

**THURSDAY 9.30 – 11.30****Robin Johnson Memorial Session**

*Session Chair Murray Doak*

**Are we there yet? Reflections on Fonterra's recent capital structure changes and the prospects regarding 'further evolution' of the Cooperative**

*Peter Fraser*

Fonterra has spent the past half-decade attempting to modify its capital structure in order to solve a problem that – at worst – never existed or – at best – had already been solved. It therefore begs the question what Fonterra's second decade will bring.

One question that remains unresolved is Fonterra's *raison d'être*: can it fulfill the promise of 2001 and emerge as a national champion that sources the majority of its milk offshore or will be hampered by being a risk-managing mechanism for its NZ domiciled shareholder suppliers?

**THURSDAY 14.00 – 15.00****Plenary Session 1**

*Session Chair Phil Journeaux*

**Agricultural productivity and Environmental Sustainability  
Are we going to throw the baby out with the bathwater?**

*Brian Bell*

Among the green lobby and the general public there is urgency for agriculture to clean up its act on environmental issues. Increased intensification of land use and in particular dairying has led to environmental spill-overs that the public is no longer willing to tolerate. Agriculture is in danger of losing its public license to operate. Policies to ensure degraded waterways are put on a path to improvement are currently being formulated. These have the potential to rob New Zealand of its international competitive advantage in agricultural production if not implemented wisely. This paper uses two case studies to illustrate the costs and the timeframes inherent in environmental improvement for pastoral agriculture and makes recommendation on policies to ensure New Zealand has good environmental outcomes and retains its international competitive advantage.

**Natural capital and New Zealand's Resource Management Act (1991)**

*Brent Clothier*

Quantifying natural resources as natural capital and the valuation of the ecosystem services that flow from natural capital stocks are emerging areas of science. Are these developing concepts compatible with current resource management legislation? Can these ideas be used in judicial proceedings to protect natural capital and maintain the portfolio value of nature's ecosystem services? We describe two recent cases in New Zealand where natural capital concepts were used in the Environment Court to protect land from peri-urban creep and to protect receiving water quality through the allocation of a nutrient discharge allowance to land. Results have been mixed, with prospects appearing good.

## Contributed Paper Sessions

**THURSDAY 11.30 – 13.00**

<b>Kotuku Room: Environmental Policy and Producer Behaviour</b>
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*Session Chair Katherine Bicknell*

### **Estimating Dairy Farms' Demand for Water**

*Alexey Kravchenko*

Resource Management's Act current "first come first served" method of distributing water rights is fast becoming inadequate to handle this increasingly over-allocated factor of production. Water markets or tariffs are one way to achieve allocative efficiency. To establish such markets or tariffs, it is imperative to estimate users' responses to having, for the first time, to pay for this currently largely unpriced input. This study seeks to provide a viable "starting point" estimate of the response curve to water price tariffs of dairy farmers – NZ's largest fresh water consumers – using the MPI dairy monitoring dataset. This paper suggests that under the assumptions of inelastic input substitutability, the farms' supply curves can provide an approximation of the farms' responses to at-site (irrigation cost inclusive) changes of water costs.

### **Modeling farmer attitudes to change and the introduction of nitrogen trading regulation**

*Simon Anastasiadis*

Allowance trading schemes are often discussed as a cost effective approach to managing water quality in New Zealand's rivers and lakes. It is common when modeling such schemes, for researchers to assume

farmers respond optimally to regulation. This is a strong assumption as farmers' attitudes indicate a resistance to decreasing nutrient emissions, a reluctance to engage in trading, and an aversion to changing land use. We propose two models that better reflect farmers' attitudes, and use these models to consider how a nutrient trading scheme might perform immediately following its introduction. We generate results in the context of nitrogen trading for Lake Rotorua using the NManager model, and contrast these results against those from the model where farmers respond optimally to regulation.

### **Policy options for managing water quality: impact of different allocation mechanisms**

*Oshadhi Samarasinghe*

Water quality, particularly nitrogen pollution has been recognized as a problem in a number of catchments in New Zealand. This has led to regional authorities proposing processes to limit nutrient losses to waterways through regional plans. Our paper uses an economic catchment model, NZFARM, to assess catchment wide impacts of different policy options for achieving proposed water quality targets, in a New Zealand catchment. We also assess how different allocation mechanisms will affect the distribution of costs across different land uses and catchments. For each policy we report the cost, how this cost is distributed across land uses and the community, land use change, the resulting nutrient losses, and changes in GHG emissions.

**Tui Room: Human Capital: Skill and Resilience**

*Session Chair Phil Journeaux*

**Estimating Resilience among New Zealand dairy farmers**  
*Femi Olubode-Awosola*

Based on a conceptual definition of resilience as found in the literature, we drew on a sample of KPIs of dairy farmers owner operators over 5 seasons (2006/07 – 2010/11) as available in the DairyBase™ database to estimate resilience among the farmers using their KPIs as surrogate of resilience. We developed a measure or indicator of farm business's resilience. We then examined whether some farmers are more resilient than others and what could be attributed to this. This might provide information on resilience strategies for future farming.

