



Conference

Conference “Addressing contemporary challenges: Business, Agriculture,
Natural Resources and the Environment”

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	Kotuku (Upstairs)	Tui (Upstairs)	Kauri (Downstairs)	Rimu (Downstairs)
Thursday afternoon	Farm Inputs Guy Trafford	Forestry Paul Dalziel	Valuing Natural Resources Mark Neal	Economic Development Meike Guenther
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2.00-2.30	Eva Schröer-Merker Status and future perspectives of smart tools and apps in NZ agriculture	Peter Edwards Small scale forestry: Economic and political moves for improved harvesting	Chris Batstone Waterbody Ecosystem Services Wellbeing Index (WESWI)	Brian Bell Pitfalls on the rocky road to good economic analysis in the Pacific
2.30-3.00	Rachael Davidson What do New Zealand dairy cows eat?	Richard Yao Identification and evaluation of biodiversity conservation sites in planted forests: An application of economic, ecological and spatial approaches	Yvonne Phillips Cumulative attraction of developed and undeveloped beaches in multiple-destination recreation trips	Anthony Anyanwu Bank credit and non-hydrocarbon output growth in oil dependent economies
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Friday morning	Consumer Demand John Saunders	Reducing GHG Thiagarajah Ramilan	International Agriculture Richard Yeo	Development and Efficiency Chris Batstone
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9.00-9.30	Sini Miller Assessment of consumer willingness-to-pay on social responsibility on food and beverages across countries and products	Phil Journeaux Modelling farm system change impact on GHG emissions on Maori farms	Mercy Kiremu Evaluation of catastrophic loss in Kenyan agriculture	Peter Tozer Ownership, region, system or ? – What leads to efficiency?
9.30-10.00	Meike Guenther Impacts on the agricultural sector in NZ from premiums of attributes in food products in developed and emerging markets	Jack Keeyes An integrated model for economic analysis of GHG reduction in NZ dairy systems	Suborna Barua Climate change impacts on agricultural trade patterns: Five decades assessment of the World, Asia and Oceania	William Wright Succession and investment in NZ farming



	Kotuku (Upstairs)	Tui (Upstairs)	Kauri (Downstairs)	Rimu (Downstairs)
10.00-10.30	Sini Miller Domestic food and beverage consumers' attitudes towards product attributes, alternative retailers and use of smart-technologies	Guy Trafford The shifting boundaries of forestry and pasture under a carbon price future	Prince Maxwell Etwire Impact of climate change on Ghana's agriculture: A structural Ricardian analysis	Caroline Saunders The Land and the brand
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1.30-2.00	Marin MacNamara Farmer compliance with environmental regulation: A preliminary look at the drivers and barriers for Canterbury dairy farmers	Alan Renwick Governance challenges in aquaculture	Helen Scarborough Exploring the economic viability of using constructed wetlands to manage waste-water in the dairy industry	
2.00-2.30	Mark Neal An ode to output-based regulation	Chris Batstone Ka Hao Te Rangatahi: New directions for the New Zealand scampi fishery?	Alison Bailey Evaluation of field wetlands for mitigation of diffuse pollution	
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Contributed Paper Session I**Thursday 1.30 – 3.30 – Kotuku Room**

Session Chair – Guy Trafford

Farm Inputs***Thiagarajah Ramilan – Ex ante analysis of irrigation interventions in Orchards***

Northern Victoria's fruit industries make a significant contribution to the economies of the regions. All orchards in the region depend on irrigation water. Water scarcity is enhanced by climatic variability as well as environmental demand. This study focuses on the economic implications of water scarcity under strategies aiming to reduce consumptive water use and maximising orchard returns through manipulating crop load. Complex biological and economic relationships present in commercial orchard systems are simulated by means of water profit functions, which capture tradeoffs among yield, quality and water consumption. These functions are used to build a representative whole-farm economic model, to capture economic implications of interventions.

Eva Schröer-Merker – Status and future perspectives of smart tools and apps in New Zealand agriculture

The pace of technological development is vast, and exponentially increasing. Research suggests that this will also have an ever increasing impact on dairy, with the deployment of drones and sensors as just the beginning.

The demand for formal control has increased greatly in recent years. This was promoted, in part, by an increased awareness about impacts on the environment and subsequent government legislation.

The Centre of Excellence in Farm Business Management is a project managed by Agri One, a joint venture between Lincoln and Massey Universities. This is funded by two Primary Growth Partnership funds: Transforming the Dairy Value Chain and Red Meat Profit Partnership. It is an independent source for information on recent developments in farm management.

Our research into decision making and information management has shown that formalisation and the use of software solutions / apps is largely driven by compliance requirements and the perceived value add.

Albeit, or because of, the large number of smart tools available to dairy farmers a whole different set of challenges arises, namely connectivity, rural broadband and the perceived overload of data / single solutions. In the future, dairy farmers will have to be able to leverage their existing knowledge and combine this with new technologies to remain not only compliant but to stay at the top of their game. Smart systems will start 'talking' to each other (Internet of Things) in order for collected data to have the biggest impact on their business and the agri-food supply chain as a whole.

Rachael Davidson – What do New Zealand dairy cows eat?

Over the last 25 years the New Zealand dairy industry has expanded with the number of cows milked doubling from 2.4 million in 1990-91 to 5.0 million in 2014-15. This increase has occurred through both more hectares (particularly in the South Island) and an increase in stocking rates. In addition, milk solids per cow has increased steadily at a rate of 4.7 kilograms per year, through increased feed eaten (+161%) and feed conversion efficiency (FCE). Given the lack of good feed data available, this project attempts to capture and estimate the volume of feed eaten by New Zealand dairy cows. Overall, feed demand increased 4.9 tonne (+53%) per hectare since 1990-91, with the volumes of pasture and pasture silage, palm kernel extract (PKE), maize silage, and in recent years fodder beet consumed all growing

significantly. Pasture and pasture silage accounted for just over half of the increase in feed consumed, but as a proportion of a cows' total diet, pasture declined from 96 per cent in 1990-91 to 82 per cent in 2014-15.

