ARGOS

AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

Annual ARGOS Sheep/Beef Sector Report 2008

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The AgriBusiness Group

Lincoln University

University of Otago

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1 ARGOS

1.1 Introduction

The Agricultural Research Group on Sustainability (ARGOS) is an unincorporated joint venture between the www.agribusinessgroup.com, Lincoln University, and the University of Otago. It is funded by the Foundation for Research, Science and Technology (FRST) and various industry stakeholders and commenced in October 2003. ARGOS is a 6 year research project with the aim to model the economic, integrated, and social differences between organic, environmentally friendly and conventional systems of production. The aim is to detail the impact of these systems and develop indicators which reflect the interactions across the social, economic and environmental factors. The ARGOS study is also assessing market developments overseas and how these are likely to affect and be implemented in NZ. The costs of implementation and potential benefits of these will be further assessed using the LTEM (the Lincoln Trade and Environment Model). This enables the impact of various scenarios relating to the level of production and consumption, premiums and production costs to be assessed, both NZ and other countries. The project covers different farming systems in a number of sectors including kiwifruit, sheep & beef, high country, dairy and farms owned by Ngai Tahu landowners.

This 2008 ARGOS Sheep/Beef Annual Report provides a summary of the work that has been undertaken by ARGOS over the last 12 months within the Sheep/Beef sector. A more substantive description of research and results for the various parts of the project are reported on in depth in separate reports which are listed in section 7 of this report.

The ARGOS sheep/beef farms are spread across the South Island in 11 clusters of 3 farms representing the following management systems ('Panels'):

- Certified Organic production
- Integrated – follow a broad base industry assurance programme
- Conventional

The location of farms assists in establishing differences/similarities between management systems on a regional basis and potentially enables extrapolation to the wider farming community. According to the results of a national farm survey we deployed in 2005, the ARGOS farms are generally representative of farms in the wider farming community.

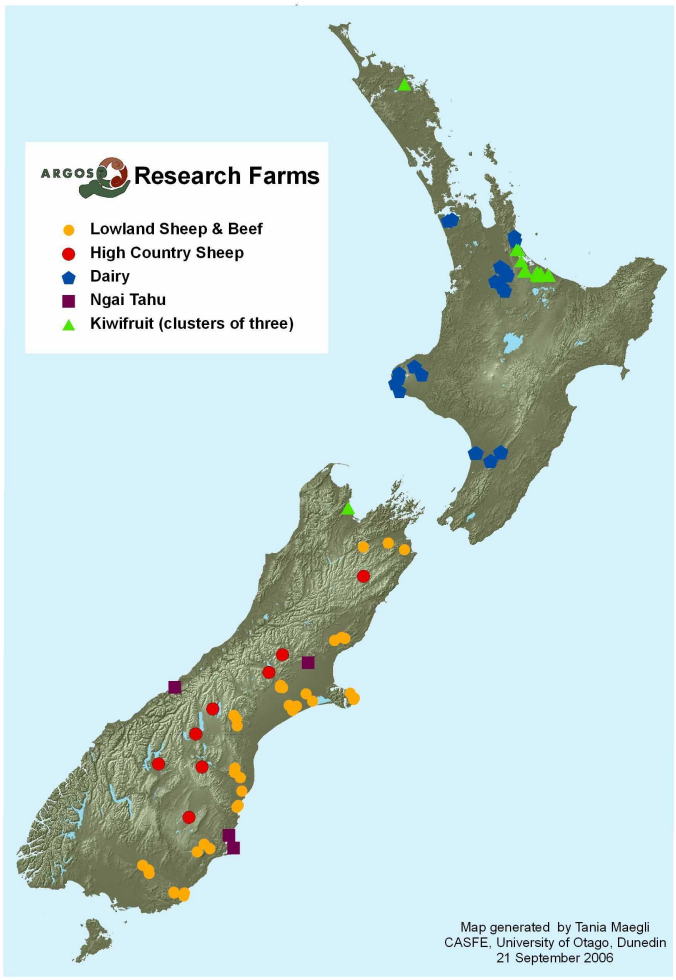

Figure 1 Location of Properties under study by ARGOS

1.2 Levels of focus in the ARGOS Project

The prime aims of this study are to undertake a comparison between agricultural sectors and between management systems within those sectors. Landforms, management units (i.e. paddocks) and soil monitoring sites are also being studied, at the individual farm level.

Agricultural Sector. ARGOS is studying dairy, high country and farms owned by Ngai Tahu landowners in addition to kiwifruit and sheep & beef farms.

Management System. For sheep and beef properties, the following three management systems are being studied:

- Organic
- Integrated - follow a broad base industry assurance programme
- Conventional

These 3 management systems may also be referred to as 'Panels' i.e. there is a panel of organic farms, a panel of integrated farms and a panel of conventional farms.

Cluster. ARGOS farms are arranged in clusters with one farm from each panel within a cluster i.e. each cluster has one organic farm, one integrated farm and one conventional farm. There are 11 clusters situated between Blenheim and Gore. Within each cluster, farms are as close together as possible to minimise differences in background variables like soil type and climate.

2 Farm Management

2.1 Introduction

Farm Management, in ARGOS, is studied from a management systems approach with 3 main areas of study; economic, social and the ecological environment. ARGOS's economics objective looks at the production aspects (both financial and non-financial) through to the socio-economics of production systems. The social objective of ARGOS studies the 'people' implications of the systems, motivational drivers, life cycles, whilst the environment objective looks at the impact/implications of the farming system on the environment. Boundaries of the three objectives overlap, leading to overarching research that is an optimal transdisciplinary study of farming systems. It was recognised that generic descriptors, of the farms under study, need to be supplied to the three objectives and this led to ARGOS's fourth objective, the farm management objective. The role of the farm management objective includes collecting physical and managerial style farm data and the preliminary analysis of this data, where appropriate.

Overview of farms

The ARGOS Sheep/Beef farms cover a total of 14,346 hectares, carrying 119,000 stock units, in eleven locations from Scargill to Gore. Farm sizes range from 145 to 1370 hectares, with a mean size of 340 hectares. Rainfall ranges from approximately 400 to 1100 mm/yr. The farms have similar overarching farming strategies in that their management is based around pastoral based systems with varying degrees of cropping. Cropping types range from fodder to cereal to small seeds production, mainly in mid Canterbury to predominantly fodder crops in Southland. Livestock production on most farms is predominantly lamb sales.

Changes

The number of sheep/beef farms being studied by ARGOS has been reduced from the original 36 to 28 due to farms being converted or sold. Over the past year, 4 farms were sold and one has converted to dairy. Because of the lack of statistical power we have also had to drop one cluster, which meant the loss of an additional farm.

Previous years work

Table 1 details work completed by various objectives in the ARGOS project during the 2007/2008 year. Planned work for the 2008/2009 can be found in a similar table towards the back of the report,.

Table 1 ARGOS Activity 2007/08

Sheep/Beef	Activity and Output	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Farm Management	Annual Farmer Report												
	Annual Stakeholder Report												
	Annual Farmer Survey												
	Collect & Collate Lamb Production												
	Causal Mapping				High Country								
	Soil & Biota Sampling												
Economic	Trade Modelling	Ongoing work throughout the year											
	Annual Farm Survey	Ongoing work throughout the year											
	Identification of Market Access Issues	Ongoing work throughout the year											
Environment	Stream Biota Survey												
	Bird Survey												
	Report -Woody Weed Encroachment												
	Report - Streams												
	Report - Birds												
Social	Report - Causal Mapping												
	Report - Research Notes												
	Report - Qualitative Two												
	Survey												
	National Survey												

Legend

- Farm Management
- Economic
- Environment
- Social

2.2 ARGOS Workshops

2.2.1 Introduction

In July, ARGOS workshops were held at Milton, Timaru and Christchurch with the following objectives:

- To show relevant outputs from ARGOS data collated to date
- To gain feedback from farmers so that we can look at the possibility of linking the data collated with current farming issues

Topics covered included:

- Summary of ARGOS work
- Transdisciplinarity modelling
- Issues around market access
- Pathways to profitability looking at options to increase farm profitability
  - Production Price Index
  - Output
  - Production
  - Diversification
- Emissions Trading Scheme
  - This is covered later in this report

And

- Where to from here

The following section of the report highlights a synopsis of the workshops detailing discussions on Market Access, Pathways to Profitability, the Emissions Trading Scheme and farmer feedback.

2.2.2 Market access

Every country that sells food is “clean & good”. What is our point of difference so that we gain/maintain markets? This is the biggest change to NZ farming and we need to adapt to meet market requirements to enhance access. Therefore it is imperative that we understand how to optimise our systems and keep them resilient to external shocks such as climate i.e. droughts, storm events.

Some of the issues round market access have been:

- Carbon emissions and Food miles as barriers of trade
- Lower meat and dairy consumption limiting demand
- Local food and seasonal consumption to ‘sway’ consumer choice
- Regulatory rules to provide safety for the public and environment
- Health and nutrition for consumer safety
- Ethical food fair trade and organic
- Biodiversity and wildlife
- Water quality and quantity

The rationale behind market assurance schemes is to assure the consumer that the food that they purchase is ethically and environmentally ‘good’ in addition to being beneficial to their health. Globalgap is an assurance scheme present in NZ that covers many of the issues outlined above through a checklist of:

- Traceability
- Stock management
- Environment and hygiene
- Environmental management including wildlife groundwater policies
- Staff facilities, training and health and safety

- Feed composition storage and use
- Housing and handling facilities

The new GLOBALGAP standard version integrates all agricultural products into a single farm audit. Producers of different crops and livestock can now avoid multiple audits to meet various market and consumer requirements.

2.2.3 Pathways to Profitability

Possible strategies to enhance profitability were discussed at July workshops. These included:

Output prices

- Market fit- This includes manufacturing specified produce to niche markets (as opposed to commodity market production). This is where developing a story (around the produce) that highlights the point of difference and developing allies with retailers will increase profitability.

Productivity

- This is about farming at an optimal level. Sometimes managers focus too much on one aspect of their business that they become suboptimal and decrease profitability. Examples of these can be:
  - Lambing percentage
  - Pasture production
  - Labour input
  - Inputs such as:
    - Labour
    - Fertiliser
    - Chemical
  - Marketing
    - Timing of supply
    - Quality of supply

Diversification

- This can range from working off farm to on farm alternative enterprises such as farm tourism.