**What people do counts - a survey of dairy farm team skills and profitability**

*Matthew Newman*

People and in particular farm managers are the key to allocating resources and to convert these into production efficiently. Therefore, it is widely believed that the decisions managers make and the skills people have will influence the financial performance of the farm. The purpose of this project was to; develop a measurement framework to assess various levels of skills of teams of people on New Zealand dairy farms; and to test the hypothesis that highly skilled farm teams (management and farm employees) leads to highly profitable farm business. This paper will present the framework, discuss the survey design and methodology for collecting data and present the findings from the 150 Waikato and mid Canterbury farms visited.

**Returns to education revisited and effects of education on household welfare in Nigeria**

*Kolawole Ogundari*

Human capital development, especially higher educational attainment attaches high premium to human skills as an important factor of production. Thus, one of important determinants of investment in education is its expected economic benefits in form of better earnings, higher economic welfare and in particular greater equity and economic growth in market economies. In view of this development, the objective of the study is defined in two folds; first, to revisit returns to education in Nigeria and second, to investigate effects of education on the economic welfare of households in Nigeria. For the objective one, the study uses Double Hurdle (DH) model that allows the analysis of both decision to participate in labour market and how much to earn while Quantile Regression (QR) which allows effects of the determinants such as education to differ at different parts of the distribution of indicator of household welfare. The empirical results show that the returns to schooling at primary and secondary levels of education are very low relative to returns to schooling at the tertiary education level. Also, we find the effect of primary and secondary education on household economic welfare to be substantially lower compared with that of tertiary education. In other words, an extra year of schooling at the tertiary education level would increase the economic welfare of households substantially more than what an extra year of schooling at primary and secondary levels of education would achieve. In summary, the effects of schooling on the two indicators of overall welfare considered in the study (earnings and total expenditure) display similar trends in the study. For example, both results show that returns to education and impact of education on household welfare are not only driven by extra investment in tertiary education, but are low (or modest) at the lower levels of education such as primary, secondary and postgraduate education in the sample.

**Kauri Room: Choice Modeling**

*Session Chair Brian Bell*

**Difficult decisions: What influences the error variance in a Choice Experiment?**

*Dan Marsh*

In choice experiments there can be heterogeneity both in individual preferences and the error in the unobserved portion of utility. The error variance, or its inverse, the scale factor, cannot be identified and so is usually normalized to one. For this study we explicitly model the effect of observed variables on error through parameterization of the scale factor. We collected data about people's preferences for water quality in the Hurunui River using a fully-ranked choice experiment with two treatment groups (best-worst and repeated-best ranking) and five alternatives on each choice card. We find that error variance increases with each level of ranking which provides evidence that it is more difficult for people to select subsequent alternatives after eliminating their favourite. As people complete the ranking task the choices become more random. The error is greater for the best-worst treatment. Choices which included a negative price e.g. willingness to accept deterioration in exchange for a reduction in taxes, have a higher error variance. Conversely, people who have seen the river, or spent longer on the choice task, or rated their own level of understanding highly had a lower error variance. If this choice data were analysed without accounting for scale variation it would confound the identification of preference heterogeneity and potentially bias welfare estimates. Care should therefore be taken when pooling choice data that varies in complexity.

**Cultural differences in environmental valuation**

*Maiki Andersen*

The application of stated preference non-market valuation approaches in settings where there are strong cultural differences in environmental perspective potentially misrepresent strengths of preferences for different groups. This paper reports on a study that measured strength of affiliation with traditional Maori identity, strength of connection with nature, and monetary measures of value derived from a choice experiment. The relationships between these three measures are explored to test the alignment of Maori identity with connection to nature, and to test the dependence of monetary valuation on cultural identity and connection with nature. The tests are applied in the context of a case study addressing water management in the Waikato Region.

**Response latency and learning effects in Choice Experiments: Evidence from forest park recreationists in the Bay of Plenty Region**

*Richard Yao*

Choice experiments (CE) continues to become more widely used in environmental economics to estimate willingness to pay for the changes in attribute levels of an environmental good. CE is preferred to other stated preference approaches (for example contingent valuation) because it presents respondents with a series of carefully structured and more realistic choice situations. The disadvantage of CE is that each respondent evaluates a series of complex choice tasks which require a significant amount of time and cognitive effort to complete. Despite this fact, the time spent by respondents on evaluating the choice task series is usually not accounted for in the choice analysis. In addition, the ordering of the series of choice tasks is also important to account for as there has been some evidence of learning gains by respondents as they go through the choice

series. We conducted an online survey participated by a sample of 267 forest park recreationists in the Bay of Plenty region. Each respondent was provided with 12 choice tasks, each of which offered a choice between three alternatives, the status quo and two adjusted states. Using heteroskedastic logit models, we examine the effect of response latency and ordering of choice tasks on willingness to pay and behavioural efficiency of respondents. We find that accounting for response latency and ordering effects significantly improve model fit and provide more robust estimates of willingness to pay values. This study extends previous studies in choice experiments that examined separately the effects of learning and response latency on behavioural efficiency and estimates of welfare improvement.

