



Markets and Water Quality: Integrated Assessment for Policy Design

Report to the Foundation for Research, Science and Technology Year 2 (July 2008-June 2009)

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1. Key activities

'Markets and water quality' is a joint project with NIWA, GNS and others in which researchers design and simulate a nutrient trading market for the Lake Rotorua catchment and work with a group of local stakeholders to develop practical policy. The project combines economics, law, hydrology and other disciplines in an attempt to explore these challenging regulatory design problems from all disciplinary angles.

We have built a prototype version of a scientifically innovative integrated policy simulation model - N-TRADER. The model is designed to be a decision support tool to guide the design, implementation, and operation of a nutrient trading scheme in the Lake Rotorua catchment. The biophysical component of this model is largely complete. This component incorporates GNS information about groundwater lag zones in the Rotorua catchment, and simulates the fate and transport of nitrogen from a farm parcel to the lake via a combination of surface and subsurface pathways. We are now developing algorithms to predict future prices of nitrogen allowances in a nutrient trading system. This component of the model predicts prices as a function of supply (i.e. the nutrient cap), demand (based on existing nitrogen exports and costs of mitigating those exports) and assumed long term interest rates. It also differentiates future "buyers" vs. "sellers" of nutrient allowances - in other words, simulates generalised "trading" of allowances under various trading system design features.

To support N-Trader we have continued work to refine our understanding of the drivers of land use change and land management. We have updated our data on land use from Statistics New Zealand both to include the most recent years and also to track the land use history back to the 1800s. We are re-estimating land use change responses that are specific for the Rotorua territorial authority. We have explored land use change at a farm scale using 1996 and 2002 land cover and 2002 land use. We have confirmed the direction of land use transitions our LURNZ (Land Use in Rural New Zealand) model assumes and gained some insight into the characteristics of land parcels that are most likely to transition between covers/uses. We are developing a new methodology to econometrically estimate probability weights for each transition for each parcel. We have also explored the spatial and temporal variation in stocking rates across New Zealand in order to improve our baseline estimates of demand for nutrient allowances. We have developed a database of profitability for three major land uses (forestry, dairy and several different classes of

sheep-beef). We have developed an algorithm using this new database that allows us to estimate the marginal cost of land use change in two distinct ways. We have reviewed the literature on the costs of mitigation and are using this to inform new detailed farm scale modelling of mitigation costs. All of this work has been presented in various research fora and is still in development.

The Nutrient Trading Study Group (NTSG) has met twice in this reporting year, making a total of twelve meetings since its inception. The NTSG is a group of researchers, landowners, iwi members, industry and representatives from local and central government, and involves a professional facilitator. Discussions are informed by research within this research programme and elsewhere, and by drawing on group members' expertise. The group is not designed to reach consensus, however the research and prototype system were greatly influenced and strengthened by comments and suggestions received from the group. This year's meetings have considered several new topics now the prototype is complete. We demonstrated N-Trader, considered legal, cooperation and compliance issues in more depth, looked briefly at the valuation of water quality, viewed the films discussed in the next paragraph and discussed strategies for communicating what we have learned outside of the study group as policy develops in the catchment.

We have created two short films to illustrate some of the issues around declining water quality in Lake Rotorua and complement our trading game as an educational tool. The films feature a dairy farmer from Hamurana, north-east of Lake Rotorua, and three Maori landowners and caretakers from Te Arawa, tangata whenua in the Rotorua region. All have knowledge of the prototype system through their involvement in the NTSG but were free to present their own views of the proposed system and its implications. The films have been released on our website and are available on DVD. We believe that the personal stories they depict will deepen understanding of the issues, so that people in the Rotorua catchment are better equipped to choose between different options for addressing lake water quality. We are now in discussions with computer game developers to use footage from the films as part of an animated online game. People who play the game will be able to learn-by-doing by becoming virtual farmers and trading nutrient allowances to manage their farms under a nutrient cap.

2. Major achievements to date

We have published one refereed article, two book chapters and ten working papers and given numerous conference and seminar presentations relating to the programme. Most of our outputs are made available on our project website www.motu.org.nz/research/detail/nutrient_trading.

Our major science achievements so far are one journal article and two book chapters:

Lock, Kelly and Suzi Kerr. 2009. "Nutrient Trading in Lake Rotorua: Overview of a Prototype System," *Resource Management Theory and Practice*, 74-90.

Kerr, Suzi and Kelly Lock. 2009. "Cost Sharing and Allowance Allocation in a Nutrient Trading System for the Lake Rotorua Catchment," *Proceedings of the Tax Policy Conference 2009: New Zealand tax reform - where to next?* Edward Elgar: Cheltenham, UK.

Kerr, Suzi and Marianna Kennedy 'Greenhouse gases and Nutrients: The Interactions Between Concurrent New Zealand Trading Systems' in Productivity Commission eds. *Promoting Better Environmental Outcomes, Roundtable Proceedings*, Australian Productivity Commission, Melbourne, 2009.

and three invited keynote presentations

Kerr, Suzi. 2008. "Greenhouse Gases and Nutrients: The Interactions Between Concurrent New Zealand Trading Systems," *Australian Productivity Commission Roundtable 'Promoting Better Environmental Outcomes'* Invited speaker, Canberra, August Kerr, Suzi. 2007.

'Water quality management and Nutrient Trading' Invited speaker, Hydrological society Rotorua, 22 November and NZ Waste Water Management Association Conference, Rotorua, 19 September. Rutherford, J.C. 2007.

"Lake Taupo - links between water quality and pastoral landuse." Keynote address: New Zealand Grasslands Association Conference. 13-15th November 2007, Wairakei Resort, Taupo, NZGA.