2.2.4 Emission Trading Scheme

Introduction

During the last twelve months, greenhouse gases and emissions trading have become common terms in debates on agricultural policy in New Zealand. In response to this, ARGOS has been awarded additional funding to examine issues related to climate change and farming. The New Zealand government and industry already invests a large amount of money in the development of technological solutions for emissions reduction, however the perceptions and understanding about climate change among farmers have received little attention. It is also very obvious that the issues surrounding New Zealand's efforts to comply with the Kyoto Protocol are poorly understood in the general public and have become overly politicised.

"Through this work we have been made very aware of the discontent among farmers in regard to policies such as the emissions trading scheme (ETS) and have voiced such concerns to MAF Policy representatives."

Because of this situation, our current research focuses both on providing information on the state-of-play for the regulation of greenhouse gas emissions and on developing a better understanding of farmers' response to and knowledge of climate change issues. Through this work we have been made very aware of the discontent among farmers in regard to policies such as the emissions trading scheme (ETS) and have voiced such concerns to MAF Policy representatives.

The challenge of emissions

While there is a need to challenge unfair or poorly developed aspects of existing climate change policy, we believe that it is also important for farmers to prepare for the growing emphasis on carbon and environmental costs in global agri-food markets. Within the existing reality of the Kyoto Protocol, the New Zealand economy is faced with the challenge of accounting for and reducing the emission of greenhouse gases (a principal factor in global climate change) to 1990 levels. The extent of the challenge is especially evident in the agriculture sector where emissions in the form of methane (primarily for pastoral animals) and nitrous oxide (from synthetic fertilisers and animal wastes) combine with carbon dioxide (mostly from farm vehicles) to make up nearly 50% of all greenhouse gas emissions in New Zealand. As a result of this situation, farmers are expected to contribute to the reduction of emissions at a level that reflects the sector's responsibilities. Current policy does not include agriculture in the regulation of emissions until 2013 (and then proposes a gradual increase in exposure over the next several years) in order to allow the sector to develop response strategies, which are likely to require longer timeframes for implementation. In order to allow for such strategies to emerge, however, farmers will need a better understanding of policies that are targeted at emissions reduction.

Current policy proposals

The current policy proposals in New Zealand (and in Australia and Europe) are based on the concept of a 'cap-and-trade' approach that relies on market-driven response from those responsible for emissions throughout the New Zealand economy. This approach involves limiting (that is, capping) emissions at their 1990 levels. In order to do this, each country participating in the Kyoto Protocol can claim a set number of 'carbon credits' (each equivalent to a tonne of carbon and totaling 1990 emissions). Because current emissions are higher than in 1990, it is necessary to create a system for the allocation of these credits to those with emissions liabilities. Thus, the purpose of the ETS is to provide the opportunity to buy and sell credits under the assumption that the cost of such credits will reflect the willingness of people to pay rather than engage in practices and activities that emit less carbon. (For example, a factory owner will buy credits only if they are cheaper than installing equipment that removes greenhouse gases from the factory's emissions.) For pastoral farmers, this means that the cost of production will increase as carbon liabilities become another element of farm accounts. The extent of the cost increase will depend on such decisions as stocking rates (carbon liabilities are currently calculated on a 'per-head' basis), fertiliser application and the creation of 'carbon sinks' (such as tree plantations). MAF is also proposing policies to encourage tree planting on farms in order to help with early adaptation to the emphasis on carbon in the economy.

Farm example

In our research project, we introduced some of the ARGOS sheep/beef and dairy farmers to the proposed ETS and the associated afforestation policies. This included providing an **estimate** of the cost of carbon liabilities for each farm

"A dairy farm of 300 cows, by comparison, would have a liability of $18,750, or $1,875 in 2013 with the 90% free allocation"

visited. For example, a sheep/beef farm with 3000 sheep and 200 beef cattle would have a total liability of $33,500 (with a cost of $25 per carbon credit). This liability would not be assessed until 2013, and then the government would provide 90% of the necessary credits as a free allocation reducing the 2013 liability to $3,350. A dairy farm of 300 cows, by comparison, would have a liability of $18,750, or $1,875 in 2013 with the 90% free allocation. (Note that neither of these estimated figures involves the costs of synthetic nitrogen fertilisers, which will also increase in order to compensate for estimated nitrous oxide emissions.)

Some of this cost can also be 'off-set' by credits earned from trees planted after 1990 (ranging from 20-30 tonnes – or $500-750, assuming $25 credits – per hectare in mature *pinus radiate* to 2-6 tonnes – $50-150 – per hectare for a native species such as totara). The accumulation of credits from trees (and a similar situation holds for soil carbon) is only given for the increase from the previous year's amount, including any harvest or accidental loss as a reduction. In other words, **a mature plantation subject to rotational harvest would likely sequester only enough carbon to compensate for harvested trees and, therefore, not earn any carbon credits.**

Research findings

Besides contributing a bucket-load of confusing detail for participants to stew over, our research project confirmed that the level of awareness about the ETS is very low and that farmers view the ETS as a mechanism to penalise agricultural producers (as opposed to fairly distributing carbon credits throughout the economy). These findings were the primary messages that we shared during a workshop in late July 2008 with members of the MAF Policy team involved with development of the scheme.

What now?

In the circumstances discussed above, it is very important that farmers develop knowledge about the impact of various aspects of farm management on the emission of greenhouse gases and on the sequestration of carbon.

The current ARGOS research provides a depth and breadth of data not available elsewhere in New Zealand, which can contribute to our understanding of carbon processes in farm ecosystems as well as to improved means of compliance with the Kyoto Protocol. Because we are actively collecting economic and social – as well as environmental – data, the ARGOS project is well positioned to inform both farmers and policy makers about the interactions, opportunities and potential barriers to a viable system of greenhouse gas regulation for the agriculture sector.

"it is very important that farmers develop knowledge about the impact of various aspects of farm management on the emission of greenhouse gases and on the sequestration of carbon"

Specific objectives for our future research targeted in this area include:

- developing means of verifying the environmentally friendly nature of New Zealand farming for export markets,
- maintaining contacts with MAF to help inform policy development and
- contributing to the creation of a decision support tool to help farmers develop response strategies.

We would greatly appreciate your feedback in regard to any of the issues addressed in this section. In addition, if you think that any of our future research objectives are of particular

importance, our ability to fund such research is greatly enhanced when you make these issues known to fellow farmers, farmers' groups (such as Federated Farmers), industry and government representatives

2.3 Farmer Feedback

It is important that ARGOS research stays relevant to farmers' needs, hence the reason for interactive workshops. Notes were recorded during the July workshops in addition to participants filling in feedback forms at the end of each workshop. A summary of questions and answers are listed below.

1. What do you see is the overall benefit of the CMP/ARGOS business partnership?

- Farmers want to be supported by someone coming from a neutral position and 'explained' to others such as CMP, Government etc.
- Production of information/data for 'other' purposes leading to a wider understanding of farm systems to combat global issues e.g., food miles, sustainability.
- Benefit will be to farmers and industry through a greater understanding of issues that impact the others, business.
- Want to respond to the challenge, so as to be the best, to move forward, improve etc.

2. What are some of the key areas ARGOS research can help?

- Getting message across to government.
- Decreasing barriers to trade eg Food miles.
- Increasing the awareness of organics e.g. with chemical companies.
- By monitoring use of fertilisers, chemicals.
- By helping farmers to be more cost effective, sustainable etc.
- Improving public awareness of farming.

3. What do you see as an effective communication tool between ARGOS and stakeholders?

- Communicating positively with people involved, one-to-one ARGOS-producer relationship.
- TV farming shows, DVD.
- Emails.
- Mail outs, hard copy, reports and newsletters.
- Internet – site where ARGOS clients can access both general and personal information.
- Producer days, on-farm meetings, workshops, discussion groups, field days, producer meetings, face-to-face (send out info to those who cannot attend)
- Radio.
- Farming papers.
- Information that is easily understood.
- Environmental updates or tools to increase sustainability .

2.4 2008 Annual Management Survey

2.4.1 Introduction

The 2008 survey collected the latest farm management information which allows us to continue evaluating timeline data across and within management systems. In addition meat productivity was aligned to costs of production. This was added to compare the production efficiencies on a cost per kilogram of meat produced basis.

2.4.2 Production

With such a vast array of "necessary" inputs available to produce meat, coupled with increasing prices, it is timely to work out the main costs involved in producing a kilogram of meat. The objective of this exercise was to assess the costs per unit of output (meat) and derive a greater understanding for the variation in costs. This will help farmers to maximise profitability through optimising meat production for their farm system.

Net 'live'[1] meat exported off farm ranged from -531 to 648 kilograms per hectare (Figure 2). The negative values were attributed to farm size increasing or a land use change. These "outliers" were removed so that comparable figures could be analysed (Figure 3).

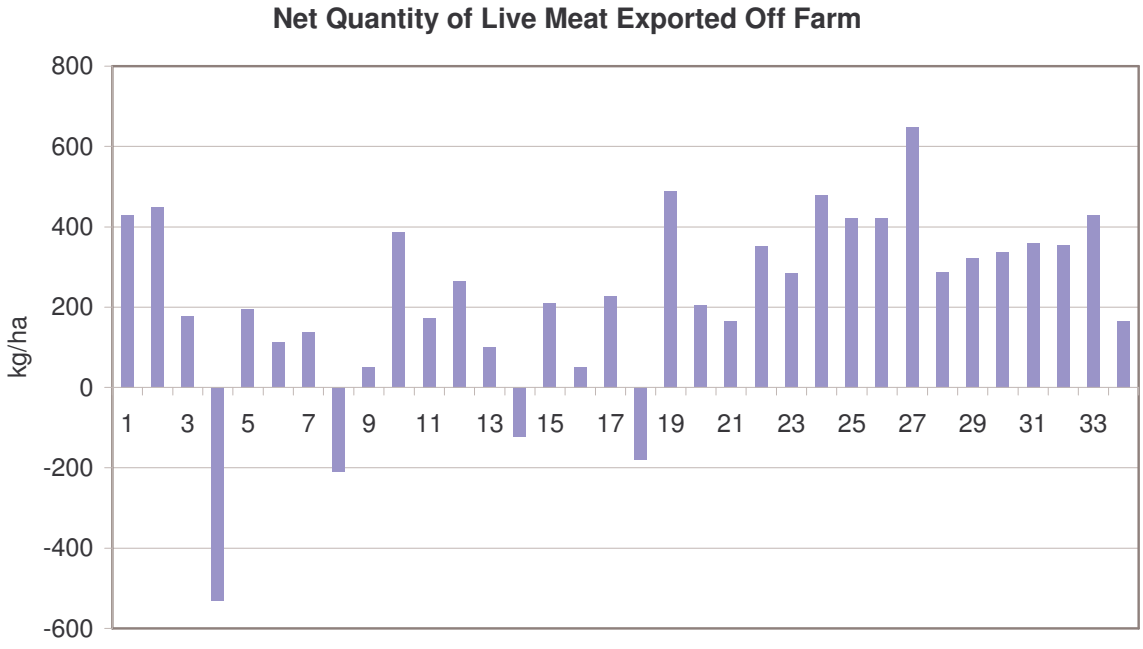

Figure 2 Quantity of meat exported off farm. Each bar represents an individual ARGOS farm.