The future is difficult to predict given the current low milk prices, volatile seasonal weather conditions, availability of water for irrigation and environmental regulation. It is likely the volumes and mix of feeds consumed by dairy cows will change to 2030-31. The impacts of these future changes will have considerable economic consequences for regions and may result in some land use change.

This paper provides a summary of the trends in the volume of feed consumed by dairy cows and the methodologies developed to capture data and estimate it over the last 25 years. Our analysis also provides some possible feed demand forecast scenarios to 2030-31 including possible volume changes in different feeds consumed by dairy cows.

Jacob Kambuta – The integration and social inclusion of migrant dairy workers in Canterbury: A preliminary analysis

A diverse stream of migrant workers brings a range of social and human capital to both the dairy industry and the surrounding rural communities. This study develops a conceptual framework for understanding the integration and social inclusion of migrant workers, and applies it to the ethnographic data collected through interviews and surveys with migrant dairy farm workers and dairy farm employers on Canterbury dairy farms. This study aims to identify the enablers of and barriers to integration, focusing on social connections, and cultural exchanges between migrants and host communities. In doing so, this research contributes to ongoing attempts to define integration and social inclusion, within the context of farming and rural communities. This research addresses integration and social inclusion in a very holistic manner, highlighting the importance of the inclusion and active participation of migrant dairy workers and their families in the economic, social, political and cultural spheres of New Zealand society. The preliminary results of this study indicate that migrant dairy workers need not face spatial separation, discrimination from the community, or a gendered and racialised labour context in order to experience social exclusion. Preliminary results also reveal the primary barriers to migrants' full participation in the life of the communities in which they live and work are factors such as physical distance, available time for non-work activities, work roster, and immigration status, and the opportunity for civic and social participation, and personal activities such as health care and education. Key words: Integration, social inclusion, migrant dairy workers, dairy farm employers, Canterbury, New Zealand.

Thursday 1.30 – 3.30 – Tui Room

Session Chair – Paul Dalziel

Forestry

Ivan Luketina– *Why do some of New Zealand's markets prefer to import logs rather than sawn timber?*

New Zealand exported logs to 33 countries and sawn timber to 63 countries (31 countries import both from New Zealand), in the year ending Dec 2015. Based on the trade volumes, some markets prefer to import sawn timber, others prefer logs. The ultimate end use driver of sawn timber is the same for both log and sawn timber markets, but markets show a preference for importing one or the other.

New Zealand's export markets are identified, and classified into sawn timber or log markets, depending on the ratio of goods exported to those countries. The markets that receive a greater ratio of sawn timber than logs were Viet Nam, USA, Australia, Indonesia, Taiwan, Thailand, and Japan, while the markets that were skewed towards log imports were China, Korea and India.

Once identified the study looks at the key variables that explain the difference between the two groups of markets. Differences in the markets include tariffs and non-tariff barriers designed to protect local industries. Tariff escalation (where more processed products attract higher tariffs) is often used to discourage imports of processed wood products.

Other variables identified include the size of the local resource, the domestic processing capacity, the type of ports in import markets, and the type of local resource e.g. hardwood markets had less experience with processing softwood.

Peter Edwards – *Small scale forestry: Economic and political moves for improved harvesting*

Small-scale foresters own approximately 50% of forested lands in New Zealand, often steeper, less accessible or desirable land. Numerous small-scale foresters have made the claim that it is uneconomical for them to harvest their blocks in isolation, and are looking for ways to gain a more optimal benefit from their holdings. In this paper we propose a conceptual framework for two possible ways of exploring optimising small-scale forest benefits to their owners. We propose to examine this issue through an economic framework and a political framework.

First, we propose to examine harvesting economics on different topographies in New Zealand, under several harvesting regimes. This will be achieved through the use of a real options framework to examine the incentives for replanting land in forest or conversion to other land uses. We will examine potential compensation for the loss of flexibility in forest planting through the value of ecosystem services on the study blocks.

Second, we propose to examine the economics of harvesting is through Ostrom's collective action framework for small-scale forest owners. We will attempt to determine with small-scale forest owners the optimum group size and type and the information needed to provide opportunities for interaction, reputation and building of trust. These factors may also help us determine how to allow collective action to become de rigueur in a collaborative but competitive environment.

The outcomes from each of these approaches can provide insight into policy options to encourage forest planting in New Zealand.

Richard Yao – *Identification and evaluation of biodiversity conservation sites in planted forests: An application of economic, ecological and spatial approaches*

Predicting the extent and rate of adoption by farmers of agricultural innovations is central to assessing the benefits to be had from research, marketing and extension programs. It is also crucial to assessing the likely response of farmers to policies offering incentives for, or compelling, the adoption or abandonment of particular agricultural technologies and practices.

In a previous paper we described an approach to predicting rates of adoption and compliance with respect to agricultural technologies and practices that drew on the dual-process model of consumer decision-making and a method for classifying innovations in farm systems. The approach results in two-dimensional maps based on the complexity and relative advantage of agricultural practices or technologies that captures their stickiness.

The placement of practices and technologies in these maps can be employed to predict rates of adoption of innovations and draw inferences about the role of incentives and extension in influencing those rates.

In this paper the results of applying this approach using data gathered from a survey of 200 dairy farmers in the Waikato and Waipa are reported. The implications of the results for predicting rates of compliance with policies regulating the use (or abandonment) of farm practices and technologies affecting water quality are discussed.

Anita Wreford – *Decision-making under uncertainty: Robust approaches for adapting to climate change using afforestation as an example*

Planning for climate change adaptation is challenging due to the unavoidable uncertainty associated with future climate changes. Uncertainty stems from natural variability in the climate, as well as

modelling, downscaling and the unknown extent of future mitigation and socio-economic changes, and may present a barrier to decision-making. Despite this uncertainty, adaptation decisions still need to be made now to effectively reduce vulnerability to climate change.