### **Thursday 15.30 – 17.30 pm**

<b>Kotuku Room: Natural Capital &amp; Ecosystem Services (soils)</b>
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*Session Chair Jude Addenbrook*

#### **The future of resource management**

*Alec Mackay*

Debates in New Zealand regarding the level of sustainable economic development possible using natural capital stocks are invariably flawed as they do not take into consideration the full costs of impacts of development on the flow of ecosystem services beyond food provision to include regulating (i.e. environmental) and cultural services. As the demands from the primary sector on these finite resources mounts, so do the demands for the other ecosystems services these landscapes provide to community. For New Zealand society to make informed choices on its

future it needs to understand the trade-offs between environmental, economic, social and cultural outcomes from the use of natural capital stocks and associated built and ecological infrastructure investments. The resilience of our future agricultural production systems will be measured by their sustainable exploitation of natural capital, whilst minimising external costs to the environment. An ecosystem service approach to resource management offers new methodology in the pursuit of this goal. An ecosystem service based approach is emerging as the preferred approach in the UK (DEFRA) and Europe in resource management and associated policy development. In New Zealand it is also starting to be used by Regional Councils, e.g. adopting a soil natural capital based approach for defining limits on emissions from land and as a proxy for life supporting capacity in Regional Policy statements, are two examples. The Land monitoring forum of Regional Councils is currently evaluating an ecosystems service approach for adding greater utility to their soil quality monitoring programme. The last joint session (3rd November 2010) of the Land Managers Group and National Land Monitoring Forum of Regional Councils identified six critical research priorities, including the requirement to develop methods to enable Regional Councils to place financial and non-financial values on soil environmental services for determining trade-offs for policy. Opportunities are also emerging for the primary sector. SLURI has been at the forefront of a number of these initiatives, taking a leadership role in the development and application of approaches for quantifying and valuing ecosystems services from pastoral soils.

**A framework for classifying and quantifying the natural capital and ecosystem services of soils**

*Estelle Dominati*

The ecosystem services and natural capital of soils are often not recognised and generally not well understood. This paper addresses this issue by drawing on scientific understanding of soil formation, functioning and classification systems and building on current thinking on ecosystem services to present a framework to classify and quantify soil natural capital and ecosystem services. The framework consists of five main interconnected components: (1) soil natural capital, characterised by standard soil properties well known to soil scientists; (2) the processes behind soil natural capital formation, maintenance and degradation; (3) drivers (anthropogenic and natural) of soil processes; (4) provisioning, regulating and cultural ecosystem services; and (5) human needs fulfilled by soil ecosystem services. Such framework has been used to quantify and value the ecosystem services of a number of soil types under dairy and sheep and beef at different scales.

**Evaluating our soil assets**

*Allan Hewitt*

New Zealand has some magnificent soils but they struggle to support our primary production unaided. The production we enjoy derives as much from massive agricultural investment in soil improvements as from the natural capital of the soils. But there is a tension here between the nature of the land and the intensity of our production inputs. The nature of the land strongly affects the location and inputs needed by our enterprises and the management of our enterprises strongly affects the health of the land. The concepts of Soil Natural Capital and Soil Services express these factors very well, and provide a framework for us to quantify and express the relationships. We are working towards a goal where it will be possible

to re-examine the state of our nation's soil resources in a new way. New perspectives will begin a new dialog between the actors in this massive land use drama we have staged in NZ. Perhaps we can arrive at a common understanding and tools to better realise, or get real, about our vision of sustainable production. A central part of this analysis has to be a resource economic analysis. But first we must be able to quantify soil natural capital and the soil services that derive from our soils. Good progress has been made to define concepts and a working framework, and develop methods for quantification and valuation. So far we have worked in limited areas. It's time to start to scale up to see if we can convincingly quantify soil natural capital and soil services across extensive tracts of land. We describe a study which has zoomed into New Zealand's abundant stony soils. We compare shallow stony soils with limited water storage that rapidly leach nutrients with contrasting deep loamy soils. Using dairying as a reference we calculate soil natural capital based on support for soil services related to drainage, water tables, and water storage. We discuss some of the issues indicated by the preliminary results.

**Tui Room: Collective Action**

*Session Chair Prakash Narayan*

**Community governance and management of nitrogen loss risk**  
*Oliver Parsons*

Following the implementation of the National Policy Statement for Freshwater Management, objectives must now be set for all water bodies in New Zealand, based on community values. While deliberative processes for agreeing upon community objectives have been explored, a number of questions remain about how to go about achieving them. Where objectives result in the development of nitrate limits for waterways and development pressure is likely to make these limits difficult to achieve, systems will be needed to manage the total load efficiently and sustainably over time. Drawing on commons research, this paper proposes a multi-level governance model for managing nitrate load, based on community self-governance. The focus is on building a flexible system for managing leaching risk, given the very high levels of uncertainty in linking nitrogen losses to objectives.

**Providing agri-environmental public goods through collective action lessons from New Zealand case studies**  
*Tetsuya Uetake*

Agriculture is a provider of food and, to a certain extent, public goods such as biodiversity and landscape, but it can also have negative impacts on natural assets such as biodiversity and water quality. Many researchers and organisations have undertaken studies on public goods and externalities, and related policy measures. However, previous research on public goods, externalities and agri-environmental policies has focused on individual farmers, but much less on collective action. For example, maintaining a

landscape usually requires the participation of several farmers working within the same area. This means that in addition to implementing policies that target individual farmers, different approaches may also be needed to promote collective action to overcome market failure associated with public goods and externalities. The literature review and three New Zealand case studies (Sustainable Farming Fund, East Coast Forestry Project and North Otago irrigation Company) have identified some findings including benefits and barriers of collective action and key factors for its success. Collective action can facilitate geographically appropriate management of resources, allow for shared knowledge among members and increase their capacities, and tackle local issues. However, free riding is a major problem, as are the new transaction costs stemming from collective action. To overcome barriers and enhance merits, several key factors for successful collective action are identified. Having precise knowledge of community resources is necessary to manage and govern them. Social capital can help individuals work co-operatively. Communication among stakeholders brings better performance. To prevent free riding and deal with local issues, effectiveness seems to entail having locally devised rules and monitoring and sanction systems. This paper also presents some policy implications.

