



## Annual ARGOS Sheep/Beef Sector Report 2007



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# **1 ARGOS**

## **1.1.1 Introduction**

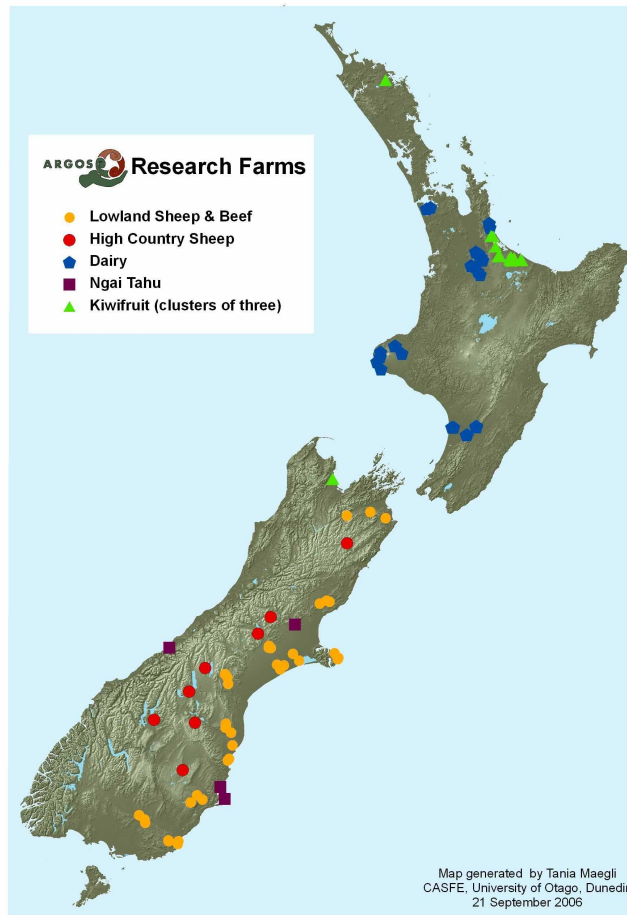
The Agricultural Research Group on Sustainability (ARGOS) is an unincorporated joint venture between the [www.agribusinessgroup.com](http://www.agribusinessgroup.com), Lincoln University, and the University of Otago. It is funded by the Foundation for Research, Science and Technology (FRST) and various industry stakeholders and commenced in October 2003. ARGOS is a 6 year research project with the aim to model the economic, environmental, 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 2007 ARGOS Sheep/Beef Annual Report provides a summary of the work that has been undertaken over the last 12 months within Sheep/Beef section of the ARGOS project as well as some results. 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 reflecting the main sheep/beef farm classes with 12 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. As outlined in the results of a large farm survey 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 systems and between management systems within agricultural systems. The management systems can be broken down to landforms, management units and soil monitoring sites.

**Agricultural System.** This is the agricultural production systems being monitored and now includes 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 three management systems (Panels) are

- Organic
- Integrated
- Conventional

These 3 management systems may also be referred to as 'Panels'. For instance, in ARGOS, there is a panel of organic farms, a panel of integrated farms and a panel of conventional farms. There is one farm from each panel to make up a 'cluster' and there are 12 clusters situated between Blenheim and Gore. Therefore each cluster has one organic farm, one integrated farm and one conventional farm.

**Landform** This term is used to describe the different geomorphology within a property. The principal landforms monitored here can be broadly described as river terrace (flats), hill crest (crest) and mid-slope (slope). Given the huge variation in soils and landscape across the properties being studied, here we study the two most dominant of these landforms within the

cluster. For hill country clusters, the same two landforms will be studied on each property. For clusters on the Canterbury Plains only one landform (flats) is studied.

**Management Unit** Management unit (MU) is a paddock. For each landform, three management units (focal paddocks) are monitored. Thus on the hill country farms, six paddocks (two landforms each with three paddocks) will be monitored. On the flat land farms with only one landform present (Canterbury Plains), three paddocks are monitored.

## 2 Farm Management

### 2.1.1 Introduction

Farm Management, in ARGOS, is studied from a management systems approach with 3 main areas of study; economic, social and the ecological environment. Economics includes production (both financial and non-financial) through to socio economics of production systems. Social 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 a 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.

### Review

The ARGOS Sheep/Beef farms cover a total of 14,346 hectares, carrying 119,000 stock units, in twelve locations from Blenheim 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 with 2 farmers mainly bull beef.

### Changes

Number of farms in ARGOS has reduced to 34. In the past 2 years 3 farms have been sold and one has converted to dairy. The latter is still involved in ARGOS sheep/beef as they still have a significant area in sheep/beef. The former farms, sold, have not been replaced as there are still enough farms to provide statistical power. We would like to extend our thanks to those for providing willing support to this research.

**Table 1** Descriptive data collected by the farm management objective

2005	Management System			
Average Data	Organic	Integrated	Conventional	All Farms
Effective hectares	323	424	352	365
Percentage farm area eff.	89%	92%	92%	91%
Sheep su	2048	3538	2811	2776
Cattle su	820	1226	1225	1096
Percentage sheep to cattle	82%	84%	64%	77%
Stock Units/ha	8	13	12	11
Lambing %	129	145	132	135
Mating weight	62	69	66	66
Number of ewes that had bearings - 2005	31	57	46	43

**Table 2 ARGOS Activity 2006/07**

Sheep/Beef	Activity and Output	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
<b>Farm Management</b>	Annual farmer report												
	Annual farmer survey												
	Livestock representative Newsletter												
	Causal map data collection												
	Retrospective economic data survey												
	GPS data for mapping												
	Soil, Grass Grub & Porina sampling												
	Stream data collection												
	Farm case study	Ongoing work throughout the year											
<b>Economic</b>	Sheep/Beef sector report												
	Annual farm survey												
<b>Environment</b>	Report -Streams												
	Report - Weeds questionnaire												
	Farm maps returned to farmers												
<b>Social</b>	Report - Panel Representative ness												
	Report - Constraints to management survey												
	Report - Quantitative survey												

**Legend**

	Farm Management
	Economic
	Environment
	Social



## **2.2 2007 Annual Management Survey**

### **2.2.1 Introduction**

The 2006 annual farm management survey targeted the finer details of the farmer's annual grazing strategy. The 2007 survey continued with this, so that we can evaluate timeline data, in addition to adding questions on pests (type and control methods), refuse disposal methods and weight data of store stock sold. The latter information will be added to productive output data to be collected later this year, so that we can compare the production levels of farms on a per kilogram of meat produced basis.