For efficient investments, the costs of an adaptation project should not exceed the benefits. In this context of deep uncertainty, the costs of adaptation actions are often observable and immediate, while the benefits are often uncertain in terms of timing, location and magnitude. Applying standard decision-making approaches such as cost-benefit analysis when such high uncertainty exists can pose challenges. So-called 'robust' approaches for economic appraisal under uncertainty are increasingly being applied in the context of climate change adaptation. Robust approaches select projects that would be suitable across a range of climate futures. They do not assume a single climate change projection but integrate a wide range of climate scenarios, by either finding the least vulnerable strategy across scenarios (Robust Decision Making), defining flexible, adjustable strategies (Real Options Analysis (ROA)), or diversifying adaptation options to reduce overall risk (Portfolio Analysis).

This presentation will outline the principles of each of these approaches, before focusing on an application of ROA applied to afforestation measures for flood protection in Scotland. We develop a simplified application of ROA which makes use of the freely available climate data of the UKCP09 weather generator and can be implemented in a spreadsheet. We provide a flexible strategy as an output but also observe the high cost of the NFM due to the maintenance of the forest.

Thursday 1.30 – 3.30 – Kauri Room

Session Chair – Mark Neal

Valuing Natural Resources

Femi Olubode – Mapping and Assessment of Freshwater Ecosystem Services and Values - The Case of Waikato Region

In the proposed Waikato Regional Policy Statement, objective 3.7 states the council will take an ecosystem services approach to recognise and maintain or enhance freshwater ecosystem services to enable these services ongoing contributions to regional wellbeing. Monitoring ecosystem services and socioeconomic and cultural values could increase the productivity and efficiency of resource use for community wellbeing. This is because the ecosystem services approach to natural resource management considers all services to all sectors of a community.

To facilitate this approach, tools such as maps and database of ecosystem services are useful at a level of detail at which policy and management decisions are made. This study set out to provide some understanding of services and values of freshwater bodies (rivers, streams, lakes and wetlands) in the Waikato region by assessing the ecosystem services with maps and underlined database system showing current and potential ecosystem services of a sample of freshwater bodies in the region. The challenge of capturing the stock and flow values of ecosystem services as well as scaling on-site observations to the catchment level were encountered. However, the project came up with a database system that allows structured querying, searching and updating of the database as more information is available on the sampled ecosystems. The ecological status and health of the ecosystems reflect on services and values of these natural resources using the Millennium Ecosystem and Assessment (MEA) and the Common International Classification of Ecosystem Services (CICES) frameworks. This will help the regional council's capacity in monitoring the effectiveness of its natural resource management and policies.

Chris Batstone – Waterbody Ecosystem Services Wellbeing Index (WESWI)

The acronym WESWI represents Waterbody Ecosystem Services Wellbeing Index. WESWI is designed to assist collaborative process decision makers weigh the trade-offs between the wellbeing associated with employment, housing and industry contribution to regional value added income, and that

associated with the ecosystem services delivered by freshwater and coastal waterbodies impacted by urban development. We examine the use of WESWI in an urban development case study located on the urban fringe of Auckland City. We show how WESWI can be used to understand the effects of contrasting urban storm water management scenarios on the wellbeing associated with ecosystem service provision by an urban stream.

Yvonne Phillips – *Cumulative attraction of developed and undeveloped beaches in multiple-destination recreation trips*

Recreation value is an important consideration in a cost-benefit analysis of the environment. The travel cost method (TCM) is often used to quantify recreation values. But choice of recreation site only partially reflects the intrinsic characteristics of that site. Visitors are also influenced by opportunities available at other sites and may visit multiple sites which is in violation of TCM the assumptions. This paper is about the recreation value of beaches on the Coromandel Peninsula. We use the principle of cumulative attraction to identify complementary sites for each beach and include these in a random utility model of site choice. The model fit is improved over a single-site model and shows that recreation values are maximised when sites are diverse in terms of development level and facilities.

Pedro A. Flores Tenorio – *Including the maintenance of ecosystem resilience of an old-growth forest as a choice for natural carbon sequestration funding. An ecological-economic approach*

Australia is one of the first countries to prepare long-term pathways studies to decarbonize its economy. Peru is a megadiverse country with the second extension of forests in the Amazon basin. The design of efficient public policies for these territories is challenging due to the fragility of public institutions and lack of economic valuation of important ecosystem services provided from old-growth forests. This paper presents first, the experimental design of a choice modelling experiment including the ecosystem resilience as an attribute. Then, in second place, presents an ecological-economic model for a key non-timber forest product of the Peruvian Amazon basin: the Brazil nut (*Bertholletia excelsa*) and analyses the bioeconomic dimensions of two ecosystem services: pollination and the forest cover to provide habitat for flora and fauna. Could the investment in natural carbon sequestration in the Amazon be the best economic option for developed countries as Australia or New Zealand to mitigate the effects of climate change instead of man-made carbon sequestration strategies? We discuss the implications of this choice from the ecological-economics perspective.

Thursday 1.30 – 3.30 – Rimu Room

Session Chair – Meike Guenther

Economic Development

John Saunders – *LAO: Long-term modelling for agriculture*

There are increasing challenges to the future of agriculture, such as climate change, food security and food scarcity, which will manifest over the long-term. While the majority of economic and trade modelling tools/approaches assess short- and medium-term outlooks. The Long Agricultural Outlook model (LAO) was developed collaboratively between the Organisation for Economic Co-operation and Development (OECD) and the Agribusiness and Economics Research (AERU) in order to address this gap in analysis. The model aims to both analyse changes in policy and trade dynamics over the long-term (up to 2050) and to supplement medium-term models with longer foresight for price developments in the agricultural sector. The model uses highly aggregated region and commodity groupings in a partial-equilibrium framework to project the state of agriculture out to 2050. As the model is currently

being validated, this paper will focus on the structure and development of the model, and present preliminary results.