**An Evaluation of compulsory levy frameworks for the provision of industry-good goods and services: A New Zealand Case Study**  
*William Rutherford*

Compulsory levies are one way to address a market failure in the delivery of industry-good goods and services that are characterised by low rivalry and low excludability. The paper discusses key components of New Zealand's compulsory levies framework for the primary sector, the Commodity Levies Act 1990 (the CLA), and assesses it against the criteria of accountability, effectiveness, efficiency and fairness. The six-yearly referendum provision to get a mandate from levy-payers for a levy is a key

component of the CLA. This has significant influence on the levying organisation's performance and the effectiveness of its levy spending. Governance requirements make the CLA a demand-driven framework where the levy-payers set the spending priorities. The CLA is found to be strong on accountability and fairness, and its flexibility enables industries to deliver industry-good activities efficiently. The paper also briefly evaluates key components of the compulsory levy frameworks for the primary sector in Australia and the United Kingdom (UK). The Australian framework does not require a levy-payer referendum, the levies are collected by a government department and forwarded to a research and development corporation, and levy spending is restricted to research and development. In the UK, the levy collection and spending is consolidated into one levy board that may establish subsidiaries for different industries for the delivery of industry-good activities.

#### **The use of policy scenarios for water quality in stakeholder consultation**

*Terry Parminter*

The paper describes an innovative approach to stakeholder consultation about agricultural landuses and water quality in rural waterways. In mid 2012 the authors prepared a number of policy options from published regional council planning documents, addressing sediment, nutrients and pathogens. These options were prepared as possible policy scenarios for the stakeholders to consider. Stakeholders from a range of agricultural and environmental organisations were invited to attend a one-day workshop. At the workshop they reviewed to proposed policy problem and objective, as well as the policy scenarios. Workshop participants then used post-it notes to complete a template that described the attributes underlying the policy scenarios. The results were used to describe areas of convergence between the different stakeholder groups and areas where there were

differences. These results have been used to develop policy options for the next phase in preparing the regional plan for the Wellington Region.

#### **Kauri Room: Forestry**

*Session Chair Richard Yao*

#### **Modeling socio-economic impacts of reducing emissions from deforestation and forest degradation/REDD-based policy: a Berau District - Indonesia case study**

*Kadim Martana*

The Government of Indonesia is committed to cut its emissions by 26% by 2020. In forestry sector, this is done through reducing emissions from deforestation and forest degradation (REDD) program. One of several pilot activities of the REDD Program is the Berau Forest Carbon Program (BFCP) which is located in the Berau District East Kalimantan Indonesia. The Program attempts to generate behavioural changes of the forests stakeholders like forest-dependent community, forestry/logging company and oil palm plantation company to contribute to the emissions reduction, which is formulated in the Program's strategies. Changes of these behaviours are reflected in the costs being borne by the relevant forest stakeholders. For example, according to relevant experts' opinion, it is estimated that applying reduced-impact logging (RIL)/forest certification would increase logging cost by 8%. The survey also estimates that required incentives for maintaining the application of the RIL and forest certification would be US\$ 35 and US\$ 600 per hectare per year, respectively. The Berau District is 34.127,47 km<sup>2</sup> (more than half of Canterbury Region). With its population of 179.444 in 2010, the GRP growth is 5.2% for the period of 2005 to 2008. In 2007, the District's economic growth is mainly contributed by the (coal) mining, agriculture, and forestry, which reflects nearly 50%, 15%, and 5% of the total GRP of IDR 4.35 trillion (~ NZ\$ 620 million), respectively. Therefore, the emissions reduction program is expected to impact the future of economic

performance of the Berau District. This research investigates potential socio-economic impacts of REDD strategies implemented by the BFCP program. A Computable General Equilibrium (CGE) is to be employed to assess the socio economic impacts of the proposed strategies. The impacts will be modelled as the changed behaviour of participants, which will provide input to the CGE. Successive model runs will identify the socio-economic impacts of REDD policies on the Berau economy. For the CGE modeling, a regional account (social accounting matrix) of the Berau District was constructed. We employed the method introduced by Kronenberg (2007, 2009a, 2009b) and combined with statistics officer' data/estimation to form the initial unbalance social accounting matrix table. Then, the matrix was balanced using the cross entropy approach (Robinson, Cattaneo, and El-Said, 1998; Robinson & El-Said, 2000); in which during the balancing process, the known information is retained. Following this development, a CGE framework for the region is also constructed. It is planned to include modeling of land conversion in the framework.