## **2.3 Fertiliser**

The second soil survey was completed in the winter (2007). The sampling variables included bulk density, nutrient cores and biota over 1.5mm in length (earthworms, grass grub, porina and beetles etc). Information from the soil analysis will be linked to additional variables that have been collected, such as:

- Physical Fertiliser inputs
  - Nitrogen
  - Phosphate
  - Potassium
  - Sulphur
  - Calcium; and
  - Magnesium

### **2.3.1 Fertiliser use on ARGOS sheep/beef farms**

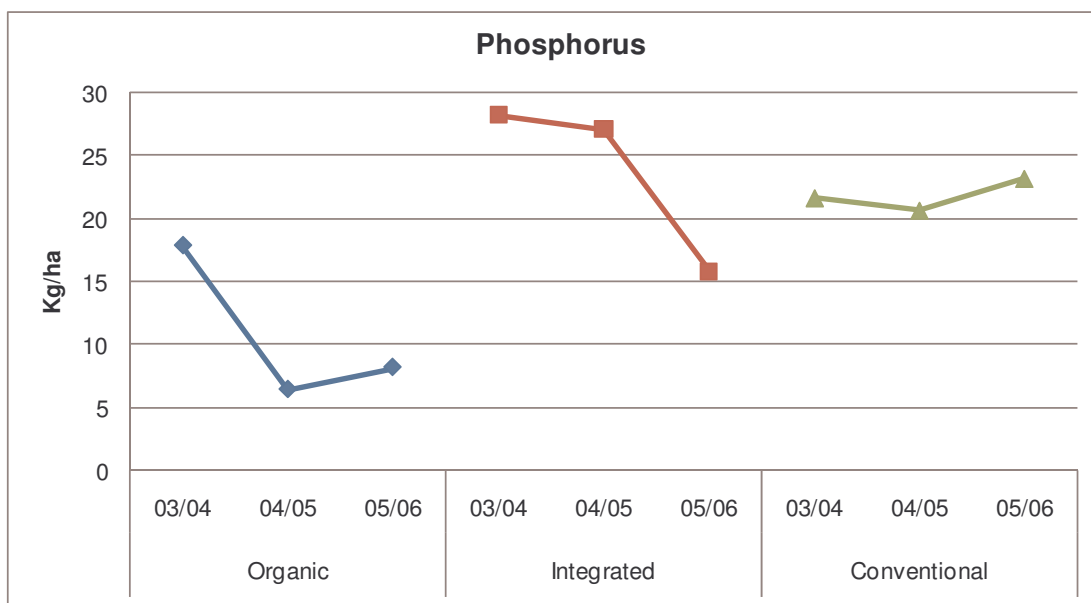
Tonnage and type of fertiliser purchased and the application rate has been broken down to a nutrient per hectare and shows input trends over three years. Figures 2 to 6 shows the average kilograms of specific nutrients (nitrogen, phosphate, potassium, sulphur, calcium and magnesium) per hectare that farmers, from different management systems, applied to their farms.

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. Uncertainty of the significance of this will be reduced with further analysis. It was interesting to note how much calcium is applied through phosphatic fertilisers, as opposed to calcium that is applied through lime.

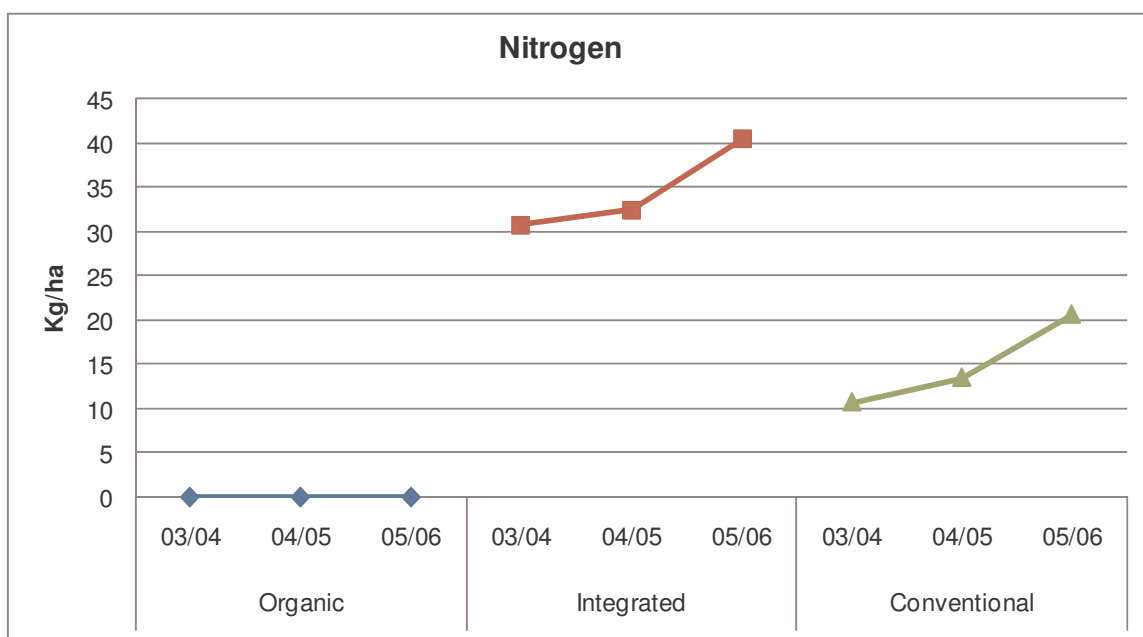
The data was analyzed in Genstat, using a general analysis of variance approach with cluster and year as blocking terms and management system as treatment.

Phosphorus was analyzed without the organic panel as there were too many zero values that skewed the data, enabling us to meet the assumption of normality that is required for an ANOVA. We found no significant difference between integrated and conventional, but the power to detect the small difference that the averages indicates, was very low.