[1] Meat that was exported off farm included all stock types and classes, whether they were sold prime or store.

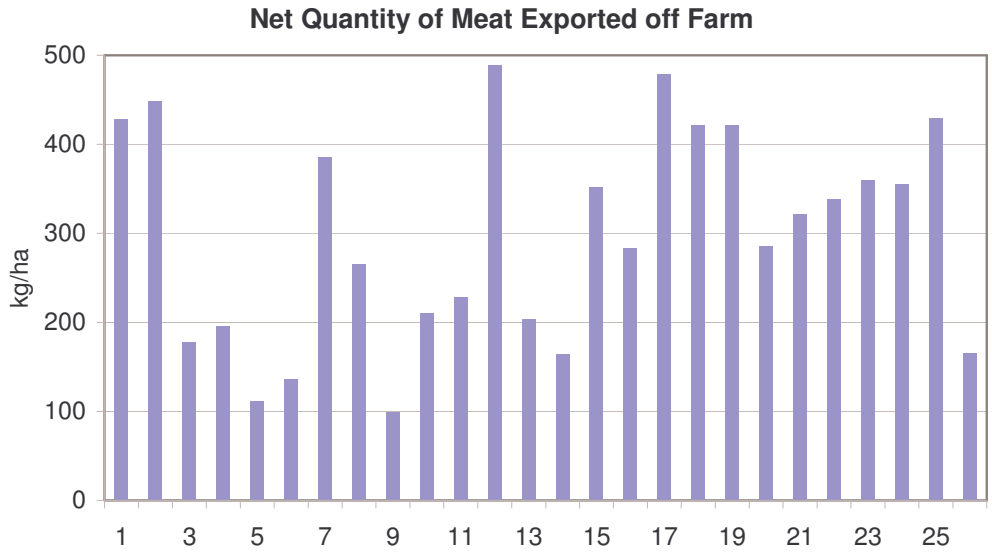

Figure 3 Quantity of meat exported off farm. Each bar represents an individual ARGOS farm. Outliers removed

Meat output and costs were aligned to the 06/07 financial year and the costs included are:

Animal health & breeding	Fodder crops
Electricity	Pasture renovation
Feed	Shearing costs
Grazing	Vehicle costs
Hay, silage	Rates

Rates were included because in some cases there is a water charge comprised in the rates. Total costs ranged from $0.29 to $1.98 per kilogram of meat exported off farm (Figure 4)

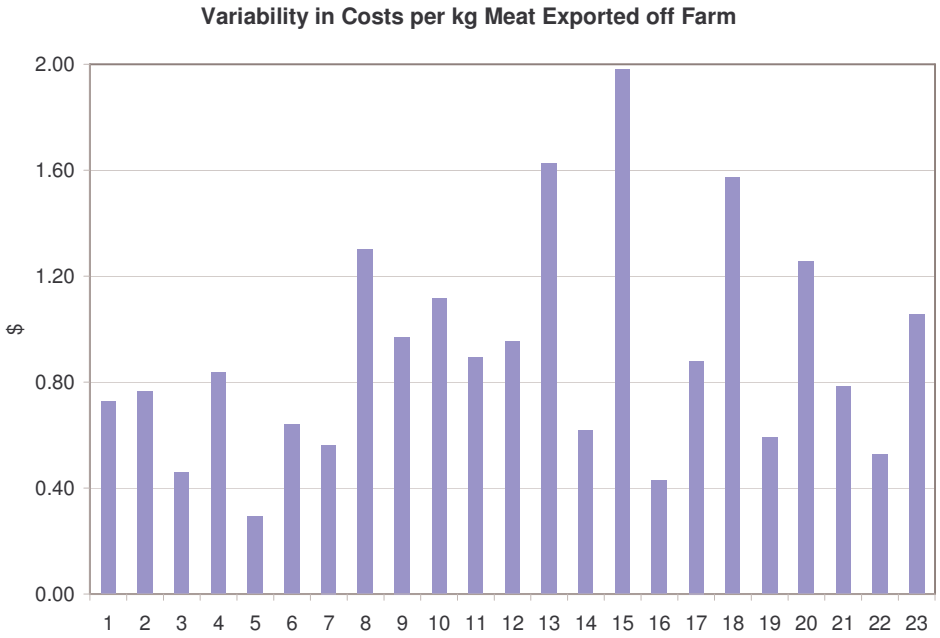

Figure 4 The cost to produce a kilogram of meat. Each bar represents an individual ARGOS farm. Outliers removed.

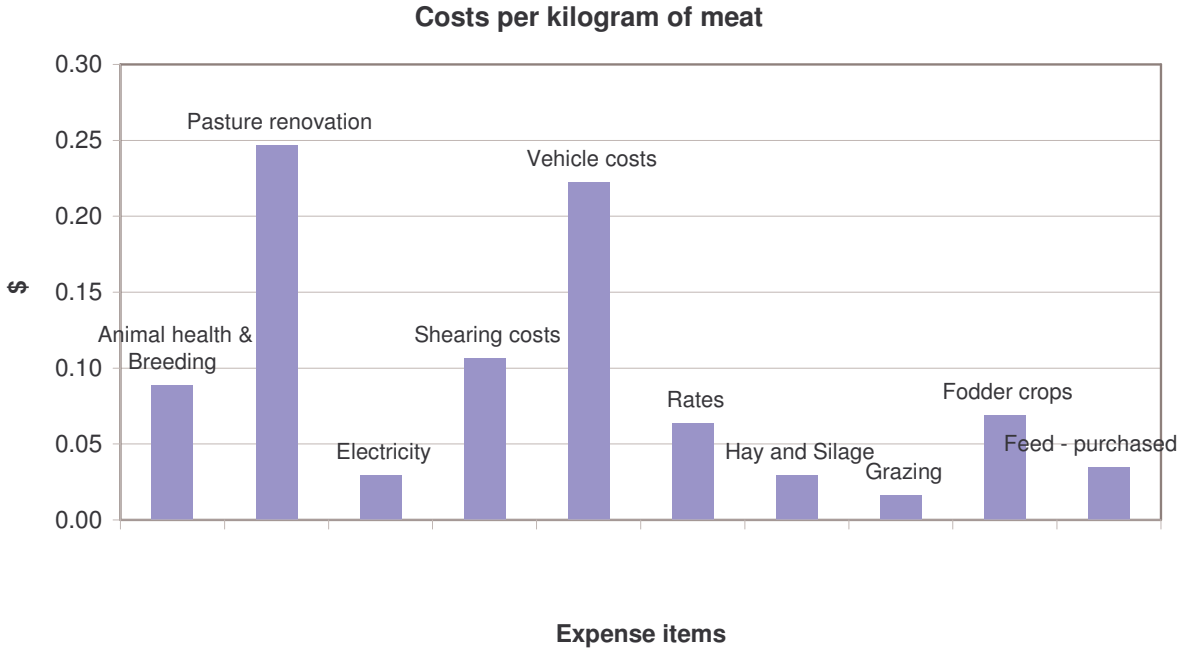

Figure 5 Apportioned expenses to produce a kilogram of meat. Averages of all ARGOS farms.

When all costs were averaged across all ARGOS farms (Figure 5), pasture renovation costs were the highest at $0.25/kg meat. Pasture renovation includes fertiliser, weed & pest, seed and any contract cultivation. It does not include farmer's time, fuel or maintenance. Fuel and maintenance was included in vehicle costs and these averaged $0.22/kg meat.

The data was analysed to establish differences between the management systems, however the variability within management system types was greater than across the management system types (organic, integrated and conventional) as shown in Figure 6. Why is there such variation?

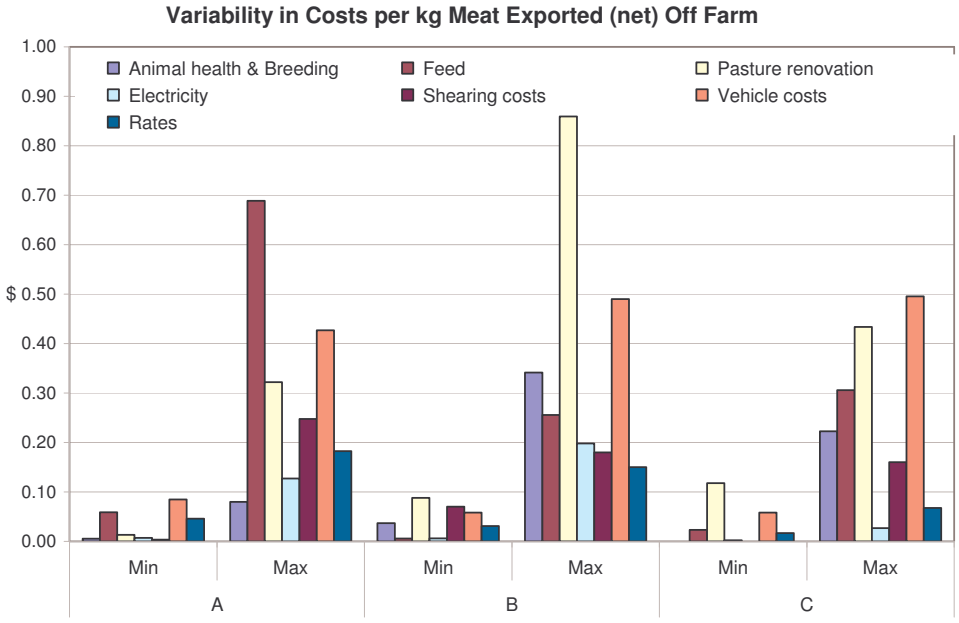

Figure 6 Variability across management systems to produce a kilogram of meat.