### **Economics of managing New Zealand silver beech for timber and carbon**

*David Evison*

Implementation of the New Zealand Emissions Trading Scheme (ETS) has raised questions about its impact on the economics of indigenous forestry in New Zealand. One of the fastest growing (and hence economically most promising) indigenous forest types is silver beech (*Nothofagus menziesii* (Hook.f.) Oerst). An economic analysis carried out using data from a long-term thinning trial in silver beech in Alton Forest, Southland provided some answers to the following questions: What is the potential financial impact on the economics of indigenous forestry of participation in the ETS? How does provision of this environmental service affect potential returns from timber? The analysis shows that, under some circumstances,

participation in the ETS might provide favourable returns to indigenous forest owners. The option of timber production later in the rotation could be retained, although under current cost and price assumptions this would not be profitable. Because of the generally unfavourable economics of timber production from indigenous forest, some methodological issues involved with the use of NPV analysis for these types of projects are also explored.

### **Small forests and environmental sustainability in Guatemala: The potential of the carbon banking approach**

*Fernando Garcia-Barrios*

Forest carbon is potentially an important income stream for small landowners in Guatemala that would help to ease deforestation and forest degradation pressures. However, the temporary nature of sequestered forest carbon, the risk of environmental disturbances releasing forest sequestered carbon, and the form of international carbon markets affect the ability of small forest owners to participate in carbon trading schemes. This paper reports the results of an investigation into the stability of carbon pools formed by small forest owners in Guatemala, accounting for forest fire risk and the effects on implementation of a carbon banking approach.

### **Where and how can policy encourage afforestation to avoid soil erosion?**

*Luke Barry*

Understanding the economic value of avoided land erosion in New Zealand is an important factor in policy decision making enabling the acknowledgement of the costs of erosion to the economy. This paper focuses on hill country marginal agricultural lands potential for afforestation to mitigate erosion risks. Spatial economic modelling is

undertaken to determine the net private and public benefit due to the avoided soil erosion from afforesting these areas. A policy framework based on the relative magnitude of net private and public benefits[1] has been employed to identify optimum policy instruments to encourage afforestation of marginal agricultural lands. This framework uses the ratio of public to private net benefits to identify, spatially, the optimal policy mechanism to encourage afforestation. In essence, the framework separates the private and public net benefits of avoided soil erosion due to afforestation, and compares these net benefits to identify policy instruments to encourage future forests activities in New Zealand. The study indicates that in some cases forestry is not viable and thus the public benefit from avoided erosion (and other ecosystem services) will not be forthcoming in these areas. Afforesting on these areas may therefore require positive incentives or novel forest farming systems-technologies, depending on the relative weight of the public and private net benefits. The policy framework applied in the study is capable of identifying optimum policy instruments that encourage afforestation on selected marginal lands while achieving efficient and effective use of public funds.

## Friday 9.00 – 10.30 am

### Kotuku Room: Environmental Policy: Market Mechanisms

*Session Chair Tony Schischka*

#### **Mixed bag: Simulating market-based instruments for water quality and quantity in the Upper Waikato**

***Jim Sinner***

We designed and implemented participatory computer simulations in three workshops to learn how market-based instruments (MBIs) might improve freshwater outcomes when managing water and land resources within limits. An Excel-based simulation platform was built to simulate the use of transferable permits and user charges for both water quantity and water quality in the Upper Waikato catchment. Each participant managed a hypothetical property in a simplified catchment that included seven farms, a pulp mill, district council, and a hydro-electric company. Based on profit schedules and policy settings, participants made choices about production intensity, land use change and trading of water and/or nutrient allowances. As expected, the ability to transfer allowances easily between users helped to reduce the financial impact of imposing limits on a catchment, and environmental objectives were achieved when limits were in place. There was a strong tendency for transactions, sometimes sub-optimal, to occur between participants in close proximity to each other, even in a relatively small room with only ten participants. Applying charges on water use and nutrient discharges to fund mitigation actions enabled river condition to be further improved. Some participants said they paid more attention to charges presented as ‘penalties’ for excessive use than uniform charges that all users paid. When participants had to manage both water takes and nutrient discharges, they found it challenging to identify the financially

optimal management strategy but improved with experience. The hydro-electric operator provided liquidity and stable prices for water allowances, enabling others to focus on buying and selling nutrient allowances. The simulations highlighted the social and cultural context in which MBIs must operate, and how that context influences the outcomes that we can expect from MBIs. Participants found the simulations to be a valuable learning experience.

**Synergies between nutrient trading markets and the New Zealand greenhouse gas (GHG) emissions trading scheme (ETS) in the Lake Rotorua Catchment**

*Boon-Ling Yeo*

The agricultural sector has been identified as the largest source of nitrogen (N) pollution. Efforts to control for air and water pollution through market-based mechanisms often treat these two sinks separately. However, when managing a dynamic pollutant like N in agricultural production, the abatement costs of nutrient runoffs and greenhouse (GHG) emissions can be interdependent. In this paper, we examine this issue in the Lake Rotorua catchment in New Zealand using the Nmanager model. We model the abatement costs, potential level of total cost savings; and environmental impacts of agricultural production under three policy scenarios: the inclusion of agricultural in (1)the nutrient trading market only; (2)the NZ GHG emissions trading scheme (ETS) only; and (3)both the nutrient trading market and GHG ETS concurrently. We find that N and GHG mitigation practices are complementary in the Lake Rotorua catchment. Regulating either nutrient runoffs or GHG emissions in agricultural production will lead to reductions in both types of pollution, and cost savings could be realized if airborne and waterborne emissions are managed in an integrated fashion.