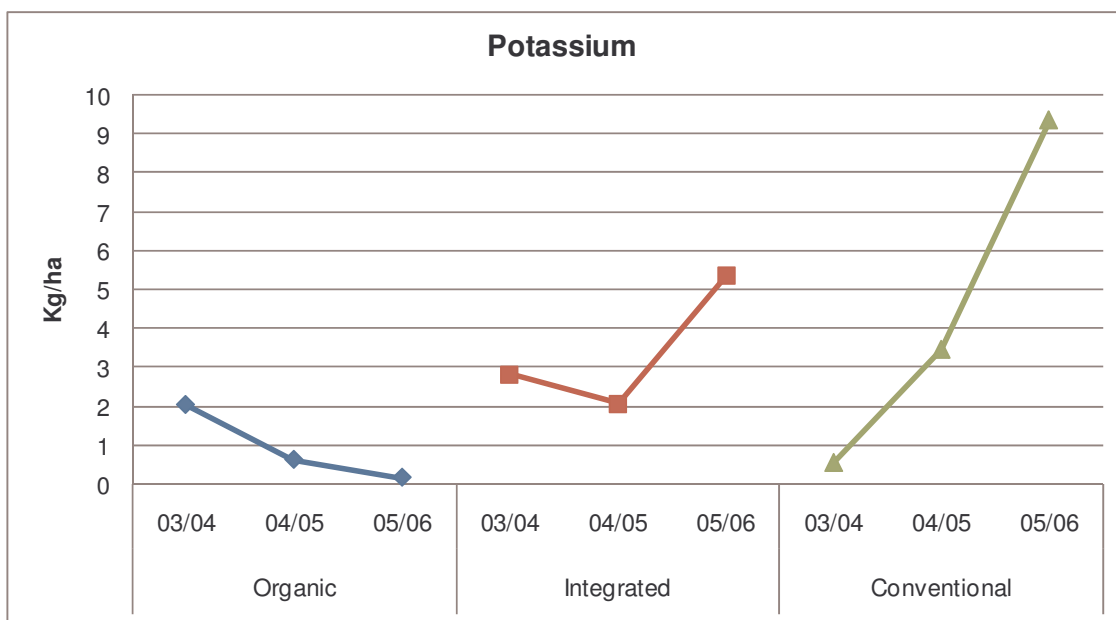


**Figure 2. Phosphorus input, kilograms per hectare, from 2003 to 2006**



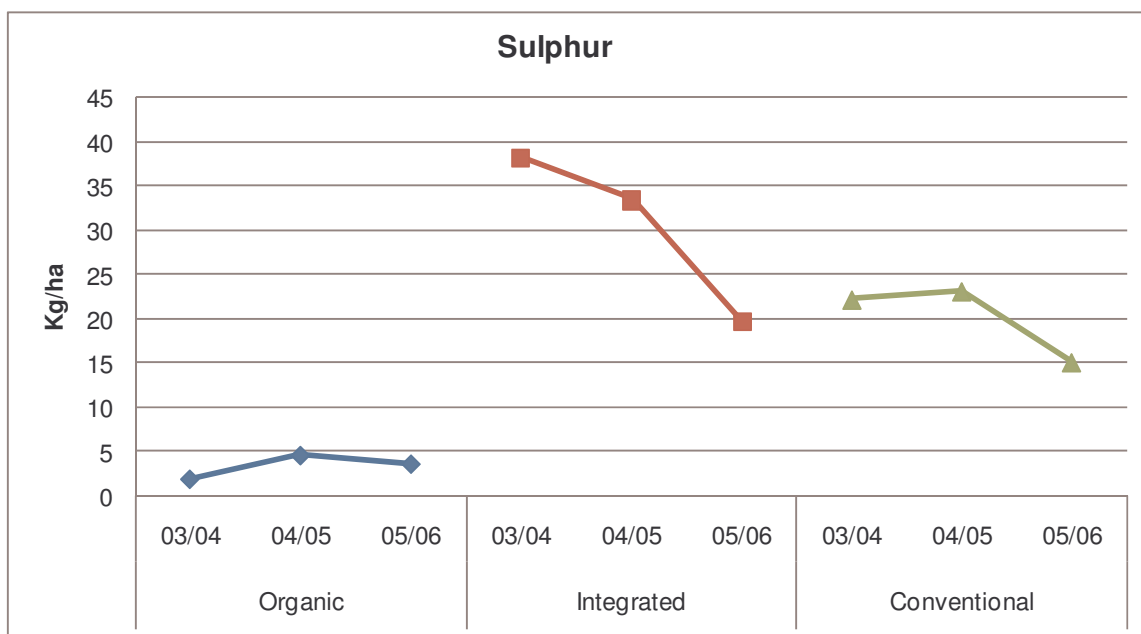
**Figure 3. Nitrogen input, kilograms per hectare, from 2003 to 2006**

Organic was excluded from the analysis of Nitrogen as well, as none of the organic farms applied nitrogen. To achieve normality the data was square root transformed. Management system were significant at the 95% confidence level ( $P=0.037$ ).

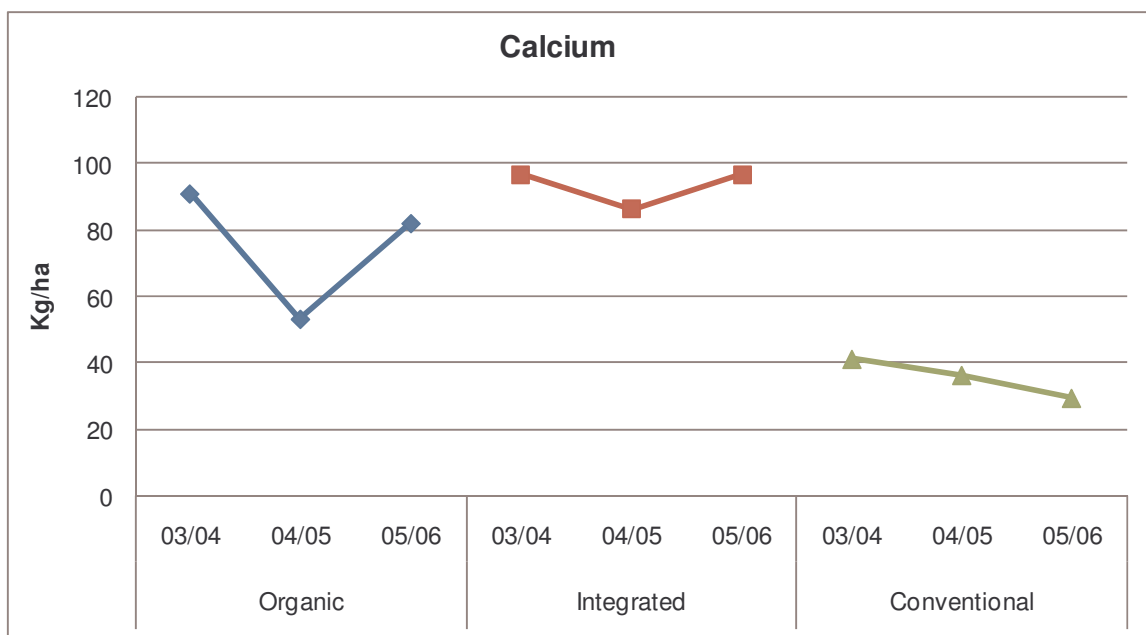


**Figure 4. Potassium input, kilograms per hectare, from 2003 to 2006**

Potassium suffers from an extremely skewed distribution (83 out of 108 data points were zero) and wasn't statistically analyzed.