Costs were analysed to compare which ones had the greatest difference when comparing farms with a low cost per unit of meat output with farms with a high cost. Figure 7 shows that the greatest differences in low versus high cost systems were in pasture renovation, fodder crops, animal health & breeding and vehicle costs.

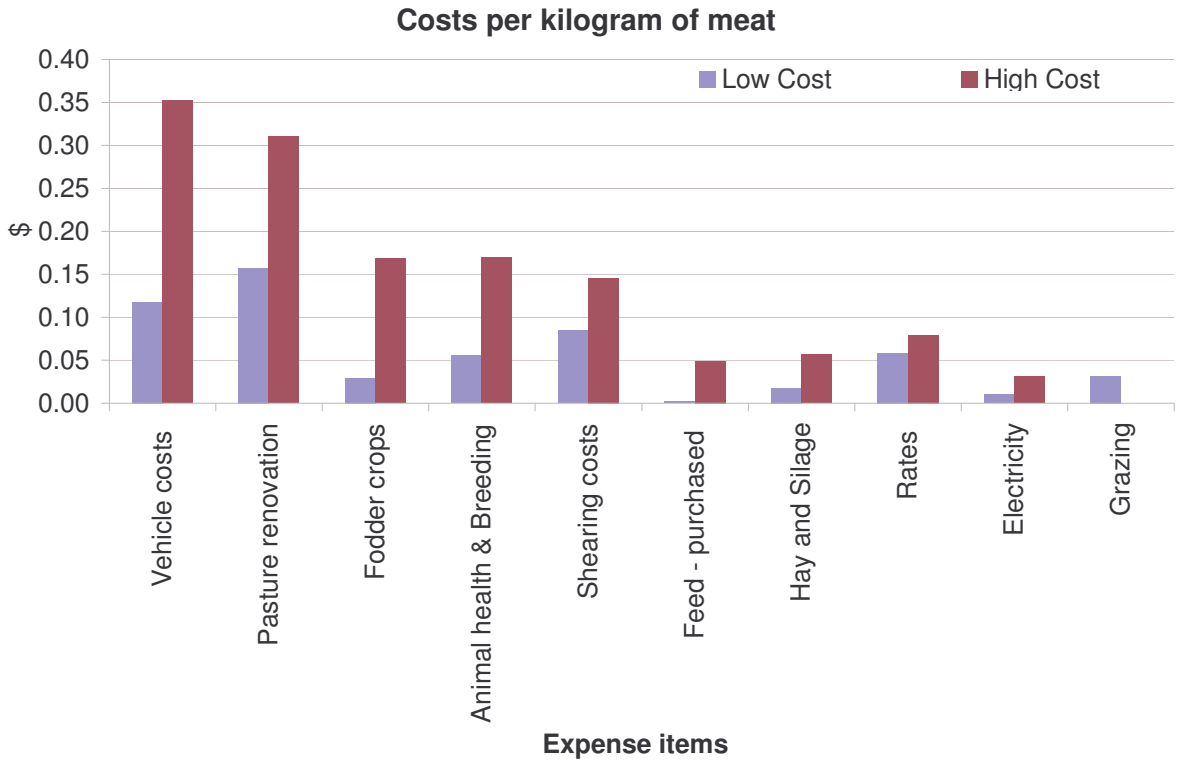

Figure 7 Comparison of five farms with the least cost per kilogram of meat exported off farm and five farms with the highest costs.

Interestingly, low or high cost systems did not lean to any one management system. The actual cost differences between high and low systems are quantified in Table 2.

Table 2 Cost per kilogram of meat exported off farm comparing low cost with higher cost systems.

	Average costs - Low and High cost $/kg meat		
	Low	High	Cost dif.
Vehicle costs	0.12	0.35	0.23
Pasture renovation	0.16	0.31	0.15
Fodder crops	0.03	0.17	0.14
Animal health & Breeding	0.06	0.17	0.11
Shearing costs	0.08	0.15	0.06

Feed - purchased	0.002	0.05	0.05
Hay and Silage	0.02	0.06	0.04
Rates	0.06	0.08	0.02
Electricity	0.01	0.03	0.02
Grazing	0.03	0.00	-0.03
	Total cost difference		$0.80

2.4.3 Fertiliser use on ARGOS sheep/beef farms

Tonnage, type of fertiliser purchased, and the application rate has been broken down to a nutrient per hectare basis for four years from 2003/2004 to 2006/2007. Figures 8 to 12 show the average kilograms of macronutrients (nitrogen, phosphate, potassium, sulphur, calcium and magnesium) per hectare that farmers, from different management systems, applied to their farms. Compost and Biodynamic Teas were unable to be analysed due to lack of industry standards.

The charts show that integrated and conventional farmers use increased inputs of, phosphate, sulphur and obviously nitrogen than organic farmers, whereas organic and integrated farmers applied increased amounts of calcium than conventional.