**Allocation and cost sharing: Nutrient trading markets and greenhouse gas markets**

*Suzi Kerr*

In either an emissions trading or nutrient trading market, the cost of mitigation is often lower than the potential transfer of wealth through allocation of allowances. Addressing these cost sharing issues is critical to achieving environmental and efficiency gains. In this paper we synthesise three pieces of work to consider three aspects of this issue. We first consider three basic principles for cost sharing: ‘polluter’ pays, share costs equally and progressive cost bearing. We then empirically compare different allowance allocation methods within the ETS and nutrient markets against these principles. We finally consider the effects of greenhouse gas policy on allocation of cost of water quality management costs between regional and national communities.

**Tui Room: Environmental Valuation and Risk**

*Session Chair Geoff Kerr*

**Quantifying visual preferences in Canterbury**  
***Pike Brown***

Over the last 20 years, dairy conversion has become New Zealand's predominant land change, and the sector has become a major focus of New Zealand's primary economy. Periodic surveys suggest that New Zealanders are increasingly concerned about the changes to the visual landscape resulting from dairy conversion, including irrigated pastures in traditionally dry areas, the removal of 0.5 million metres of shelterbelts, and dairy cows being held in more confined paddocks than dry stock. A comprehensive survey was undertaken to better understand which aspects of the landscape are important residents of Canterbury and what solutions may mitigate their unfavourable impressions of dairying. We then adapted visual assessment study methodologies from urban studies to critically analyse various mitigation strategies using a cross-classified random effects model, which accounts for dependence of errors among both survey respondents and landscapes. We find that most Cantabrians have noticed increased dairy conversion in recent years, and the majority perceive those changes negatively. However, this view is strongly influenced by residents' perceptions of the importance of dairying to the local economy. There is surprising consistency among rural and urban Cantabrians about the features of the visual landscape that are both liked (particularly shelterbelts) and disliked (namely, dairy cows, irrigators, silage bales, and overgrown road verges). For example, images depicting roadside shelterbelts score 0.62-0.73 points higher on a 7-point Likert scale, *ceteris paribus*, and images depicting irrigators scored 0.86-0.91 points lower. Furthermore, Cantabrians prefer native shelterbelts to exotic shelterbelts and strongly prefer shelterbelts with high biodiversity value.

**RiVAS and RiVAS+ - insights and lessons from 5 years' experience with the river values assessment system**

***Kenneth F.D. Hughey***

RiVAS and RiVAS+ - insights and lessons from 5 years' experience with the River Values Assessment System Kenneth FD Hughey Lincoln University The River Values Assessment System (RiVAS (2008 ongoing) and RiVAS+ (2011 ongoing)) was developed in response to an expressed need for a method that would enable regional councils and others to 'objectively' and systematically evaluate the rivers of their regions for their relative importance across the range of river values (e.g., native birds, irrigation and tangata whenau). RiVAS (which essentially assesses existing importance) has now been applied to 10 values, and to a large number of these in each of three regions (Tasman, Gisborne and Hawkes Bay). RiVAS+ (essentially restoration potential) has had limited application in Tasman but more thorough testing in Hawkes Bay and Gisborne. The experience from these applications is fascinating. First, there seems little question that RiVAS and now RiVAS+ are highly cost effective and valuable tools that all councils, and indeed central government, should be supporting and undertaking. At around \$5000 per value-application councils obtain: a collaborative approach that typically results in stronger relationships between councils and stakeholder groups; up to date (and user friendly and accessible) information on value-related data often never collected otherwise; lists of rivers ranked according to national (high), regional (moderate) and low (importance) using the same method; indications of where the best prospects for restoration activities exist; information that is immediately useful in the broader policy making processes of councils and other parties. Lessons from RiVAS implementation include: the importance of having a council champion; the need to ensure participants are committed to a collaborative process; acknowledgement of the need to have an ongoing process for managing new or improved data; having a clear understanding of what the generated

information will be used for. Future opportunities for RiVAS include: assisting councils in identifying indicators for monitoring key values; and more detailed examination how RiVAS and RiVAS+ could be used in tradeoff analysis and associated policy approaches.

### **Hazardous substances in Australian industries: Risk weighting and trends**

*Noor Muhammad*

Firm environmental performance can be measured as a reduction in the firm-specific amount of waste (Al-Tuwaijri, 2004; Clarkson, Li, Richardson, & Vasvari, 2008; Hart & Ahuja, 1996; King & Lenox, 2002; Sharfman & Fernando, 2008). This quantitative approach provides just one angle on environmental performance but is considered to be an important measure which can be estimated in aggregate, at the sector level, for individual companies and for individual plants (Clarkson, Overell, & Chapple, 2011; Hamilton, 1995; Murphy, 2002; Patten, 2002). This study analyses toxicity weightings for the Australian government toxic inventory and trends over ten years in seven different sectors. The results show that overall the Weighted Average Risk (WAR) of toxicants has increased in five sectors, declined in one sector and only changed nominally in another sector. At the company level the results were mixed whereas, on average at the facility level, five out of seven sectors show WAR declined and only in two sectors did WAR increase during the period of study.