**Figure 5. Sulphur input, kilograms per hectare, from 2003 to 2006**



**Figure 6. Calcium input, kilograms per hectare, from 2003 to 2006**

Calcium application on the integrated farms were significantly (95% confidence level) higher than on conventional and organic farms. The power to detect the small difference between organic and conventional was very low (0.126).

This data will be linked to the soil testing done in 2005 and 2007 to establish relationships between fertiliser inputs, nutrient outputs and the impacts that these have on soil biota, nutrient availability and farm productivity.

## **2.4 Earthworms**

### **2.4.1 Introduction**

Earthworms can play a variety of important roles in agroecosystems. Their feeding and burrowing improve the physical and nutrient status of the soils by burying and decomposing plant material, mixing the soil, improving soil structure and creating channels through the soil. As the earthworms ingest soil, litter and dung there is an increase in the mineralisation of soil nitrogen and in the availability of phosphorus. Earthworms improve soil physical properties, which increase water drainage and infiltration, aeration and root development. The increased root development also aids the nutrient uptake and water availability

Earthworms are most active during the winter months, as, unless the soil is irrigated, it generally becomes too hot and dry for them during the summer. Some species may even appear to die out altogether in the summer, but they will have left their eggs behind ready to hatch when the conditions become suitable for them. Other species burrow down to a cooler spot in the soil and tie themselves up into a small knot ready to get through the dry summer months. Once the conditions are suitable these earthworms will become active again.

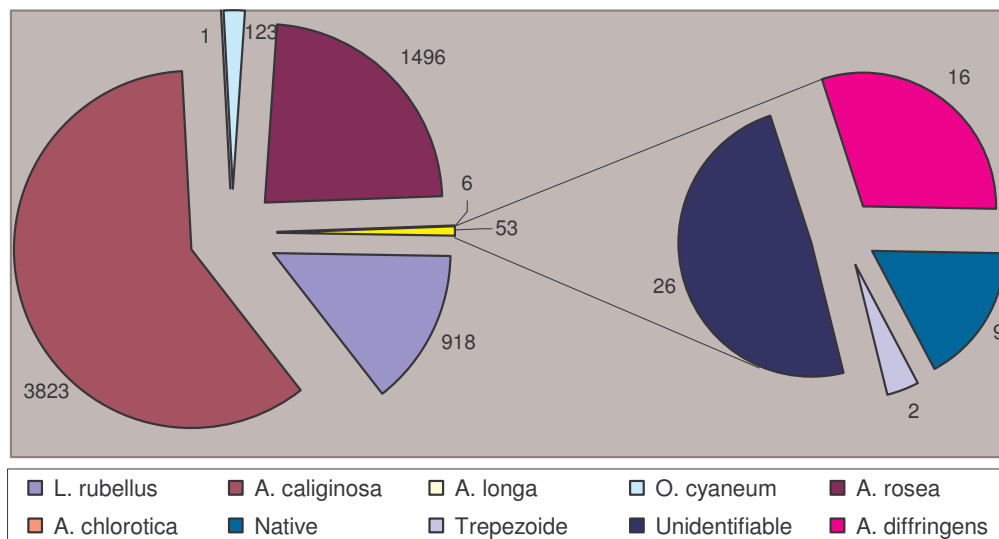
Overall, a much larger population of earthworms is usually supported under a pasture than under a crop, since higher amounts of organic matter are returned to the soil under the pastoral system. In regards to cropping the tillage method (direct drilling versus conventional cultivation) also has a large effect on earthworm population size and composition in arable soils. Earthworm populations can be up to three times higher under direct drilling than conventional cultivation.

As worms are deemed important to a pasture based system, and the environment as a whole, a worm collection and identification survey was carried out in July 2007 on the ARGOS sheep/beef farms. Worms were collected from a spit measuring 15 x 15 x 20cm deep from the soil monitoring sites (3 per focal paddock and 3 to 6 focal paddocks per farm) used to collect soil bulk density and nutrient core data from the ARGOS sheep/beef farms. Preliminary survey results are detailed below.

### **2.4.2 Preliminary Survey Results**

#### Total worms found

In total 6420 worms were collected, identified and weighed during the 2007 winter. Figure 7 shows the three common worms were the *Aporrectodea caliginosa* (3823), *Aporrectodea rosea* (1496) and *Lumbricus rubellus* (918). These made up 97% worms found and is the types expected to be found in Sheep/beef pastures in the South Island.



**Figure 7. Species of worms found on ARGOS sheep/beef farms**

### Three common worm species

#### **Aporrectodea caliginosa**



This field worm is the most common in New Zealand that does most of the work of mixing and recycling dead plant matter in our soils. Pastures devoid of these species tend to develop a thatch of plant material, which limits the ability of water and fertiliser to integrate into the soil. These are the species that are commonly used to improve these 'thatch bound' soils.

#### **Aporrectodea rosea**



Similar to the Aporrectodea caliginosa and is found in the same habitats except in lower numbers. The main differences are the transparent tails and A. rosea have a more pronounced pink colour, especially at the head. The saddle can also be a distinctive orange colour. This worm is also a useful species to have in the soil