Brian Bell– *Pitfalls on the rocky road to good economic analysis in the Pacific*

Seen it all? 30 years of experience as a development economist working in PICs and still able to be blindsided. This paper provides insights into the realities of applying natural resource management principles to programmes and projects in the Pacific. The best analysis for investment and policy is often compromised by deficiencies in management and governance: the Pacific way. Why we should persist.

Anthony Anyanwu– *Bank credit and non-hydrocarbon output growth in oil-dependent economies*

Over the last decade, oil-dependent countries have been promoting diversification towards the non-oil sector. In particular, significant priority has been given to the financial sector since finance is essential to fund private sector-led economic diversification and thus sustain long-run economic growth. Our research study investigates the role bank credit plays in oil-rich economies and whether this role differs in the non-oil sector.

Utilizing panel co-integration and pooled mean group techniques, over the period 1990-2012 for 28 oil-dependent countries, our results show that a one percent increase of bank credit to the economy significantly increases GDP per capita by 0.06 percent, whereas, a one percent increase of bank credit to the non-oil sector decreases non-oil GDP per capita by 0.01 percent, though insignificant. In other words, bank credit has no effect on the growth of the non-oil sector.

This research study is important because there is a need for oil-dependent economies to diversify away from natural resources and explore other sources of revenue. Non-natural resource sectors are the major drivers of the economy; they are a labour intensive industry, have more linkages to the rest of the economy, and generate more employment unlike the natural resource sector, which is capital intensive. The economic potential of non-natural resource sectors is great and the resources remain largely untapped.

Contributed Paper Session II**Friday 8.30 – 10.30 – Kotuku Room**

Session Chair – John Saunders

Consumer Demand

Caroline Saunders – Maximising Export Returns: Consumer preferences for credence attributes in developing and developed country markets and how these can be communicated through smart technologies

Understanding international consumer preferences and attitudes towards credence attributes in food products is important for countries like New Zealand that depend heavily on food exports. Over the last few decades, New Zealand's export focus has changed from almost all exports going to Europe, to more into Asian markets, in particular to China. It is therefore important that different cultures and preferences in these markets are considered and understood. This paper will present results from a series of surveys in various countries including the UK, Korea, Japan, India, China and Indonesia. The surveys focus on how consumers in different markets respond to different attributes in food products and on how New Zealand producers can communicate those using digital media and smart technology. Results showed that overall respondents in developing countries considered food attributes more important than those in developed countries. The surveys then examined in more detail the importance of factors affecting key attributes of environmental quality, animal welfare, human health and food safety and the relationships between these. Also this did differ across countries.

Sini Miller – Assessment of consumer willingness-to-pay on social responsibility on food and beverages across countries and products

Choice experiments have been used to assess consumer preference and willingness to pay (WTP) for different food attributes worldwide. This context often includes credence attributes which are the product attributes that are not immediately seen or experienced by consumers in purchase situations, such as animal welfare, food safety and social responsibility. While extensive research considering some of these attributes exists, social responsibility has been explored less. Building on the previous work on comparing developed and developing countries, this paper focuses on WTP estimation on social responsibility. Five online surveys with 1000 respondent each were conducted in United Kingdom, Japan, India, Indonesia and China in 2015. The results show that the average WTP for social responsibility ranged from 18% to 90% (median 10%-48%) to move from minimum to an improved level, and 3% to 41% (median 6%-81%) to move from improved to a high level. The premiums vary between countries and products. These results increase the understanding of consumer preferences in different countries and indicate where there could exist a potential for a premium from social responsibility attribute.

Meike Guenther – Impacts on the agricultural sector in NZ from premiums of attributes in food products in developed and emerging markets

Consumer preferences for different credence attributes in food vary across different countries and commodities; and consumers in both developed and developing countries are willing to pay premiums for food carrying these attributes (e.g., food safety, animal welfare, environmental sustainability). Hence, countries like New Zealand and the EU (28) that are large exporters of agricultural commodities

can capture price premiums by including credence attributes in food products for overseas markets. This study assessed the potential economic impact on agricultural returns of different levels of premiums for food attributes in New Zealand and the EU (28). The analytical approach employed the Lincoln Trade and Environment Model (LTEM). This partial equilibrium model forecasts international trade, production and consumption of agricultural commodities. Four scenarios were developed with varying levels of premiums for food attributes in three developing countries (India, China, Indonesia) and six developed countries (Australia, Canada, EU (28), Korea, Japan and the United States of America). Results showed that different ranges of premiums for credence attributes in food products in the countries of interest were projected to increase EU (28) and New Zealand producer returns for dairy, beef and sheep meat by 2024. In particular, for New Zealand significant increases of producer returns were projected for cheese and sheep meat while in the EU (28) returns were high for butter.

Sini Miller – Domestic food and beverage consumers' attitudes towards product attributes, alternative retailers and use of smart-technologies

Food and beverage products include different attributes categorised as search, experience and credence attributes. While some research has examined consumer preferences for food attributes internationally, domestic consumer preferences in New Zealand have not received the same consideration. This paper presents initial results of a nationwide survey exploring domestic consumer attitudes and preferences for the selected attributes including food safety, environmental condition, animal welfare, social responsibility, health enhancing benefits and traditional Māori cultural elements. In addition, the survey explored consumers' use of alternative retailers (supermarkets, farmers markets, specialty shops and food delivery services) and the reasons behind these uses. Finally, we also looked into consumers' current use and attitudes on smart technology which could be used to communicate credence attributes. This study builds on the international survey conducted in previously on five overseas markets, which allows a comparison between domestic and international responses. This information is useful for New Zealand producers to increase understanding what domestic consumers consider important and how this compares to consumers at export markets.