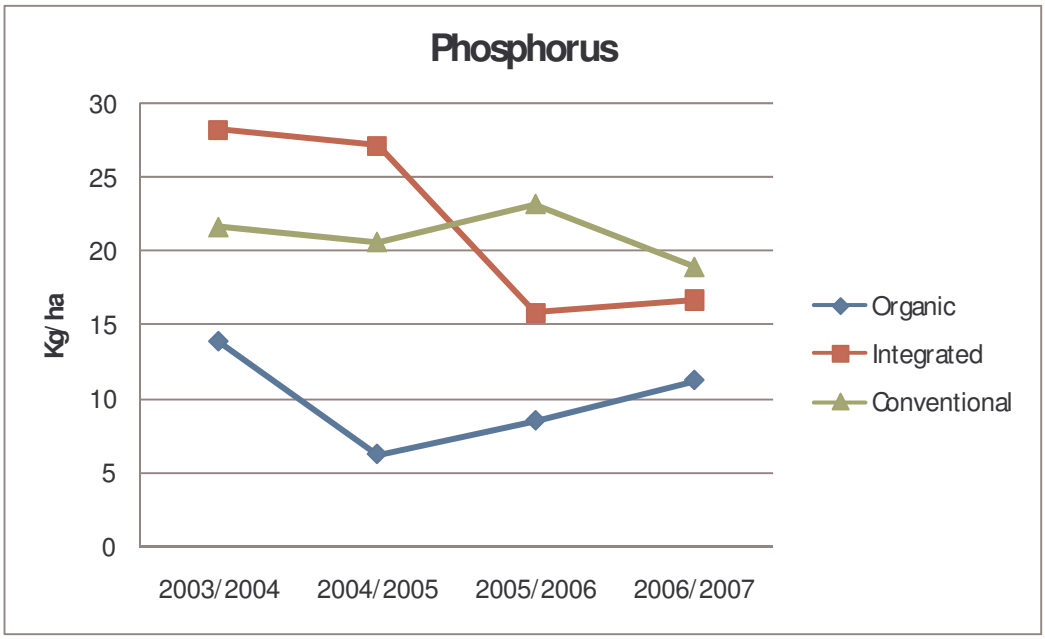

Figure 8 Phosphorus input, kilograms per hectare, from 2003 to 2007

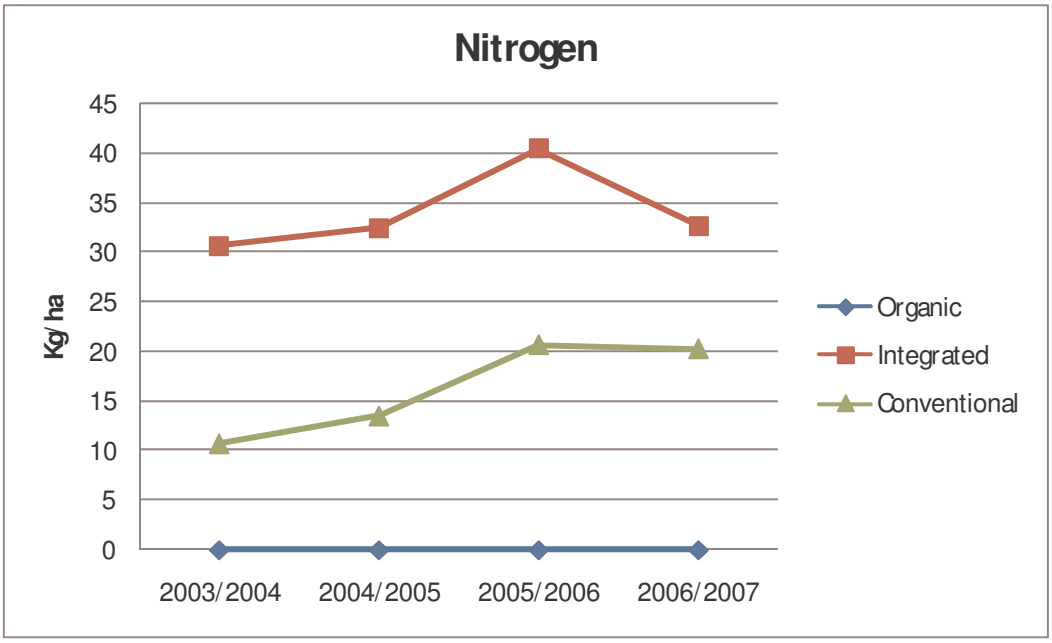

Figure 9 Nitrogen input, kilograms per hectare, from 2003 to 2007

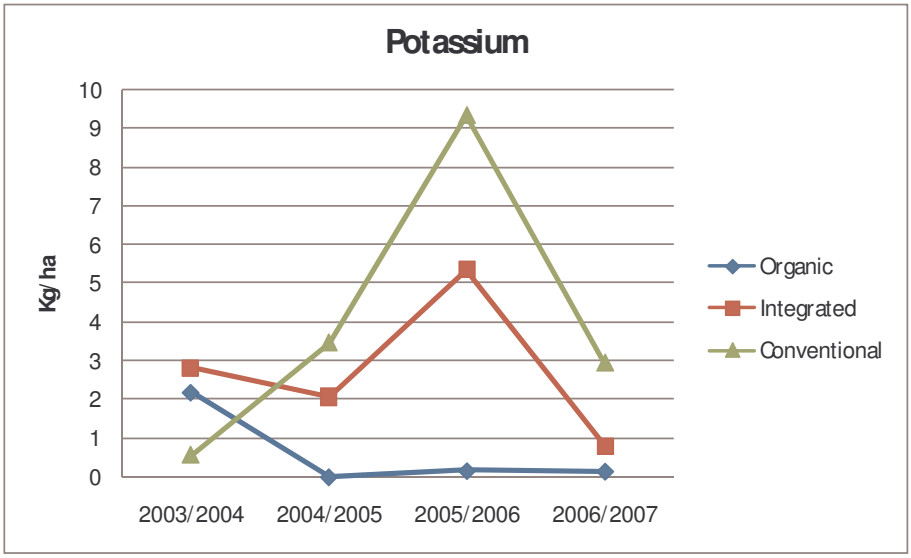

Figure 10 Potassium input, kilograms per hectare, from 2003 to 2007

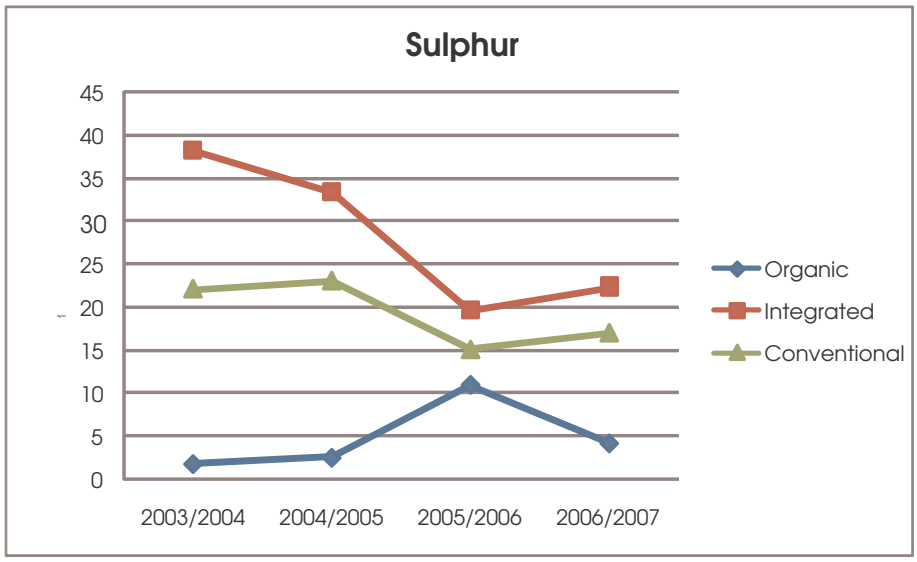

Figure 11 Sulphur input, kilograms per hectare, from 2003 to 2007

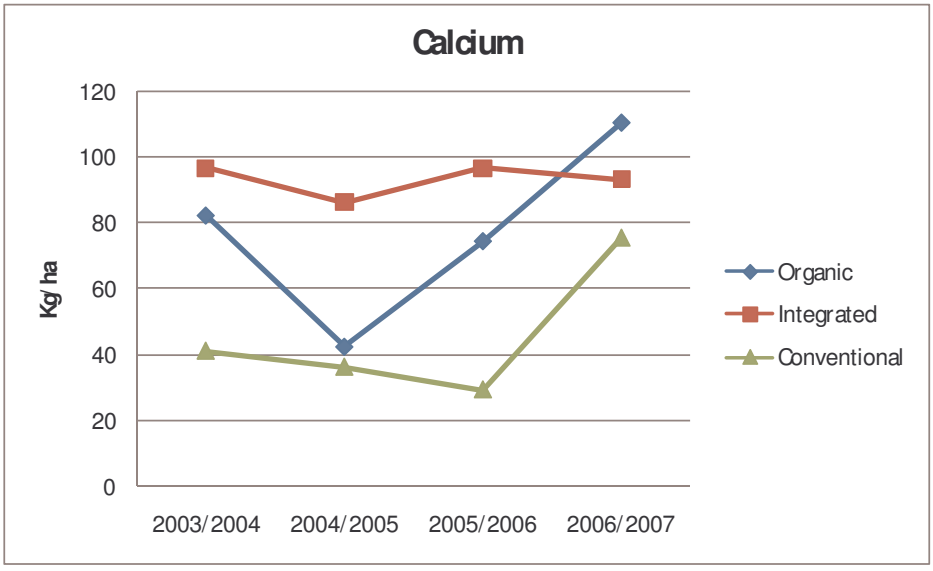

Figure 12 Calcium input, kilograms per hectare, from 2003 to 2007

3 Economic

3.1 Introduction

The economic objective of ARGOS focuses on the relationship between agricultural markets and resource allocation in New Zealand. The economic research is, therefore, undertaken at two levels: the global market (and its impacts on New Zealand agriculture), and the operations of the ARGOS farms. The research on global markets and their impacts on New Zealand agriculture have involved the identification and understanding of issues that may affect access to export markets and consumer demands.

At the farm level, researchers have been collecting farm financial accounts for four years. Each year's data is analysed to determine trends over time, as well as systematic differences amongst the three different management systems

3.2 Market Access

Introduction

There are currently a number of market, consumer, policy trends/changes that have the potential to impact on NZ's agriculture industry. These include the changes in consumer

behaviour and increasing emphasis on the sustainability attributes of products, such as carbon footprinting and these are growing into areas such as water footprinting, and wildlife and biodiversity protection.

The following is a synopsis of a larger report from the AERU, Lincoln University and covers global market access issues.

Market Access issues

Market developments

- There are an increasing number of consumers that are concerned with environmental and social sustainability. Associated with this are the growing trends of buy seasonal, buy local, alternative food networks and ethical production. Often these trends are supported through industry and government initiatives. These trends may potentially lead to a reduction in the consumption of imported products.

Food prices

- Global food price hikes are being attributed to a range of factors, these include poor harvests, restrictive trade policies, increasing price of oil, diversion of crops for biofuels and increasing demand especially from developing nations such as China. This may lead to the facilitation of a rise in the price of meat as consumer demand increases. The offset to this is demand for food security in some countries and potential to reduce imports.

Environmental concerns

- Of increasing importance are the issues of water scarcity ('water miles' or 'water footprints'), water quality, and biodiversity/wildlife. These issues may lead to imposition of additional audit requirements for sheep/beef farmers so as to meet market/customer specifications.

Trade factors

- The recent WTO Doha negotiations collapsed meaning a resolution of the round is now some way off. The potential benefits of a resolution for the NZ agriculture industry is a reduction in tariffs currently applied in export markets. However, depending on how additional policies unfold there may be the potential for increased competition from domestic producers in some export markets.
- The CAP 'Health Check' is increasingly moving towards cross compliance in relation to environmental issues and the US Farm Bill is also implementing similar policies. The changing focus of agricultural policy expenditure in the EU and US will aid their farmers to meet the growing requirements of market assurance schemes from retailers which emphasise the sustainability attributes of products. This will only make it more likely that retailers will demand more of these attributes.

The changing focus of agricultural policy expenditure in the EU and the US will help their farmers to meet growing requirements of market assurance schemes from retailers which emphasise the sustainability attributes of products. This will only make it more likely that retailers will demand these attributes.

3.3 The Farm Financial Analysis

Introduction

Five years financial data are now available on the ARGOS sheep and beef panel farms and there has been on-going analysis of the extent to which the management system adopted affects the financial sustainability of farms. The panels (management systems) are defined as:

- Certified organic;

- Involvement in a quality-assurance audited supply chain (integrated);
- Minimally audited (conventional)

The inclusion of a fifth year of data (2006/07) has not altered the conclusions drawn from last year's analysis with respect to differences between the relative performance of the panels.

Panel Differences

The ARGOS sheep and beef farm clusters are spread throughout the South Island and their location has a significant influence on the type of farming and the costs and returns of each cluster. A type of statistical analysis known as Analysis of Variance is used to take account of the variability that results from this location effect when estimating the differences in mean values that can be attributed to each management system.

We have found a number of significant differences in some individual farm working expenses between panels. However among the aggregated costs only Cash Farm Expenditure (CFE) differs significantly between panels on average over the five year period as Figure 13 shows.

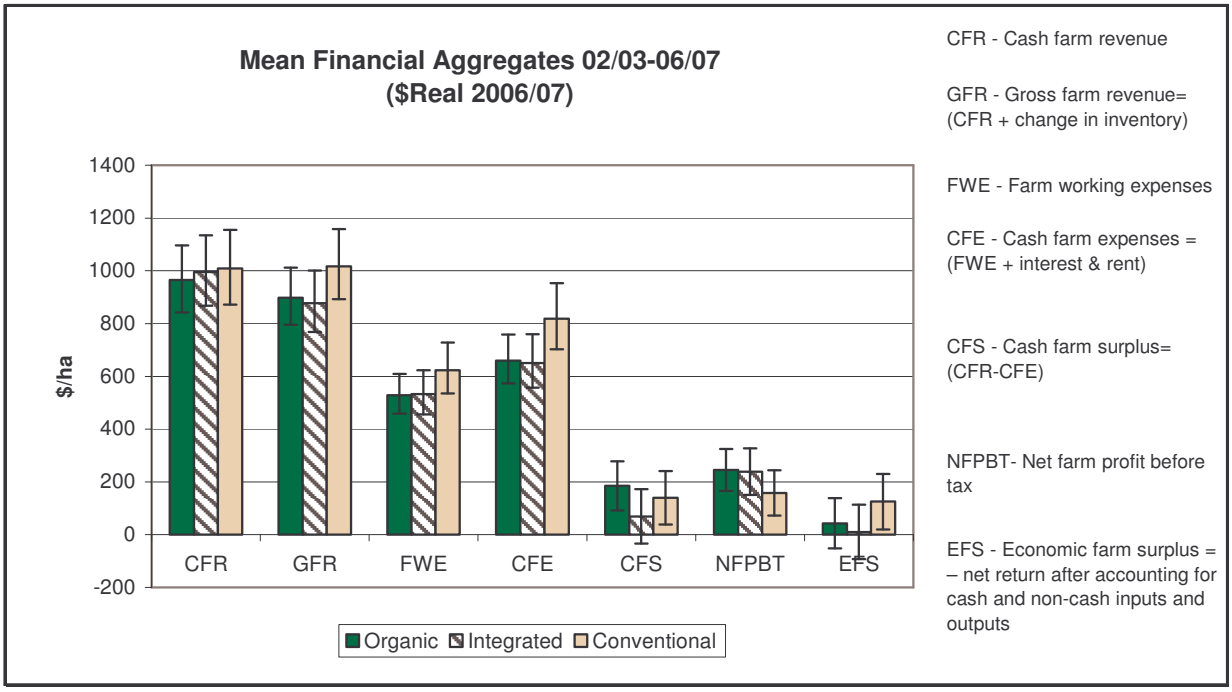

Figure 13 Sheep/Beef panels financial aggregate measures over five years

Although some of the differences in mean values between panels appear large, the huge variability within each of our panels means that we cannot be certain that the means are truly different (i.e that the difference is statistically significant). For us to be 95 percent confidence of any difference, one mean must differ from another by more than the difference indicated by the bars in Figure 13 Therefore, in Figure 13, we can see that CFE is clearly higher on Conventional farms than others and that the differences in FWE are approaching significance.