#### **Lumbricus rubellus**

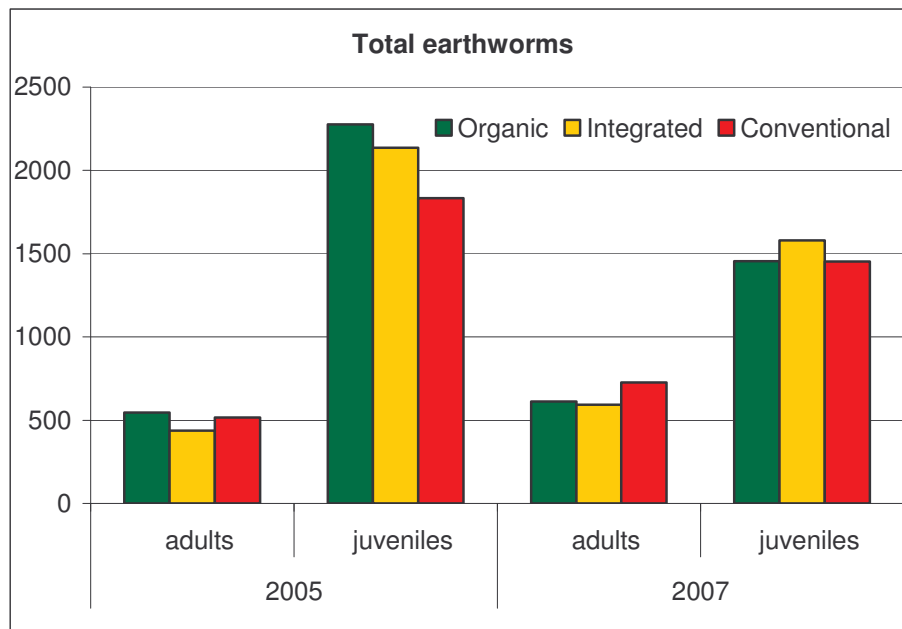


Otherwise known as the 'Dung' or 'Red' worm this one lives near the surface and are often the type that blackbirds can be seen pulling out of the lawn. They are very active and can move rapidly across the surface. Hence were the 'escape' artists during the worm collection process

L.rubellus is a useful soil incorporating worm that is quite often found in soils with high organic levels. Their numbers can be reduced by applying ammonium sulphate fertilisers or spraying with a pesticide such as carbaryl at the recommended rate.

#### Adults and juveniles - 2005 versus 2007

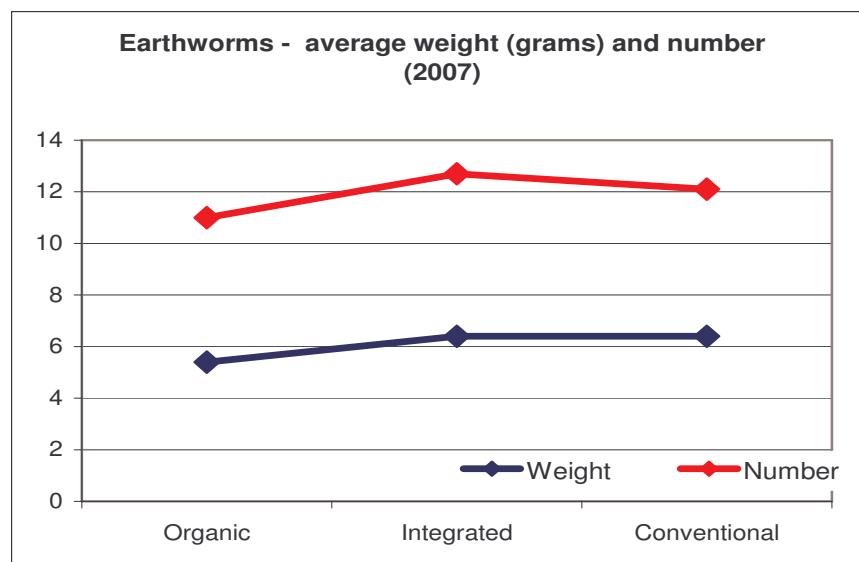
A greater number of worms were found in winter 2005 than in winter 2007 (8192 compared with 6420), however in both years the proportion of juveniles was greater than adults. Figure 8 shows the ratio of juvenile worms to adults and the proportion of worms found in each panel (Organic, Integrated and Conventional).



**Figure 8. Adult and juvenile earthworm numbers, 2005 and 2007**

#### Earthworms - per soil monitoring site (sms)

Figure 9 suggests that there were more worms found per sms on integrated farms with the least number found on organic. The same trend is suggested in regards to the average weight of worms. However the organic panel had the highest individual worm weight average due to a 9.2 gram native worm found on an organic farm. The typical common earthworm weighed approximately 0.5 grams across both adult and juvenile worms.



**Figure 9. Average number and weight of earthworms per soil monitoring site.**

## 2.5 Carbon Balance of Seven ARGOS Sheep and Beef Farms - Pilot Study

### 2.5.1 Introduction

The significance of food miles was outlined in last year's ARGOS annual report and this has expanded to the carbon footprint debate, which is gaining traction in overseas markets, with supermarkets, such as Tesco, stating that they aim to develop a carbon footprint labeling measure for all products sold in their store.

A carbon footprint is the total amount of CO<sub>2</sub> and other greenhouse gases, emitted over the full life cycle of a product or service. It is expressed as grams of CO<sub>2</sub> equivalents, which accounts for the different global warming effects of different greenhouse gases. The carbon footprint is calculated using the Life Cycle Assessment (LCA) method. The life cycle assessment is the assessment of the environmental impact of a given product or service throughout its lifespan. Energy use (MJ/kg) and Co<sub>2</sub> emissions (kg Co<sub>2</sub>) of typical inputs used in many farming systems are shown in table 3.

**Table 3** Energy use (MJ/kg) and Co<sub>2</sub> emissions (kg Co<sub>2</sub>) of typical inputs used in many farming systems

	Energy Use (MJ/kg)	Co <sub>2</sub> Emissions (kg Co <sub>2</sub> /MJ)
Diesel (per litre)	43.6	68.7
Petrol (per litre)	39.9	67
Oil (per litre)	47.4	35.9
Electricity (per k Wh)	8.14	19.2
Nitrogen	65	0.05
Phosphorus	15	0.06
Potassium	10	0.06
Sulphur	5	0.72
Lime	.06	0.06
Herbicide (Paraquat, Diquat & Glyphosate) (kg ai) <sup>a</sup>	550	0.06
Herbicide (other) (kg ai) <sup>a</sup>	310	0.06
Insecticide (kg ai) <sup>a</sup>	315	0.06
Fungicide (kg ai) <sup>a</sup>	210	0.06
Plant Growth Regulator (kg ai) <sup>a</sup>	175	0.06
Oil (kg ai) <sup>a</sup>	120	0.06
Other (kg ai) <sup>a</sup>	120	0.06
Fodder	1.50	0.058
Vehicles	65.5	0.09
Implements	51.2	0.10
Buildings (m <sup>2</sup> )	590	0.10
Shipping (per tonne m)	0.114	0.007

(kg ai)<sup>a</sup> = kilograms active ingredient.