Friday 8.30 – 10.30 – Tui Room

Session Chair – Thiagaraja Ramilan

Reducing GHG

Steven Upton – Analysing the implications of increased nitrogen application on greenhouse gas emissions and productivity of New Zealand sheep and beef farms

This study analysed the implications of increased nitrogen fertiliser application on productivity and greenhouse gas emissions for New Zealand sheep and beef farms using decision support models Farmax Pro and Overseer. Three scenarios were modelled to use the additional pasture production achieved from the different rates of nitrogen fertiliser. The results were compared with a base model sheep and beef farm based on Beef and Lamb class 9 averages. These scenarios were (1) better feeding livestock to increase end live weight, (2) increasing stocking rate and (3) better feeding livestock to reduce the number of grazing days. Simulations were then run with the different rates of nitrogen fertiliser ranging from 20 to 100kgN/ha/annum through each scenario.

Consistent with the hypotheses, the efficiency of utilisation of extra grass production is an important determinant of the ratio of product output to GHG emissions. For scenario 1 and 2, productivity increased with the ratio of profit to kg of GHG emissions increasing. In scenario 1, the profit per kg of GHG emissions increased 27% in simulation 1 from the base model farm. This occurred when nitrogen fertiliser was increased to 20 kgN/ha/yr from 5.6 kgN/ha/yr. The ratio increased 0.6% for scenario 2

for the same change in nitrogen fertiliser. In scenario 3, the ratio of profit to kg of GHG emissions decreased 9% for the same change in nitrogen fertiliser. In all scenarios, GHG emissions increased.

When N fertiliser application is increased, productivity increased, greenhouse gas emissions could not be reduced and the proposed emissions trading scheme will have little impact on profitability.

Strategic use of N could improve hill-country resilience. With an increase in strategic N fertiliser application, livestock can be better fed; thus, increasing live weight and reducing the number of grazing days.

Phil Journeaux – Modelling farm system change impact on GHG emissions on Maori farms

The paper covers the modelling exercise which is part of a larger project to assist the Maori pastoral sector to improve productivity while reducing GHG emissions.

The modelling work has been carried out on 4 focus farms; 2 dairy, and 2 sheep; beef. Meetings with the Trustees identified farm systems they were interested in, with the subsequent modelling, using Farmax and OVERSEER, identifying the feasibility of the system, the change in farm profitability, and the change in both GHG emissions and nitrogen leaching. Planting up of marginal areas into forestry or manuka were also modeled.

The results show the change in farm profitability relative to any change in GHG emissions, along with any changes in emission intensity.

An LCA approach was also investigated with respect to supplementary feeds bought into the farming system, as well as a comparison between a straight carbon tax imposition and the current ETS approach via the processors. The impact of a carbon neutral situation was also investigated.

Jack Keays – An integrated model for economic analysis of greenhouse gas reduction in New Zealand dairy systems

The New Zealand dairy industry is associated with significant greenhouse gas emissions. Despite the importance of the dairy industry to the New Zealand economy; being accountable for climatic impact is an increasing responsibility. Emission reduction is commonly thought to occur at the expense of production and profit; however all three must be enhanced simultaneously for a sustainable future. This research was undertaken to evaluate various potential methods of achieving lower emissions without compromising production and profit.

The goal of the research was to identify opportunities for reducing greenhouse gas emissions while maintaining or enhancing milk production and farm profit. A ‘standard’ Waikato dairy farm model was created using Farmax Dairy Pro and Overseer software. These programmes were used in an integrated modelling process for an environmental and economic analysis of greenhouse gas mitigation options.

A 22.4% decrease in total on-farm greenhouse gas emissions, while growing production 4.7% and increasing economic surplus by 1.8% was achieved through a combination of halving nitrogen application across the farm, doubling palm kernel expeller offered, and a stocking reduction of 10% in addition to conducting effective agroforestry, crop rotation, conservation tillage and nutrient cycling practices.

The results indicated that an average performing Waikato Dairy Farm can implement specific farm system changes to achieve a reduction in greenhouse gas emissions without causing a negative impact in production and/or profit.

Although the research results do not reflect exact emission, profit and production changes, they do indicate which mitigation options are most likely to have the most significant on-farm impact when applied in a practical setting. This research also indicates potential results that could be observed when applying a combination of farm system changes simultaneously in an attempt to lower the emissions footprint of Waikato dairy farms.

Guy Trafford – The shifting boundaries of forestry and pasture under a carbon price future

Nearly 50% of the total carbon emissions (CO₂e) in New Zealand come from farmed livestock, (MPI, 2010) unusual for a developed country and a situation which creates its own difficulties in addressing. One measure which is being considered is putting a carbon tax on all emissions, including livestock. Countering this tax is an opportunity that is also provided where those that develop technologies and methods to sequestered CO₂e can benefit from receiving income at the same rate as the 'tax' is applied to emitters. This research examines extensive hill country sheep and beef farms on the East Coast of the North Island of New Zealand and models the effects of a changing carbon price on the use of farmland. By planting trees farmers are not only able to balance their livestock and other CO₂e emissions but potentially also gain valuable income if they can sequester carbon at a greater rate than it is being emitted. By incorporating a tree planting programme on land less suited to livestock pastoral systems Farmers can not only obtain an offset for farm carbon emissions but potentially gain a financial advantage from the carbon payments and also the value of the timber at harvest. In the modelling programme the region was divided into three different land types; steep, which had 30% steep over 25degrees slope, 50% over 15degrees slope and 5% classed as flat down to intensive which had 5% over 25degrees, 80% over 15 degrees slope and 15% classed as flat. Falling in between was medium classed land. Three farm models were developed reflecting the three varying different ratios of land types, intensive, medium and steep. This paper focuses on the extensive sheep and beef model.

The modelling approach used is an optimising Quadratic Linear Programme which includes a totally integrated sheep and beef system which captures livestock CO₂e emissions' plus the economic outputs. In addition, linked in, is an IRR/NPV spreadsheet which models the economic returns per hectare of forestry which is then annualised to provide a financial input into the farm model.