### **Kauri Room: Agent-based Modeling and Heterogeneity**

*Session Chair Charlotte Cudby*

#### **Economic and geographic methods to develop an agent-based model of rural land use**

*Fraser Morgan*

This paper outlines an effort to merge the economic-focused catchment-level New Zealand Forest and Agriculture Regional Model (NZFARM) and a spatial heterogeneous agent-based model to investigate farmers and their land use decisions (called the Farmer Decision Model). Merging these models was undertaken need to improve the level of heterogeneity in models that estimate how farmers respond to environmental policy, the way environmental mitigation techniques are transferred through their peer networks, and the effect that both have on the resulting effectiveness of environmental policy are under examined in the literature. The incorporation of these micro-level perspectives of human behaviour through an approach such as an agent-based model can provide a better understanding of land use change processes, and will improve the resulting estimates of how policy could influence changes in land management and land use. The resulting Agent-based Rural Land Use New Zealand (ARLUNZ) model provides a tight coupling between the two models that enables a more realistic representation of land use by taking into account the structure, networks and approaches to farming while also providing an economic foundation on which the farmers make decisions against. We present the results from the initial application of the model, focused on the Hurunui and Waiau catchments in the North Canterbury region of New Zealand's South Island, and also provide an insight into the coupling of these two approaches for other models of land use change.

**Farmer social networks and risk profiles: an application of Desktop MAS, a multi-agent system model for rural New Zealand communities**  
*Chris Schilling*

This paper describes a multi-agent system (MAS) model, Desktop MAS, designed for New Zealand's pastoral industries. Desktop MAS models the strategic decisions and behaviours of individual farmers in response to changes in their operating environment. Farmer responses determine production, economic and environmental outcomes. Each farmer has a risk profile that governs their decision-making, and a social network with whom they can interact. Information transfer between farmers occurs through this social network. We consider a simple scenario analysis that investigates the impact of emissions prices on industry mix and farming intensity. We then investigate the importance of farmer interaction and heterogeneity of farmer risk profiles. We find that farmer social networks and risk profile impact particularly on farming intensity decisions within land-use industries. Land-use change between industries is sensitive to farmer attitudes when the profitability differential between land-uses is smaller.

**Mitigation and heterogeneity in management practices on New Zealand dairy farms**  
*Simon Anastasiadis*

We consider two approaches to quantify New Zealand farmers' ability to mitigate their farm's environmental impact: The construction of marginal abatement cost curves and improvements in farm management practices. Marginal abatement cost curves can be constructed by combining information on the effectiveness of mitigation with cost data. However, we find that the available data is not sufficient to support this approach. We consider improvements in management practices using a distribution of farm production efficiency with regard to nitrogen and greenhouse gas (kg

production per unit of emissions). Where differences in production efficiency are due to factors that can be managed by farmers, targeting less efficient farmers to encourage the adoption of management practices similar to those of the more efficient farmers is a potential mitigation strategy.

**Friday 13.00 – 15.00 pm**

**Kotuku Room: Council focused special session: Valuation and Planning**

*Session Chair Sandra Barnes*

**Towards an economic valuation of the Hauraki Gulf: The finding of an eco-cluster?**  
*Barbera Mattia*

This report summarises the results of the first phase of the investigation on the total economic valuation of the Hauraki Gulf, a multi-phase research project. The Hauraki Gulf is a complex ecological and geographical feature providing a wide range of environmental benefits which have attracted human settlers since the beginning of the colonisation of New Zealand. Today the Gulf represents one of Auckland's most important environmental, economic, social and cultural assets, and the most important marine asset for the Waikato region and it generates a vast and constant flow of benefits for human beings. By focusing almost exclusively on economic values/activities, the project's phase one has identified the environmental and economic benefits provided by the Hauraki Gulf and produced a general view of its economic value. Preliminary results show that the vast majority of the assessed economic values relate to recreational activities. The major contributor is tourism, followed by the recreational marine cluster, the Ports of Auckland,

commercial fishing and aquaculture, recreational fishing and the cruise industry. Therefore, from a holistic and ecological perspective, the Hauraki Gulf's economic activity is only minimally the result of an algebraic sum of competing values or a space where the focus has to be on conflicts and trade-offs; instead, a thriving ecosystem is necessary to support the economy and to realise the vast untapped economic potential of the Hauraki Gulf. The report suggests that the Hauraki Gulf is home to a cluster of economic activities that have the environment at the very core of their value proposition and share a common interest in protecting the environment as they depend critically on the flow of ecological goods and services provided by the Gulf. These economic activities could increase their value by collaborating more with each other. Therefore, they could be defined as an eco-cluster.

### **Valuing the direct use of water in Northland**

*Darryl Jones*

The National Policy Statement (NPS) for Freshwater Management 2011 requires regional councils to establish freshwater objectives and set environmental flows and/or levels for all water bodies of freshwater in its region, and to do this in a manner that provides for the efficient allocation of freshwater to activities. The Northland Regional Council has adopted an NPS implementation plan which involves addressing catchments on a priority basis. Prioritisation will be determined by an assessment of, among other things, the level of existing allocation, ecological values, direct and indirect use values, cultural significance and future pressures. This paper outlines the initial work that is being done to value the direct use of water by productive activities in Northland. The direct use of water includes both consented takes and estimates of permitted takes for each catchment. Activities include irrigation of pasture and horticultural crops, industrial uses such as cement manufacture, and meat/dairy/wood processing, and municipal water takes. Catchments can then be prioritised

in terms of their economic importance. This ranking can then be compared to other criteria such as current allocation, to determine, for example, whether those catchments that are most allocated are also those that are the most important economically. The valuation analysis will also help council set allocation limits and decide on the steps needed to achieve an efficient allocation of freshwater.