(Adapted from: AERU Research Report No. 297)

In July 2007 Seven farms in two clusters (clusters 6 and 9) plus an additional farm (4A), were surveyed to determine their greenhouse gas emissions and the extent to which these were offset by the annual sequestration of carbon in the woody biomass on their own farms.

#### Inputs of carbon (Carbon sequestration)

- All woody biomass was included in the analysis (trees, scrub, bracken and wetland vegetation), irrespective of whether or not it would qualify for carbon credits under the Kyoto Protocol.

#### Outputs (Uses) of carbon

- Greenhouse gas emissions included carbon dioxide from resource use inputs such as fuel and fertiliser, and methane and nitrous oxide emissions from animals and nitrogen fertiliser.



This study will be subsequently expanded to include soil carbon.

### Carbon Sequestration

Carbon sequestration is the term describing processes that remove carbon dioxide from the atmosphere.

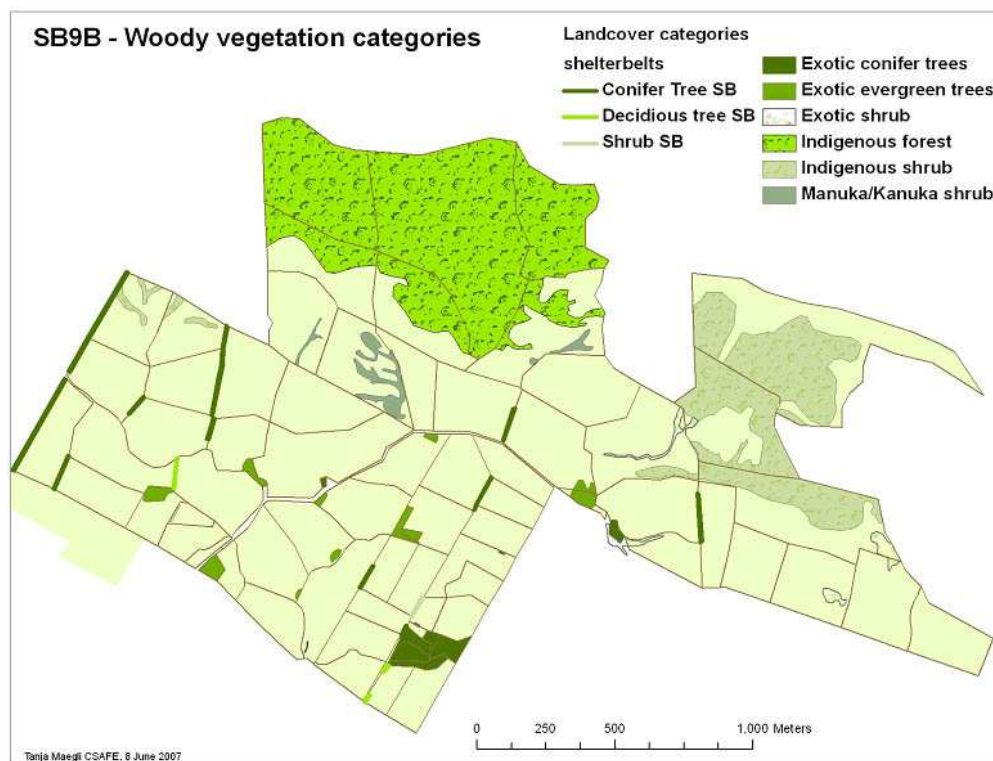
Table 3 describes the farms in each cluster.

**Table 4** Farm description

	Total area (ha)	Total effective area (ha)	Total tree and shrub area (ha)†
Cluster 6 + 4A	289	276	4.4
Cluster 9	609	475	160.3

† Some of this area may also be included in the effective area where stock graze under trees.

Data collection for these factors was made easier because GIS maps of the ARGOS farms (figure 10) already had maps of stratified areas of woody vegetation and it was simply a matter of validating previous data collected and classifying them into categories as defined by the Land Cover Database (University of Waikato website)



**Figure 10. Example of farm with standing wood categorized using GIS.**

### 2.5.2 Results

Table 4 presents the results as a carbon balance sheet with carbon sequestered (income) and emitted (expenditure). No farms sequestered more carbon than they emitted with the woodiest farm sequestering on average 50% of its annual emissions. The figures in brackets show the range of results using low and high carbon sequestration rates for each type of woody biomass.

**Table 5** Carbon Balance Sheet – tonnes CO<sub>2</sub>

	Cluster 6 and 4A	Cluster 9
Sequestered (Revenue)	31.7	741.0
Emitted (Expenditure)	932.4	1,702.5
Deficit	-900.7	-961.6
Sequestered carbon as a % of that emitted	5% (4 - 6%)	43% (28 – 59%)

### 2.5.3 Discussion

The pilot study highlighted a large gap in the knowledge of sequestration rates for various types of scrub and forest and the need for more robust rates to be established. No data was found for sequestration rates of low vegetation material. This leads to the carbon and carbon dioxide sequestering numbers being a best guess with variances that need to be reduced in the future. Despite this, differences in carbon sequestration were identified across different farming landscapes.

## **3 Economic**

### **3.1.1 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. In addition, this year the economics research team looked into the extent to which the business management information examined to assess the financial success or performance of conventional businesses applies to farm businesses.

### **3.2 Market Access**

The Doha round negotiations in the World Trade Organisations have not yet achieved a global trade arrangement but some agreement has been reached, such as the elimination of all forms of export subsidies in agriculture and reduction of some of the highest agricultural tariffs. In addition, the EU has converted most of its Common Agriculture Policy (CAP) direct payments into Single Farm Payments (SFP), which is less trade distorting. A successful Doha WTO agreement will bring advantages to New Zealand producers as it might result in reductions in import tariffs and export subsidies. A failure or delay of the Doha agreement will bring more focus on bilateral free trade agreements. The New Zealand Government is in the process of negotiating a free trade agreement with China, which is the fastest growing consumer market. Hence, New Zealand agricultural exporters have growing opportunities in the world market as export subsidies and tariffs are reduced and removed.