Key inputs are able to be altered to reflect different realities i.e. namely changing prices of carbon, livestock returns and different percentages of CO₂e liability within the agricultural sector.

The outputs are the changing forestry pastoral frontier and the different economic returns and physical outputs provided by the farming system (including forestry).

Friday 8.30 – 10.30 – Kauri Room

Session Chair – Richard Yeo

International Agriculture

Thang Chien Mai – Price asymmetry of coffee beans: Evidence from Vietnam

Coffee is an important crop for the agricultural economy of Vietnam, accounting for about 22% of the agricultural export value in 2014. During last three decades as the nation transitioned from a planned to a market economy, Vietnam has become more integrated into the regional and global market. The government has also partially liberalised the coffee sector by restructuring state-owned enterprises, providing favourable credit for private businesses, and permitting foreign-owned companies since 2000. However, with this move domestic coffee prices have become more exposed to the volatility of world coffee prices, so that the extent of any benefit from these policies depends on the nature of the price transmission between the two markets. If asymmetric price transmission (APT) occurs, the welfare gains for farmers may not be as great as expected from such economic reforms. Alternatively, if the price transmission is symmetric, such policies may be a change for the worse in times of downward prices.

The research aims to evaluate the price transmission between export and farm prices for Vietnam's Robusta coffee beans in regard to the long-run (LR) relationship and the short-run (SR) adjustment. This study applies both standard and threshold vector error correction models to detect any APT. These models are also able to provide evidence of linear and non-linear nature of the adjustment process.

Preliminary results suggest that APT exists for export prices in the LR and for farm prices in the SR when thresholds are considered. Despite the trivial asymmetries, the daily speed of adjustment is so high as to lead one to conclude that the price transmission is symmetric. One possible explanation could be the absence of market power resulting in price-taking behaviour in the domestic market. Given a downward trend over the past five years, such results imply that these liberalisation policies alone are inadequate to ensuring the welfare of coffee farmers.

Mercy Kiremu – Evaluation of catastrophic loss in Kenyan agriculture

Agriculture is a sector that is highly sensitive to climate variability and extreme weather conditions such as droughts and floods. The occurrence of these events is predicted to increase in frequency and intensity due to climate change. These events have adverse effects on agriculture, especially rain-fed agriculture leading to food insecurity for millions of people. As a result, it is necessary to determine approaches that facilitate better estimation and management of resources needed given the occurrence of these extreme weather events. This is important for better financial risk management and consequently enhancing sustainable growth of the agricultural sector. This paper explores application of the Value at Risk (VaR) method in estimating financial loss as a result of drought. Agricultural loss as a result of rainfall variability and drought is calculated. Extreme Value Theory (EVT) is used to model the distribution of the agricultural loss. Future actions will be proposed with a view to enhancing financial risk management in the agricultural sector. This has the potential to enhance resilience to disasters.

Suborna Barua – Climate change impacts on agricultural trade patterns: Five decades' assessment of the World, Asia and Oceania

Climate change variability alters the specialization and portfolio of production and trade in agricultural markets. Previous studies suggest that climate change has a negative impact on economic growth and production patterns; in particular climate variability may significantly affect yields and commodity prices.

This paper investigates the impact of climate variability on agricultural trade using detailed estimates of temperature and precipitation for more than 70 countries over a period of 50 years. This study uses as control variables estimates of national income, comparative advantage in land, climatic zone differences, and estimates of national agricultural rates of assistance and trade membership. The estimation framework utilizes Driscoll-Kraay, Newey-West, and FGLS regressions on panel data, and produces comparisons of estimates for the World, Asia and Oceania. Findings suggest that, variations in temperature and precipitation over the period considered have a significant impact on total and agricultural exports at global and regional level. This paper provides evidence that agricultural exports patterns are vulnerable to variations in climatic conditions. These estimates could be used in future projections considering climate change as a determinant of agricultural production and trade patterns.

Prince Maxwell Etwire – Impact of climate change on Ghana's agriculture: A structural Ricardian analysis

Several techniques have been used in the literature to estimate the economic impact of climate change on agriculture, many of which do not explicitly consider adaptation and thereby tend to produce biased estimates. Using a two-stage optimization procedure known as the structural Ricardian model, we estimate the impact of climate change on crop production by relying on climate, farmer and farm observations from Ghana. We make two contributions to the related literature. First, we estimate the response function between agricultural profits and land tenure system. In addition, we examine the influence of functional form on structural Ricardian estimates. We find that the impact of temperature on crop production is more noticeable than that of rainfall. In addition to climate, soil productivity and land tenure system influence crop selection and profit. Even though functional form does not seem to affect the structural Ricardian estimates, it influences the resulting predictions. Linear and semi-logarithmic specifications tend to simulate larger impacts of climate change as opposed to a Box-Cox transformation.

Friday 8.30 – 10.30 – Rimu Room

Session Chair – Chris Batstone

Development and Efficiency

Suzanne Trafford – Economic impacts of lamb rearing systems on sheep milking profitability

In New Zealand sheep dairying is receiving increasing attention as a potential new land use option; however, there is little information available about different lamb rearing options and the impacts upon the whole systems economics. There are multiple lamb rearing options ranging from; euthanising surplus lambs at birth; artificial rearing; keeping on ewes until ready to wean (weaning date may range from 30 days up to 12 weeks); share milking on ewes up to 35 days (milking ewes once-a-day up to that time). Increasing interest in sheep dairying in the Canterbury region (a traditional sheep farming area) depends on farmers being able to assess their relative system options. This has been difficult to do. This research fills the information void. It involves the modelling (using linear programming) of four potential lamb rearing systems, to assess their profitability. Production assumptions are based upon both international and limited New Zealand data. Key output measured were net farm profitability, milk production available for sale and sheep numbers.

Peter Tozer – Ownership, region, system or ? – What leads to efficiency?