### **Cost benefit approaches to valuing nature: Case studies in New Zealand**

*Ross Wilson*

Regional and local councils need to maintain and enhance the benefits provided by the natural environment, but also to minimise the financial and economic costs to the community. Conversely, councils need to ensure that the benefits of growth and economic development can be achieved with minimal environmental costs. In order to manage the trade-offs between the various environmental and non-environmental costs and benefits, Section 32 of the Resource Management Act requires councils to evaluate the efficiency and effectiveness of any proposed regional or district plan, plan change or variation. Pure, fully monetised cost benefit analysis is in theory the ideal preferred approach for evaluations, but it is at one extreme of a whole spectrum of related approaches based on the level of detail and of quantification or monetisation. The Local Government Act 2002 requires councils to exercise judgement regarding where to sit on that spectrum. In practice, few s32 evaluations to date are fully monetised, and most are either purely qualitative (descriptive or matrices) or a mix of qualitative and quantitative (numerical or scoring) with little or no monetisation. This may have been appropriate in the past, but now new techniques and resources are more readily available to enable more detailed analyses. This paper reviews existing case studies and literature outlining approaches on current best practice Cost Benefit Analysis for section 32 and other environmental policy initiatives in New Zealand councils. The paper notes the importance of sound decision-

making, and the main legislative requirements on councils regarding their decision processes. It summarises the theory of cost benefit analysis, including principles of valuation and comparison, giving a framework for the levels of quantification or monetisation expected in practice in New Zealand. Case studies in New Zealand can then be categorised by their level of quantification and monetisation

### **Ecosystem services and local government policy and planning** *Georgina Hart*

It is vitally important we acknowledge that New Zealander's wellbeing and prosperity is crucially reliant on well-functioning natural systems, and that the decisions we make today affect the capacity of ecosystems to provide life supporting services to people in the long term. One way to achieve this is to incorporate a "multiple ecosystem services" approach into decision making around development decisions. At the local government level in New Zealand this means incorporating ecosystem services into policy, planning and resource consent decision making processes. Based on literature review and workshops with regional council staff we are developing guidance for regional councils, outlining why, how and where an ecosystem services approach and information could be usefully incorporated into natural resource management. This paper summarises our work on incorporating an ecosystem services approach into resource management practices in New Zealand. We assess the current regulatory framework, how and where an ecosystem services approach fits within the current framework and council processes; and how an ecosystem services approach could influence environmental outcomes from the regional to the local scale through a number of case studies.

### **Tui Room: External Shocks and Rural Outcomes**

*Session Chair Rod Forbes*

#### **Passing the buck: impacts of commodity price shocks on rural outcomes** *Sean Hyland*

Producers of agricultural commodities generally treat world commodity prices as exogenously determined on international markets. Domestic commodity prices then directly reflect world prices adjusted for the relevant exchange rate. Prices facing regional producers can also be considered exogenous when we aggregate producers over small districts. Through estimation of a vector autoregression (VAR) model on panel data covering rural districts of New Zealand over 1990-2011, we consider the impacts that exogenous shocks to commodity prices have on rural areas. We find that a positive shock to commodity prices leads to a permanent increase in local farm prices, house prices and new house building consents. Commodity price shocks also affect the NZD exchange rate, but the NZD does not fully cushion local producers from the effects of commodity price changes. Thus long run rural community outcomes are determined, in part, by exogenous global influences as represented by international agricultural commodity prices.

#### **Modelling climate change impacts on agricultural production in New Zealand at the catchment scale** *Kanika Jhunjnuwala*

This paper uses New Zealand Forest and Agriculture Regional Model (NZ-FARM) to assess the potential economic and environmental impacts of climate change in 2040 and 2090 on the agriculture and forestry sectors in

the Manawatu and Hurunui-Waiiau catchments in New Zealand. Our estimates find that climate change will have mixed results in both catchments, depending on the land use, ability for the landowner to adapt to a changing climate, and the year of the climate change projection. Revenue in Hurunui-Waiiau is expected to decrease, but environmental impacts such as GHG emissions and nutrient discharges also decrease due to the shift in land use from primarily sheep and beef to forestry. As more water becomes available for irrigation with the inclusion of the Waitohi Irrigation Scheme, an increase in farm profits is expected for landowners who benefit from access to the additional water, but so do environmental impacts such as water quality degradation. Climate change impacts are projected to raise net revenue in Manawatu with a substantial increase in arable cropland and grain production due to possible benefits from climate change, again resulting in threats to water quality.

### **Price, Quality, and International Agricultural Trade**

*Darian Woods*

The average value of a particular class of agricultural exports varies widely across different destinations. This raises the question: in the event of a supply shock, such as the implementation of the Emissions Trading Scheme, can farmers offset higher costs by raising their average prices by contracting exports to lower value destinations? If the difference in value reflects different prices because producers have market power, the answer will be “yes”. If the difference in value reflects differences in the quality of goods exported to different destinations, the answer is “no.” This paper use a variety of trade data and techniques to examine which explanation is most likely to be relevant. While the answers are not definitive, there is little support for the hypothesis that exports are curtailed.