However, the growing opportunities in the world market may well rely on production meeting various environmental criteria especially to access high-value markets. Climate change is the most recent example of these criteria from which issues such as food miles have arisen. This is clearly an erroneous concept as it ignores the full energy and carbon emissions from production as the Lincoln AERU Food Miles report showed. Food miles, whilst still having traction with the popular media and maybe consumers, has lost credibility with the supermarkets and government agencies who have turned their attention to carbon footprinting. The emphasis now is therefore on measuring the carbon footprint of products and currently DEFRA (Department for Environment, Food and Rural Affairs), the Carbon Trust and BSI (British Standard Institute) are developing a method to do this. The key factor is reducing carbon footprint over time. The rise in importance of the carbon footprint cannot be seen as temporary issues given the policy and consumer attitudes around this. Nor is this just an issue in the UK but also the EU and increasingly other markets such as Japan all of which have proposed some form of reduction in emissions. There are even signs in the US that this is growing in importance.

It is to be emphasised that producers overseas, particularly in the EU are likely to be subsidised to meet these targets, as recently announced by the EU. Currently farmers are required to meet various environmental standards to obtain subsidies and can receive additional subsidies to meet market assurances schemes. This does imply that the requirements of supermarkets and others on producers are likely to increase not just for reductions in carbon footprint but in terms of other factors such as biodiversity and water quality.

Food safety is another issue that affects market access. There is a call for tougher food safety legislation and more inspections, and the FAO and World Health Organisation have urged all countries to strengthen their food safety systems. Whilst this is not a major concern for New Zealand due to a good track record of food safety, it is important that our good reputation is

maintained and that sufficient bio-security measures are in place to ensure the country remains disease free. Consumers are also concerned about food safety. Market research investigating consumer demand clearly shows that one of the most important attributes for consumers is food safety together with quality and price. Consumers are also increasingly demanding food that is healthy and conveniently packaged. In addition, there is a growing trend in consumer interest in animal welfare and the environmental impact of food production.

### **3.3 Relevance of conventional business management practices**

The extent to which the business management information examined to assess the success or performance of conventional businesses applies to farm businesses have been investigated in order to understand the key elements of business activities within the agricultural sector. Information, or indicators, used to assess the success of conventional businesses are based on models of business success and include factors relating to structure of firm; business strategy; customer focus; quality; employee relations; innovation; and social/environmental indicators.

The economics objective examined the degree to which these indicators are related to sheep and beef farms' financial performance and if farms with different management systems differ in the indicator measures. For most part, the results suggest that many of the indicators are not related to farms' financial performance and there does not appear to be any differences in the indicator measures amongst the different management systems. Consequently, the models and indicators of business success for conventional firms may not be relevant for sheep and beef farms. Hence, there is a need to identify alternative indicators that are more relevant to agribusinesses. Were there any suggestions in Evas report to what they would be

## **3.4 The Farm Financial Analysis**

### **3.4.1 Introduction**

Three panels of farms have been defined in each of the Kiwifruit and Sheep/Beef sectors, on the basis of the growers' involvement with market audit and certification schemes. These schemes impose and/or prohibit particular farm management practices and, as such, may be expected to change the relative magnitudes of costs incurred. An objective of the financial analysis is the estimation of the extent to which these effects influence financial sustainability. The panels are defined as:

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

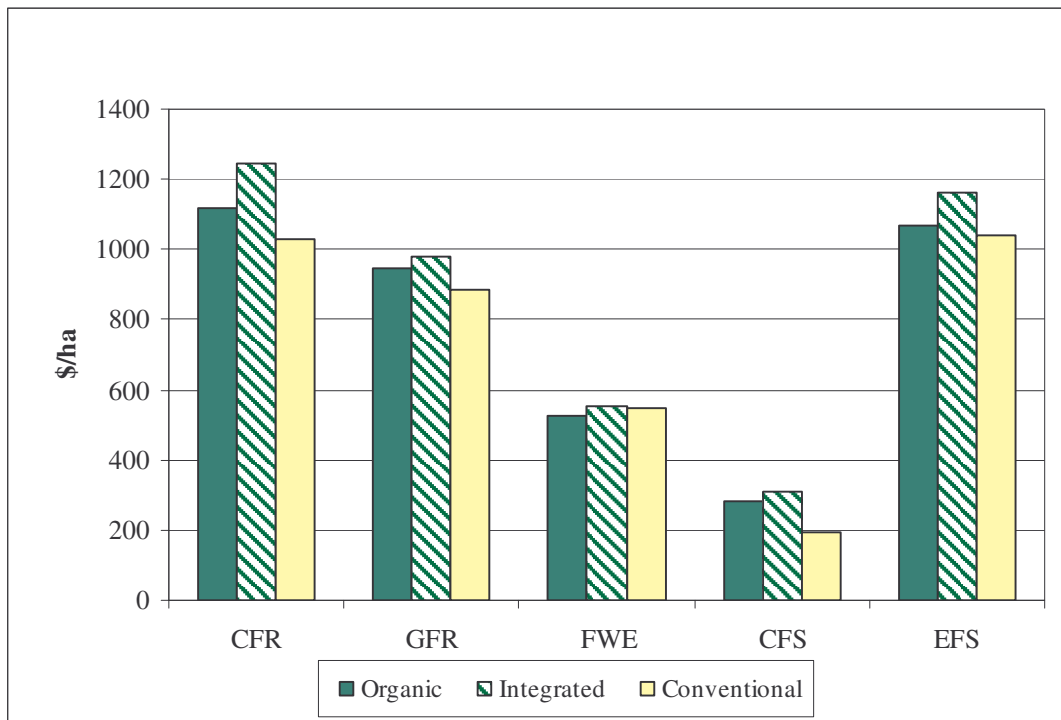
### **3.4.2 Panel Differences**

Analysis of Variance (unbalanced treatment structure) was conducted in order to determine whether there were significant differences between panels with respect to financial variables. Individual year analyses were carried out for each variable with relatively few differences detected, but when the entire dataset was converted to real 2005/06 values using the Consumer Price Index (all groups) more significant results were found. A number of significant differences have been detected between panels, particularly with respect to individual cost elements in the sheep/beef analysis and income. However, further analysis is required before we can say the lack of any significant panel differences with respect to many other variables reflects an actual lack of difference, or a lack of power to detect any difference. Further analysis in this area will be conducted.