Employing stochastic frontier analysis, the efficiency of milk solids (MS) production in a seasonal milking system in New Zealand was studied. The production function comprised supplementary and pasture costs; health, reproduction, and other costs; stocking rate and labour to estimate the yield of MS per hectare. Inefficiency in MS production was captured in a second model incorporating feeding system type, region, and the percentage of cows calving in the first 6 weeks of the milking season. A data set of 392 dairy businesses, owner operators and sharemilkers, from New Zealand for the 2013-14 milking season was used in the study. The results showed that average relative efficiency across all farms was 84 per cent, the most “efficient” producers fed a relatively higher level of supplements, and achieved a higher percentage of cows calving earlier in the milking season; “inefficiency” was linked to feeding system, such as all-pasture fed or relatively low levels of supplements utilised, and sharemilkers were more “efficient” than owner operators. The average cost of inefficiency, using 2013-14 milk prices was \$1585 per hectare. Comparing “efficient” and “inefficient” producers needs to be done with some care as some “inefficient” producers trade off efficiency, for example feeding pasture only to achieve other non-economic or non-production goals such as risk reduction. In the context of this study the costs and benefits of improving reproduction efficiency must also be considered when attempting to increase the overall efficiency of the farm system.

William Wright – Succession and investment in New Zealand farming

Farm operations in New Zealand are traditionally run as family businesses in which land and capital are handed down from one family generation to the next. Such family businesses have time horizons that are measured in generations rather than years, and the identification of a successor encourages long-term planning that farms without successors cannot justify. Currently, only 30% of New Zealand farms have identified successors. So few farms having identified successors has implications for the efficiency of the New Zealand agricultural sector because farms without successors will be under capitalised as current farmers approach retirement.

Using two stage ordered probate regression with instrumental variables, we demonstrate a causal effect of succession planning on farm investment. We also identify two instruments for succession planning, namely, the extent to which farmers report that they farm due to family tradition and the number of generations that the family has farmed in New Zealand.

Our findings suggest a role for policy to support succession planning in New Zealand agriculture to ensure efficient farm management

Caroline Saunders – The Land and the brand

The purpose of this research is to indicate the contribution of the agri-food sector to New Zealand and how this may continue to contribute economic prosperity into the future. The agri-food sector makes substantial direct and indirect contributions to the level of economic activity within New Zealand at, in 2011/12, a total share of the national economy to 19 per cent. The report models the impact of the changing trends in global markets that are currently affecting New Zealand producers. The results in this report suggest that the agri-food sector will continue to play a dominant role in the New Zealand economy over the next decade if it succeeds in maximising value creation through integrating domestic industry developments, science and technology innovation and trusted commercial brand creation in the new international trading environment. The paper suggests six aspects that could facilitate the sector's growth: the importance of industry leadership; private-public partnerships; effective science and innovation systems; market awareness, responsive skills development ecosystems; and cooperative investment to support value chain enhancements.

Contributed Paper Session III**Friday 1.30 – 3.00 – Kotuku Room**

Session Chair – Anita Wreford

Environmental Regulation

Marin MacNamara – *Farmer compliance with environmental regulation: A preliminary look at the drivers and barriers for Canterbury dairy farmers*

In order to develop an effective regulatory framework, an understanding of what factors influence dairy farmer compliance levels is critical. The literature suggests that participation in environmental management programs and compliance behaviour on farm is multi-dimensional and may vary depending on the desired activity or outcome and locality. Consequently, compliance behaviour on farm must be investigated on a case-by-case basis. To this end, an email-based electronic questionnaire was sent to 548 Canterbury dairy farmers identified as dairy effluent discharge consent holders. A theoretical framework drawn from the Theory of Planned Behaviour and discrete choice theory informed the development of a behavioural model which was tested utilising the quantitative data collected. The preliminary results from this analysis will be discussed.

Mark Neal – *An ode to output-based regulation*

It has long been established that an output-based regulation will, in the absence of transaction costs, and under a broad range of circumstances, be superior to input-based regulations. However, the temptation, when faced with real uncertainties and unavoidable transaction costs, is to revert to input-based regulation. Using the example of a stocking rate restriction, and the available science, the costs and benefits of input and output approaches are compared. The results are discussed, and their relevance to the current policy landscape.

Phil Journeaux – *The Impact of Environmental Constraints on Land Values*

There are three fundamental drivers of land value:

- (i) Productive value; the value relative to the rent, or profits, obtainable from the land;
- (ii) Consumptive value; this includes amenity factors such as recreational opportunities and scenery, plus intangibles such as the countryside is a nice place to live, a great place to bring up children, you're your own boss, and farming is a great lifestyle; and
- (iii) Speculative value; the ability of an asset to retain its value/the return on the asset as an investment, or the ability to improve the asset (i.e. land use change)

Across New Zealand, there is now a concerted effort to reduce the environmental footprint of farming. This is largely around reducing diffuse contaminant discharges to water, but could also potentially include GHG emissions.

This will impact (or has impacted) on farming in two ways;

- (i) By increasing costs/decreasing profitability, which affects the productive component of land value, and
- (ii) By significantly reducing the opportunity to intensify production, both in-situ, and via land use change, which affects the speculative component of land value.

Potentially, an environmental improvement may result in an increased consumptive value, helping to offset the productive/speculative effect. This is difficult to quantify generically as it depends on individual circumstances.

The paper will discuss these aspects and the interactions between them, will look at what empirical evidence there is in NZ, and the implications for impacts on land values.