The absence of between-panel differences at this stage and the high level of within-panel variation are consistent with both the international literature and with New Zealand farm management understanding for several reasons.

- Firstly, the range of management skills, adaptive behaviour and learning patterns, which are key determinants of farm financial sustainability, between farmers in any sector, is very wide and a skilled farmer is likely to achieve good results under any management or production system.

- Financial differences between management systems may be more apparent in intensive monocultural systems where the differences between organic and conventional systems are more extreme.
- In the arable and pastoral sectors where an organic practice is shown to be effective and lower-cost than conventional practice, it will be adapted for inclusion into conventional systems by others.
- Five years is a comparatively short period in which to be able to detect relative shifts in the resilience of soil/plant/animal ecosystems under different management systems, and their translation into changes in financial performance.

While statistically significant differences have been detected in the levels of a number of soil nutrients between the organic and other panels in both sectors, these are not ecologically significant as yet so have no impact on production or income levels. In time it may be possible to detect the impact of differences in the extent to which issues such as anthelmintic resistance are affecting animal performance and, therefore, financial performance under differing management systems.

Like other sheep and beef farmers the financial position of ARGOS farmers has deteriorated over the period 2002/03 to 2006/07. Figure 14 shows the real ($2006/07) mean values of GFR and CFE for the three panels in each year. For each panel the difference between revenues and costs has declined over the period.

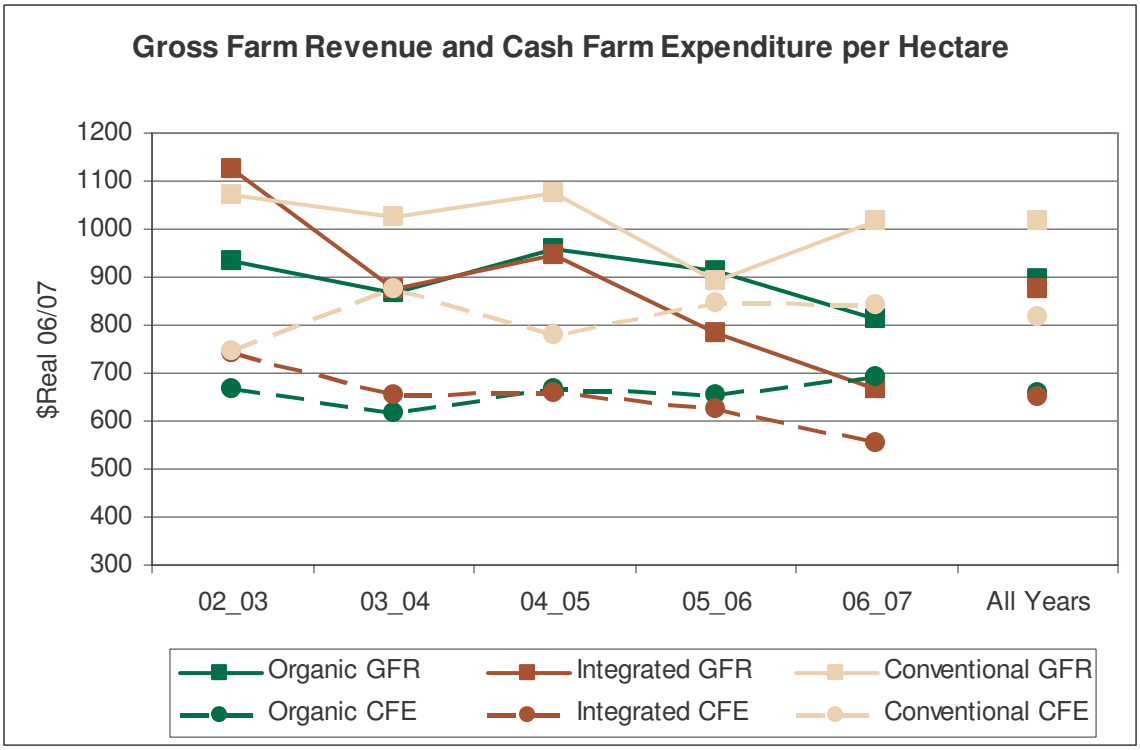

Figure 14 Sheep/Beef panels mean GFE and CFE 2002/03 to 2006/07

Individual cost elements

Some significant differences were, however, detected in individual cost elements between the panel In particular, animal health and fertiliser costs are very much lower on Organic farms than on Conventional and Integrated farms while Organic farms have on, on average higher overhead costs (reflecting, in part, certification costs) and other working expenses. Pasture renewal and maintenance costs are significantly higher on integrated farms than in

the other panels, while general repairs and maintenance costs are lower. The cash costs of labour and fertiliser costs are the most significant costs on Conventional and Integrated farms, while on Organic farms, overhead costs come second to labour costs. Figure 15 shows the mean real values of individual cost elements for each of the panels.

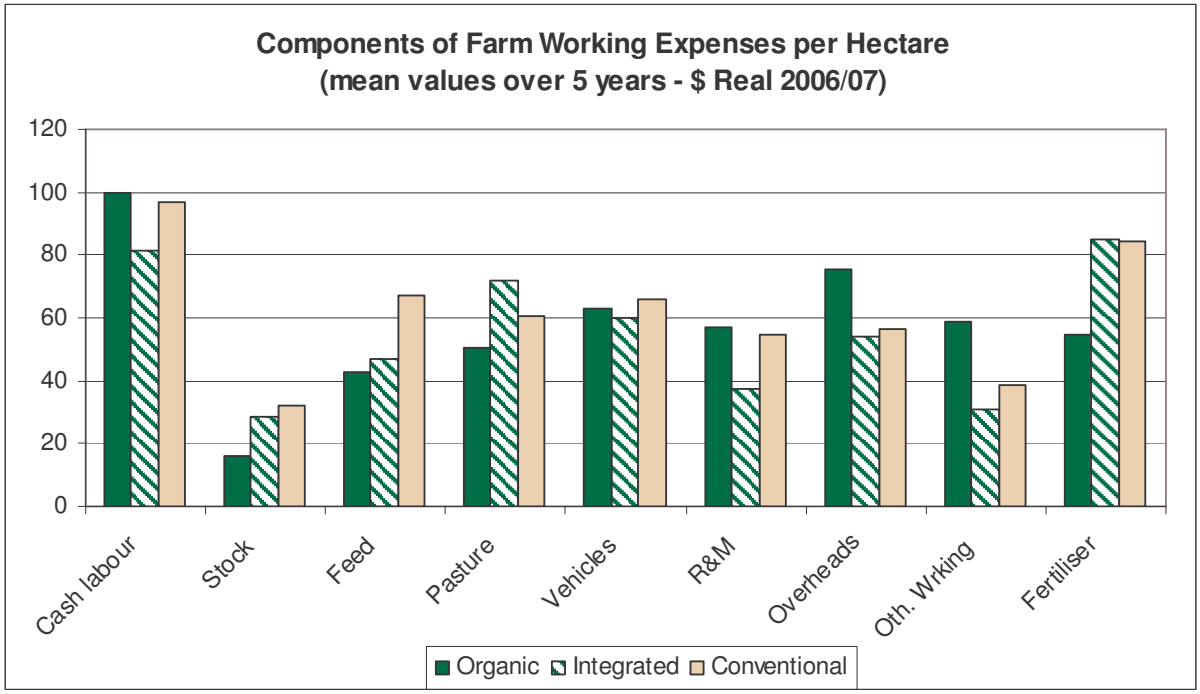

Figure 15 Sheep/Beef panels mean farm working expenses over five years

Other Key Performance Indicators

No significant differences were detected in the ratios of FWE:GFR and CFE:GFR between panels but in all panels these ratios have increased throughout the period and are, on average above farm management guidelines for financial sustainability s Table 3 shows. The debt servicing ratio (Interest and rent as a proportion of GFE) is significantly higher on Conventional farms than others and has deteriorated throughout the period for all panels.

Table 3 Key financial ratios over five years

	FWE:GFR	CFE:GFR	Debt servicing:GFR
ARGOS Organic	61.7%	76.5%	14.9%
ARGOS Integrated	63.3%	78.9%	15.2%
ARGOS Conventional	64.7%	84.3%	21.7%
Farm management guideline	50.0%	75.0%	

4 Environment

4.1 Introduction

The environment objective of the ARGOS programme aims to clarify the environmental impacts of different farming systems to assist in the identification and subsequent implementation of more sustainable and resilient farming systems. This section of the report covers an interesting report detailing the current knowledge on the impacts of New Zealand agriculture to biodiversity and illustrates a poster on stream health that was based on past stream surveys. The final section describes recent biological soil analysis.

4.2 Intensification of NZ Agriculture

Intensification is a hot topic at the moment and this can impact on governmental policies, however, what concrete evidence is there as to the degree that intensification has on the land? The following is a summary of a review that highlights critical knowledge and information gaps currently hindering efforts to develop strategies to lessen negative effects of intensification and looks at future options.

