://www.motu.org.nz/building-capacity/datasets>.

Todd, Maribeth. 2009. "Land Use New Zealand (LUNZ) Map with Slope Information," Restricted derived dataset. Details online at <http://www.motu.org.nz/building-capacity/datasets>.

Zhang, Wei. 2009. "Map of Potential Farm Classes and Earning Before Interest and Tax (EBIT) from Pastoral Activities. Farm class map with associated data. Details forthcoming online at <http://www.motu.org.nz/building-capacity/datasets>.