Friday 1.30 – 3.00 – Tui Room

Session Chair – Yvonne Phillips

Fisheries

Alan Renwick– Governance challenges in aquaculture

Globally aquaculture is seen as an increasingly important component in the quest to achieve food security in light of such drivers as declining fish stock, an expanding global population and climatic change. At national and local levels it can also be a significant source of income and employment often in economically disadvantaged (peripheral) rural areas. However, despite the seemingly heavy political support behind aquaculture at global and national levels, in many regions aquaculture is failing to meet its potential in terms of growth. Irish aquaculture in general and oyster production in particular represents a microcosm of this global situation. Ireland has a number of advantages in terms of its physical geography for the production of oysters. These include a suitable climate and a good number of coastal sites suited to oyster production. This means that, in physical terms at least, it could support significant growth in the industry. In addition, significant market opportunities appear to exist, particularly in Asia. This has led a number of recent high profile reports to all highlight the potential for growth in the Irish aquaculture sector and the contribution that it can make to food production and economic development in rural areas of Ireland. However, in Ireland, as elsewhere, the oyster industry has and continues to face a number of governance challenges that could thwart these ambitions. This paper, based on a study of the Irish Oyster industry, identifies the governance challenges faced by the sector and how these are constraining growth ambitions. Based on this analysis it then considers how improved governance can lead to increased resilience in the sector which will enable it to cope better with the wide range of risks that it faces.

Chris Batstone– Ka Hao Te Rangatahi: New directions for the New Zealand scampi fishery?

This paper addresses the conference themes by describing a Maori commercial fishing enterprise pursuing innovation that will deliver commercial added value while caring for the environment. In 2013 Cawthron Institute and industry partners Waikawa Fishing Company were granted six years' Ministry for Business Innovation and Employment (MBIE) funding to investigate two options for new directions for New Zealand's scampi (*Metanephrops challengeri*) fishery beyond the practices of the current deep water trawl fishery. In this paper we detail the economic rationale for this research, and report progress in the development of innovations for scampi aquaculture and pot fishing industries.

Nguyen Tuan Kiet– An experimental study of solution to a nonpoint source pollution with externality – Shrimp farming

What we have ignored is what citizens can do and the importance of real involvement of the people involved – versus just having somebody in Washington make a rule; Elinor Ostrom (1933-2012)

Shrimp farming in many parts of the world causes pollution to the environment. Upstream shrimp

farmers dump untreated waste water that typically contains unconsumed feed, chemicals and even diseases into river system, polluting surrounding areas as well as downstream areas. We study experimentally solutions to the wastewater pollution problem of shrimp farming with upstream and downstream externality. The results show that an external monitoring and certification agency does not help while communication helps greatly laboratory shrimp farmers in solving the pollution problems. Once the problem is solved, the farmers manage to sustain self-governance. This suggests the possibility of community-based solutions in the field.

Friday 1.30 – 3.00 – Kauri Room

Session Chair – Sini Miller

Wetlands

Helen Scarborough – Exploring the economic viability of using constructed wetlands to manage waste-water in the dairy industry

Industry faces increasing problems in dealing with waste products resulting from production processes. One specific problem is that of waste-water, where the management of production process waste often imposes costs, not only to the firm, but also to society. This paper addresses the question of the management of industry waste-water, from the perspective of both the individual firm and society in general, by analysing a case study of a dairy factory. Construction costs of horizontal-sub-surface-flow wetlands of a sufficient size to treat a dairy factory's process waste-waters are estimated. Short term profitability objectives do not prompt project development, however, over the long term, some of the project options modelled reveal both a net private benefit as well as a net social benefit. In the absence of estimated externalities, projects become viable after 11 years (2.% discount rate), and 16 years (7% discount rate). However, without some form of environmental policy, no project options will be considered because of the company's 4 year return on investment rule. This highlights the policy dilemma associated with sharing the burden of the costs of improved environmental outcomes between the private and public sectors.

Alison Bailey – Evaluation of field wetlands for mitigation of diffuse pollution

Diffuse pollution, and the contribution from agriculture in particular, has become increasingly important. Land management approaches, such as construction of field wetlands, provide one group of mitigation options available to farmers. Although field wetlands are widely used for diffuse pollution control in temperate environments worldwide, there is a shortage of evidence for the effectiveness and viability of these mitigation options in the agricultural context. The Mitigation Options for Phosphorus and Sediment Project was undertaken to make recommendations regarding the design and effectiveness of field wetlands for diffuse pollution control in UK landscapes. Ten wetlands were constructed built on four farms in Cumbria and Leicestershire. This paper focuses on sediment retention within the wetlands, estimated from annual sediment surveys in the first two years, and discusses establishment costs. It is clear that the wetlands are effective in trapping a substantial amount of sediment. Estimates of annual sediment retention suggest higher trapping rates at sandy sites (0.5–6 t ha⁻¹ yr⁻¹), compared to silty sites (0.02–0.4 t ha⁻¹ yr⁻¹) and clay sites (0.01–0.07 t ha⁻¹ yr⁻¹). Establishment costs for the wetlands ranged from £280 to £3100 and depended more on site specific factors, such as fencing and gateways on livestock farms, rather than on wetland size or design. Wetlands with lower trapping rates would also have lower maintenance costs, as dredging would be required less frequently. The results indicate that field wetlands show promise for inclusion in agri-environment schemes, particularly if

capital payments can be provided for establishment, to encourage uptake of these multi-functional features.

Beth Hampton– Weed-matting effects on riparian planting establishment

Industry faces increasing problems in dealing with waste products resulting from production processes. One specific problem is that of waste-water, where the management of production process waste often imposes costs, not only to the firm, but also to society. This paper addresses the question of the management of industry waste-water, from the perspective of both the individual firm and society in general, by analysing a case study of a dairy factory. Construction costs of horizontal-sub-surface-flow wetlands of a sufficient size to treat a dairy factory's process waste-waters are estimated. Short term profitability objectives do not prompt project development, however, over the long term, some of the project options modelled reveal both a net private benefit as well as a net social benefit. In the absence of estimated externalities, projects become viable after 11 years (2% discount rate), and 16 years (7% discount rate). However, without some form of environmental policy, no project options will be considered because of the company's 4 year return on investment rule. This highlights the policy dilemma associated with sharing the burden of the costs of improved environmental outcomes between the private and public sectors.

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