Intensification of New Zealand agricultural practices is an ongoing and accelerating process which potentially threatens the environment, biodiversity and even the sustainability of agricultural production. However, neither the exact nature of this threat nor the extent of its impact has received adequate analysis. There is clear evidence that agricultural intensification has degraded aquatic biodiversity, but there is a critical lack of research and monitoring of robust indicators of terrestrial biodiversity in New Zealand production landscapes. Therefore, we can only assume a generalised likelihood that intensification has also reduced terrestrial biodiversity and agro-ecosystem resilience.

It is unknown whether biodiversity and ecological services provided by the actual land growing crops, pasture or wood fibre are degrading because of intensification. Increased use of nutrient and energy inputs may have compensated, at least in part, for the increased rate of food production (nutrient and energy outputs). Lasting practical solutions to enhance sustainability can only be identified by long-term transdisciplinary research of ecological disturbance in agro-ecosystems.

Working with intensification to identify environmental and social gains at the same time as capturing economic efficiencies is more likely to support biodiversity than simply attempting to stem or reverse intensification. A change in world view of both rural and urban dwellers, from the philosophy that allocates land to either preservation or production to one that promotes sustainable land-use practices (that integrate extractive resource use with conservation), is the key to lessening impacts of agricultural intensification.

This review team highlighted the following steps that they believe will reduce the impact of intensifying agriculture:

- Retention or reinsertion of elements of indigenous vegetation into New Zealand's agricultural landscapes. Some introduced species will undoubtedly help support biodiversity also, and could form part of a general thrust to increase the structural complexity and diversity of the production landscapes. Although we do not subscribe to Meurk & Swaffield's (2000) goal of having 20% cover of woody vegetation in production landscapes, we do agree with the general thrust of their recommendation to encourage woody revegetation. This will often involve retention of wetlands, riparian areas, hedgerows, herbaceous leys, and forest patches irrespective of whether introduced or indigenous species predominate.

- Minimising chemical inputs and optimising their time of application by improved integrated management decision support and precision agriculture are sensible, **even profitable**, ways of reducing risk to biodiversity from intensification.
- Realignment of land uses within farm boundaries to create biodiversity refuges where farming was less profitable will simultaneously meet economic, social and ecological goals.
- Finding extractive uses for indigenous species will indirectly support co-evolved indigenous biodiversity. This relates to providing habitats so that some species will enhance other species that may be beneficial to farming.
- Replacing land allocation conservation models with integrated, whole-landscape approaches to management are paramount. The compatibility of an integrative production-cum-conservation ethic with existing and emerging agricultural practices remains an open question in New Zealand.

4.3 Soil Survey

Introduction

Monitoring soil quality is a key component of the environmental and sustainability objectives of ARGOS. The sensitivity of the soil to land management practice is determined by the soil forming factors (climate, topography, parent materials, organisms and time) meaning soil quality is often a relative quantity that differs from region to region and is variable to management pressures.

This year the focus has changed towards a biology focus, as opposed to traditional nutrient analysis. One reason for this is to enhance understanding of the soil biota and how this links to production. Figure 16 compares the microbial activity between management systems and shows that there is a significant difference in respiration (COC_C) between organic and non organic systems. However more analysis is required to understand the reasons behind this. Definitions to understand figure 16 are as follows:

Definitions:

a. **Soluble carbon (SolC_C)**. A measure of labile organic matter and serves as an index both of available substrate for microbial respiration as well as aggregate stability.

b. **Microbial biomass carbon (MC_C).** This is a measure of the total amount of living microbes in a soil. Microbial biomass levels will differ between soil types and land use history.

c. **Basal respiration (CO_2_C)**. Soil micro-organisms recycle essential nutrients when they decompose dead plant and animal material. Hence an active microbial population is a key component of good soil quality. Basal respiration is a process that reflects the potential activity of the soil microbial population. Microbial respiration is the amount of carbon dioxide production measured over a fixed period.

d. **Metabolic Quotient (Met-Q)**. The ratio between microbial biomass carbon (the size of the soil microbial population) and basal respiration (the activity of the soil microbial population) is a useful indicator of the metabolic efficiency of the microbial population.

e. **The Deaminase (ARG-N)** test measures the enzymatic ability of the soil to convert amino acids within the soil to mineral N. The various enzymes cleave the ammonium group from organic proteins and this is what is measured. Potentially we might find differing activities between the systems. We didn't however.

f. **The FDA** test measures general microbial activity and looks at the ability of the soil enzymes to degrade a substrate to a fluorescent form that we measure after a specified time (units are absorbance units per g soil per hour). Again we did not find any significant differences.

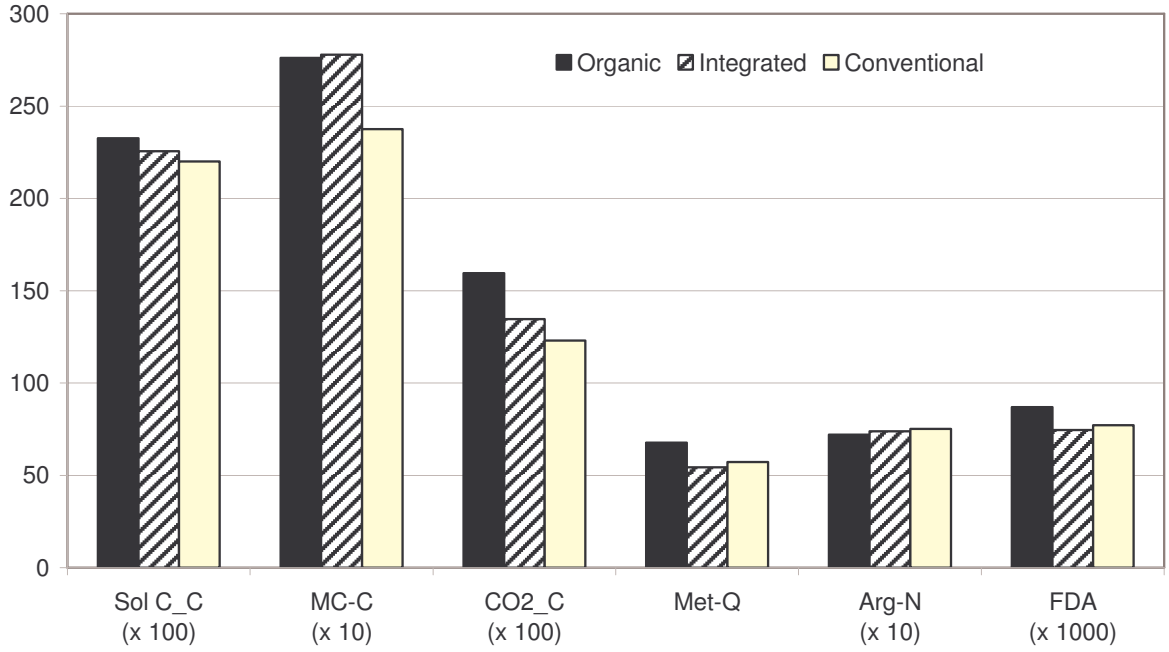

Figure 16 Microbial activity comparing organic, integrated and conventional systems. Terms are defined above.

5 Social

5.1 Introduction

Improving the sustainability of farming involves social, as well as economic and environmental, dimensions. For example, while it is possible to assess the relative viability of farm incomes, the earning potential of a given farm household may reflect issues of succession, retirement objectives, ethical decisions or pressures exerted by family or society more generally. Similarly, whereas the promotion of more bio-diverse farmscapes may appear to involve relatively straight forward decisions regarding resource management, the influence of shared ideas of appropriate farm management or the availability of sufficient skills and labour may limit the feasibility of such decisions. The social research component of the ARGOS programme is designed to examine a range of social features that have been shown to impact the way in which farmers approach farm management and engage with issues of sustainability.

5.2 Comparing management styles across sectors using causal maps

Introduction

Last year we reported on a type of cognitive mapping, called causal mapping, which was used to develop a better understanding of farm management, broadly defined to include economic, environmental and social factors, as seen by farmers. Now we have extended this survey to include High Country, Dairy and Kiwifruit. The following reports on the similarities/differences found across the varying pastoral sectors. This work has helped the ARGOS team to further comprehend the complexities of pastoral systems in addition to understand the degree of variability between systems within and across the different sectors in ARGOS.

Method

The mapping method we used allows farmers to first identify the factors important in the management of their farm system broadly defined, and then by making their own map by connecting factors that causally influence each other. Farmers used a score from 1 to 10 to show the strength of the causal connection between factors. Each farmer completed a map and data from each individual's map was then used to prepare a group map for all ARGOS farmers in each sector. The map shows the centrality score for each factor, which is a measure of its importance within the farming system. The same process was used for 34 sheep/beef, 20 dairy and 8 high country farmers. In this report we look at similarities of 3 pastoral farming sectors (Dairy, High Country and Sheep/Beef) using causal mapping techniques.