We have also developed a new approach to regulating resources where the timing of impact is important. This work has been presented as a working paper and at international conferences and is now being applied to climate change policy

3. Major outcomes to date

This research has generated positive outcomes at local government level. Bill Bayfield, CEO of Environment Bay of Plenty has shown strong support for the prototype we have developed. He and his team are evaluating the prototype alongside other leading regulatory options within the catchment. Motu and CommonGround will continue to provide technical support for this process as needed. The prototype has also attracted considerable interest in central government and with international audiences.

The prototype we developed and the experience we developed working with rural sector stakeholders has been invaluable in our new research supporting the development of the agricultural component of the emissions trading system. There are some key commonalities between the two design processes as well as some critical differences. The lessons from each and the tensions between them are proving to be mutually constructive as the policy design processes evolve in tandem.

4. Publications in 2008/09

Lock, Kelly and Suzi Kerr. 2009. "Nutrient Trading in Lake Rotorua: Overview of a Prototype System," *Resource Management Theory and Practice*, 74-90;

Kerr, Suzi and Kelly Lock. 2009. "Cost Sharing and Allowance Allocation in a Nutrient Trading System for the Lake Rotorua Catchment," *Proceedings of the Tax Policy Conference 2009: New Zealand tax reform - where to next?* Edward Elgar: Cheltenham, UK;

Kerr, Suzi and Kelly Lock. 2009. 'Nutrient Trading in Lake Rotorua: Cost Sharing and Allowance Allocation' *Motu Working Paper 09-07*

Kerr, Suzi and Marianna Kennedy 'Greenhouse gases and Nutrients: The Interactions Between Concurrent New Zealand Trading Systems' in *Productivity Commission eds. Promoting Better Environmental Outcomes, Roundtable Proceedings, Australian Productivity Commission, Melbourne, 2009:*

Kerr, Suzi and Marianna Kennedy. 2009. 'Greenhouse gases and Nutrients: The Interactions Between Concurrent New Zealand Trading Systems' *Motu note 09-02*

Lock, Kelly; Suzi Kerr, Tim Cox and Kit Rutherford. 2008. "Assessing the Design Options for a Nutrient Trading System using an Integrated Model" *Poster and paper in Proceedings of ESAM08 – Markets and Models: Policy Frontiers in the AWH Phillips Tradition, Wellington, New Zealand*

Rutherford, J.C. and Chris Palliser. 2008 "Rotorua water balance modelling – sizing the aquifers," *NIWA Client Report HSM2008-068*

Rutherford, J.C. 2008. "Nutrient targets for Lake Rotorua – a revisit," *NIWA Client Report HAM2008-080R*

5. Presentations in 2008/09

Kerr, Suzi. 2008. 'A Prototype Nutrient Trading System for Lake Rotorua'

MAF and MFE, July

NZ Association of Resource Economists, Nelson, August

Resource Management Law Association, Dunedin, September

Motu Public Policy Seminar, Wellington, November

Waikato University, June, 2009

- Lock, Kelly. 2008 “Using Trading Markets to Address Environmental Concerns”
Local Government New Zealand conference presentation and workshop, Rotorua, July.
Professional Development Programme for Economics Teachers, Palmerston North, November
Massey University Executive Masters of Business Administration class, Palmerston North, November.
- Kerr, Suzi. 2008. “Greenhouse Gases and Nutrients: The Interactions Between Concurrent New Zealand Trading Systems,”
Australian Productivity Commission Roundtable ‘Promoting Better Environmental Outcomes’ Invited speaker, Canberra, August
NZ Association of Resource Economists, Nelson, August
Phillips Conference / ESAM08, Wellington, July
- Rutherford, Kit and Tim Cox. 2008 “Nutrient Trading” Environment Waikato, December
- Cox, Tim. 2008. “N-TRADER: Overview and Update on Model Development” presentation to NIWA, August 11.
- Lock, Kelly. 2008. “Assessing the Design Options for a Nutrient Trading System using an Integrated Model” NZ Association of Resource Economists, Nelson, August.
- Kerr, Suzi. 2008. ‘Interdisciplinary science is greater than the sum of its parts’ Provocation at ‘Running Hot’, Wellington, October.
- Kerr, Suzi. 2008. ‘Temporal Emission Trading Markets’ National Bureau of Economic Research Summer Institute, Environment and Public Policy workshop ‘egg-timer’ session, Cambridge, Massachusetts. 21 July.
- Kerr, Suzi. 2008. ‘Data challenges in creating LURNZ, an econometrically based model of Land Use in Rural New Zealand’ Global Land Project Workshop on Data and model integration for coupled models of land use change, Aberdeen, 17th – 19th July.
- Cox, Tim. 2009. “Nutrient Trading in New Zealand,” presentation to CDM, Denver, CO, March.
- Kerr, Suzi. 2009. ‘Cooperation as the backbone of compliance policy’ Nutrient Trading Study Group, Rotorua, May.
- Kerr, Suzi. 2009. “Environmental Markets: How can they work for water quality and climate change?” Auckland Public Policy Seminar, April.
- Kerr, Suzi. 2009. ‘Cost sharing and allowance allocation in a nutrient trading system for the Lake Rotorua catchment’ Tax Policy Conference 2009 New Zealand tax reform - where to next? Wellington 13 February.
- Law Cameron. 2009. “Compliance in the RMA,” presentation to the Nutrient Trading Study Group, May 25.
- Law, Cameron. 2009. “How to Operate a Nutrient Trading Scheme Within the RMA,” presentation to the Nutrient Trading Study Group, March 25.