Comparison across high country, dairy and sheep/beef sectors in terms of causal maps:

There was broad similarity across the three farming sectors in that each of the group maps has the same top five factors within the top six rankings. Figure 17 shows how 8 key factors compare across Sheep/Beef, High Country and Dairy sectors

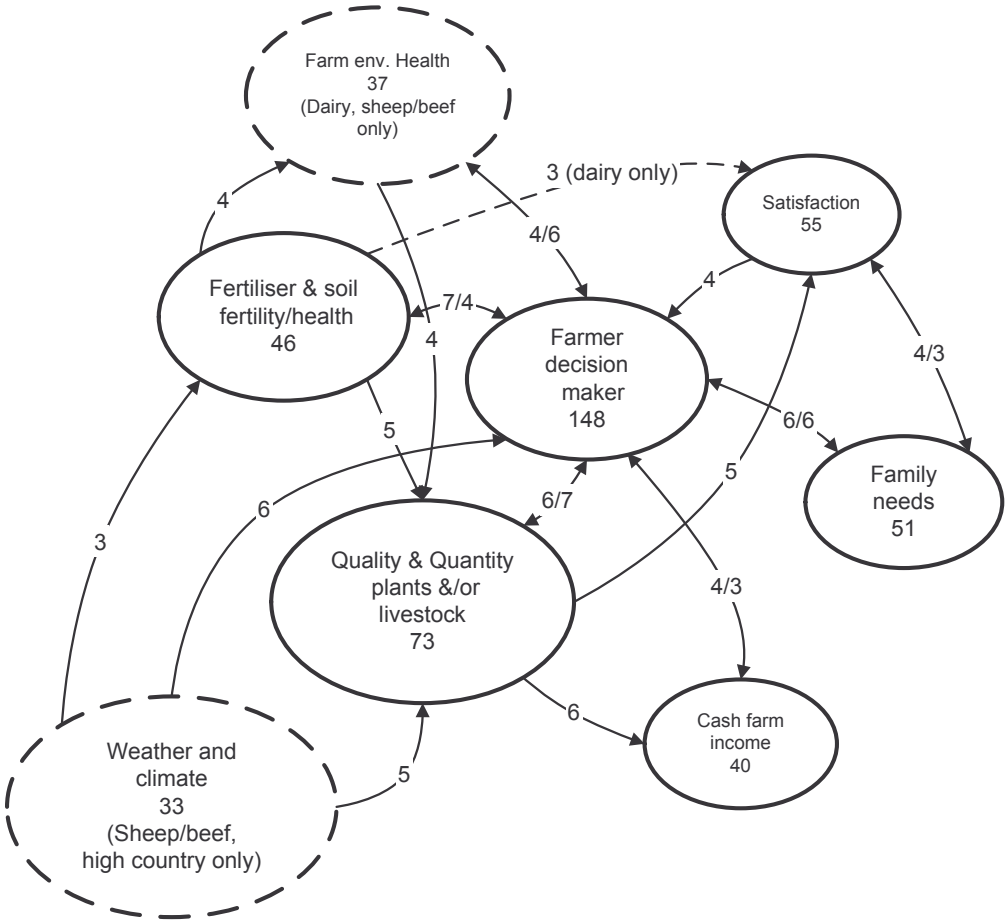

Figure 17: The eight key factors in pastoral systems as exhibited by high country, dairy and sheep/beef farm causal maps (averaged data)

- The high country farming system had less emphasis on production and more emphasis on family, soil type and neighbours.
- High country, compared to dairy only, gave more importance to weather and climate, and to off-farm activities.
- High country, compared to sheep/beef only, gave less importance to off-farm product quality.
- Sheep/beef, compared to dairy only, gave more importance to customer requirements and to advisors and consultants.
- Location and time in farm work were more important to high country farmers as a source of satisfaction while farmer decision maker was not an important source of satisfaction.

Comparisons across sectors in terms of map characteristics:

- High country, compared to dairy and sheep/beef, had more factors and lower map density (fewer connections compared to the number of factors).
- Dairy, compared to high country and sheep/beef, had more transmitter factors (arrows going out) and fewer receiver factors (arrows going in).
- Dairy compared to sheep/beef had fewer double arrows.

Interpretation

- Farm environmental health is less important to high country farmers because they see nature as robust and healthy, or because they see their farming system as fragile and have learned to work in synergy with the environment.

- The importance given to weather and climate, soil type and topography, neighbours, off-farm activities and family needs is consistent with the particular character of high country farming. High country farmers assigned relatively less importance to production.
- There is evidence that high country causal maps are more complex than those for the sheep/beef and dairy farming.
- Across the high country, sheep/beef and dairy sectors there are some key similarities which show up as eight common elements of pastoral systems and can be illustrated as a map.

Table 4 compares the sources of satisfaction across high country, dairy and sheep/beef farms. The table shows that while there are some overlaps in the sources of satisfaction, these occur more across dairy and sheep/beef. Location and time in farm work are more important to high country farmers while farmer decision maker is not an important source of satisfaction.

Table 4: Comparison of sources satisfaction across the three sectors

Link to satisfaction	High country	Dairy	Sheep/beef
This location	4	2	1
Time in farm work	3	2	1
Production	3	6	6
Family needs	4	5	3
Farm environment as a place to live	4	4	3
Farmer decision maker	2	4	5
Net profit before tax	2	3	2

6 2008/09 Plan

Table 5 ARGOS Planned Activity 2008/09

Sheep/Beef	Activity and Output	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Farm Management	Annual Farmer Report												
	Annual Stakeholder Report												
	Annual Farmer Survey												
	Cameo Study - Timeliness of Supply												
	Soil & Biota Sampling												
Economic	Trade Modelling	Ongoing work throughout the year											
Environment	Further analysis - Birds & soils	Ongoing work throughout the year											
Social	Qualitative Interview 3												
	Causal map 2												
	Report – Qual 2 (learning)												
	Interview – Climate Change												
	Survey – Climate Change												

Legend

- Farm Management
- Economic
- Environment
- Social

7 Acknowledgments and References

7.1 Acknowledgements

The ARGOS programme has been designed and implemented with the intention of providing quality information to both farmers and their associated industries to ensure that they are broadly sustainable, internationally competitive and profitable. To facilitate this, we greatly value the input provided by the farmers and industry partners to enable us to undertake the research and ensure that our outputs are relevant. We would also like to acknowledge the Sustainable Farming Fund for their support in the Streams and Weeds projects.

To also assist us in this process we have an Oversight Committee which meets to review progress and provide suggestions on how we can enhance our overall performance. The members of the Oversight Committee are;

Dr Neil Clark
Simon Langley (Canterbury Meat Packers)
Dave Lucock (ARGOS Sheep Beef Field Manager)
Jon Manhire (ARGOS Programme Manager)

Thank you for your support and input.

PUBLIC REPORTS

The following are publicly available on the ARGOS website (www.argos.org.nz). Please contact ARGOS if you would like a copy.

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05/03 Soil quality on ARGOS sheep & beef farms, 2004-2005, by Andrea Pearson, Jeff Reid, and Dave Lucock, June 2005

05/04 Food Markets, Trade Risks and Trends, by Caroline Saunders, Gareth Allison, Anita Wrexford and Martin Emanuelsson, May 2005

05/05 ARGOS biodiversity surveys on Kiwifruit Orchards and Sheep & beef farms in summer 2004-2005: rationale, focal taxa and methodology, by Grant Blackwell, Stephen Rate and Henrik Moller, June 2005

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05/10 Sketch Maps: Features and Issues Important for the Management of ARGOS Orchards and Farms, by Marion Read, Lesley Hunt and John Fairweather, July 2005

06/01 Understanding Approaches to Sheep/Beef Production in New Zealand: Report on First Qualitative Interviews of ARGOS Sheep/Beef Participants, by Lesley Hunt, Chris Rosin, Marion Read, John Fairweather, Hugh Campbell, February 2006

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07/01 Soil Properties on ARGOS Dairy and Sheep & Beef Farms 2005-6, by Peter Carey, Dave Lucock and Amanda Phillips, May 2007

07/02 Understanding sheep/beef farm management using causal mapping: development and application of a two-stage approach, by John Fairweather, Lesley Hunt, Chris Rosin, Hugh Campbell and Dave Lucock

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07/04 Applicability of Performance Indicators to Farms and Orchards, by Caroline Saunders, Eva Zellman, William Kaye-Blake

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07/07 New Zealand Farmer and Grower Attitude and Opinion Survey: Analysis by Sector and Management System, by John Fairweather, Lesley Hunt, Andrew Cook, Chris Rosin, Hugh Campbell

07/11 Economics Objective Synthesis Report, by Caroline Saunders, Glen Greer, Eva Zellman

07/12 Environmental indicators from alternative farm management systems: Signposts for different pathways to sustainable primary production in New Zealand?, by Tanja Maegli, Sarah Richards, Sarah Meadows, Peter Carey, Marion Johnson, Monica Peters, Katherine Dixon, Jayson Benge, Henrik Moller, Grant Blackwell, Florian Weller, David Lucock, David Norton, Chris Perley and Catriona MacLeod

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ARGOS High Country Environmental Report

No. 1, August 2006 - High Country Environmental Monitoring Report 2005-06

Research Notes (short research summaries)

1. Background to the ARGOS Programme
2. Transdisciplinary Research
3. Cicadas in Kiwfruit Orchards
4. Market Developments for NZ Agricultural Produce
5. Spiders in Kiwifruit orchards
6. Organic Kiwifruit Survey 2003
7. Analysis of ZESPRI's Organic Kiwifruit Databases
8. Types of Kiwifruit Orchardist
9. First Kiwifruit Interview: Individual and Orchard Vision
10. Sketch Map Results : Kiwifruit Sector
11. Sketch Map Results: Sheep/Beef Sector
12. Positive aspects of wellbeing for ARGOS sheep & beef farmers
13. What makes ARGOS sheep & beef farmers stressed?
14. Ways in which ARGOS sheep & beef farmers managed the stress of farming
15. Soil nematodes in kiwifruit orchards
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17. Bird Sampling Methods
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20. Management of Data in ARGOS
21. Evaluation of the bait-lamina test for assessing biological activity in soils on kiwifruit orchards
22. Annual monitoring of cicadas and spiders to indicate kiwifruit orchard health
23. Cicada Species in Kiwifruit Orchards
24. Shelterbelts in kiwifruit orchards
25. Biodiversity on Kiwifruit Orchards: the Importance of shelterbelts
26. Kiwifruit orchard floor vegetation
27. Monitoring stream health on farms
28. Stream management: it really matters what you do on your own farm!
29. Soil Phosphorus and Sulphur levels in Dairy farms
30. Soil Phosphorus and Sulphur levels in Sheep & Beef farms
31. Assessing the sustainability of kiwifruit production: the ARGOS study design
32. Fertiliser use on ARGOS kiwifruit orchards
33. How ARGOS uses Geographical Information Systems (GIS)
34. Food Miles
35. Understanding sheep/beef management using causal maps
36. Earthworms in kiwifruit orchards
37. Four types of sheep/beef farmers across the ARGOS panels
38. Audits and Sheep/Beef Farm Management
39. Quality Assurance Programmes in Kiwifruit Production
40. High Country Woody Weeds
41. The Relevance of Performance Indicators Used for Non-Agribusinesses to Kiwifruit Orchards
42. The Relevance of Performance Indicators Used for Non-Agribusinesses to Sheep and Beef Farms
43. Common elements of pastoral farming systems as shown by causal mapping