No significant differences were detected in any of the overall financial aggregates between panels in any single year or in the combined data set by the analysis carried out over the

four years from 2002/03 to 2005/06. Figure 11 shows the estimated real (\$2005/06) mean values in \$/ha of:

- Cash Farm Revenue (CFR);
- Gross Farm Revenue (GFR=CFR plus value of inventory changes);
- Farm Working Expenses (FWE=cash operating expenses i.e excludes debt servicing),
- Cash Farm Surplus (CFS=CFR- Cash Farm Expenditure, which includes debt servicing) and
- Economic Farm Surplus (EFS – net return after accounting for cash and non-cash inputs and outputs)



**Figure 11. Sheep/Beef panels mean values over four years**

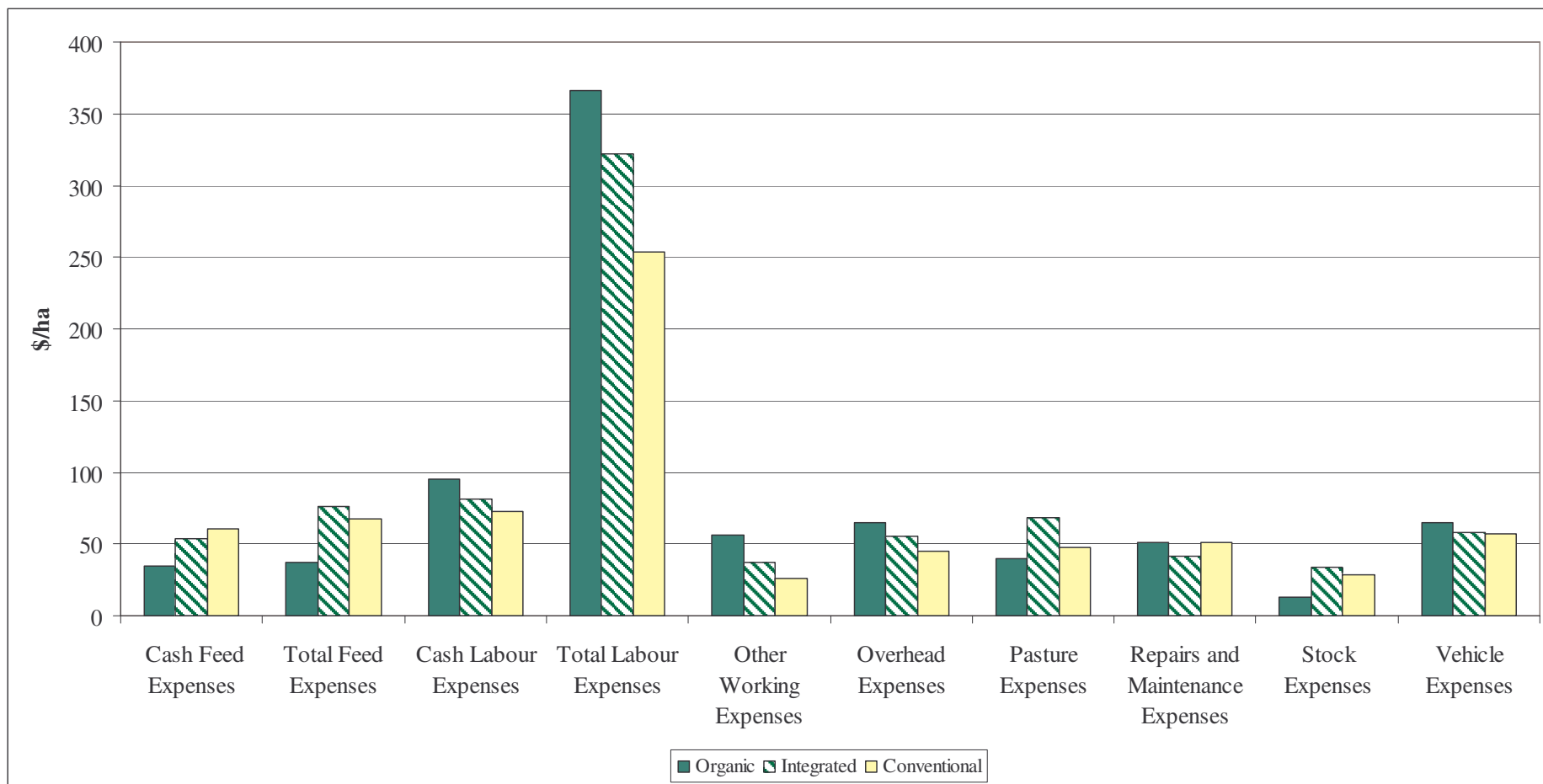
### 3.4.3 Individual cost elements

Significant differences were, however, detected in individual cost elements between the panels, although skew and kurtosis effects in the data on total feed costs (cash feed costs plus change in feed inventory values) and a slight skew in the pasture renovation cost data necessitates caution in interpreting these results. As feed inventory changes were included only for 2005/06, cash feed costs over the period may provide more meaningful results in future years. Table 5 shows the differences detected between panels.

**Table 6** Sheep/Beef panel differences in individual working costs

	Significance of difference	Difference
Stock expenses	1%	(C,I)>O
Cash feed expenses	5%	C>O, C=I, I=O
Total feed expenses	5%	(I>O)(C=I)(C=O)
Cash labour expenses	NS	
Total labour expenses	1%	(I,O)>C
Pasture expenses	1%	I>(C,O)
Fertiliser expenses	1%	(C,I)>O
Repairs and maintenance expenses	NS	
Vehicle expenses	NS	
Overhead expenses	5%	C>O,C=I,I=O
Other working expenses	1%	C>O, C=I, I=O

Lower inputs of animal health products and fertiliser on Organic farms have, as expected, led to significantly lower stock and fertiliser costs on Organic farms than on the Conventional or Integrated farms, although this has not translated into clearly lower feed and pasture renewal costs on these properties. Pasture renewal and maintenance costs are significantly higher on integrated farms than in the other panels and cash feed costs are higher on Conventional than Organic farms. Overhead costs are also higher on Conventional than Organic farms despite the inclusion of organic certification costs under this heading for Organic properties. The higher level of “other” working expenses on Conventional farms does not appear to reflect a consistently higher level of any one of the costs included in this total. Figure 12 shows the mean real values of individual cost elements for each of the panels.



**Figure 12. Sheep/Beef panel mean values over four years**



## 4 Environment

### 4.1.1 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 the continuation of past surveys on stream health, soils, and GIS farm mapping.

### 4.2 Farm Mapping

Farm mapping is an integral part of ARGOS, providing information in a visual format that can simplify some of the complexities in a transdisciplinary project. The maps have also been designed to provide updates for farmers to assist them in their daily management. The farm/orchard maps are important reporting tools and the illustration the maps provide is essential for an effective dialogue between farmers and researchers. The maps can show where the monitoring areas and survey transect lines are, and relate the research results to these visual 'queues'. This is an effective way of communicating the results from our research and has proven invaluable during interviews with farmers.

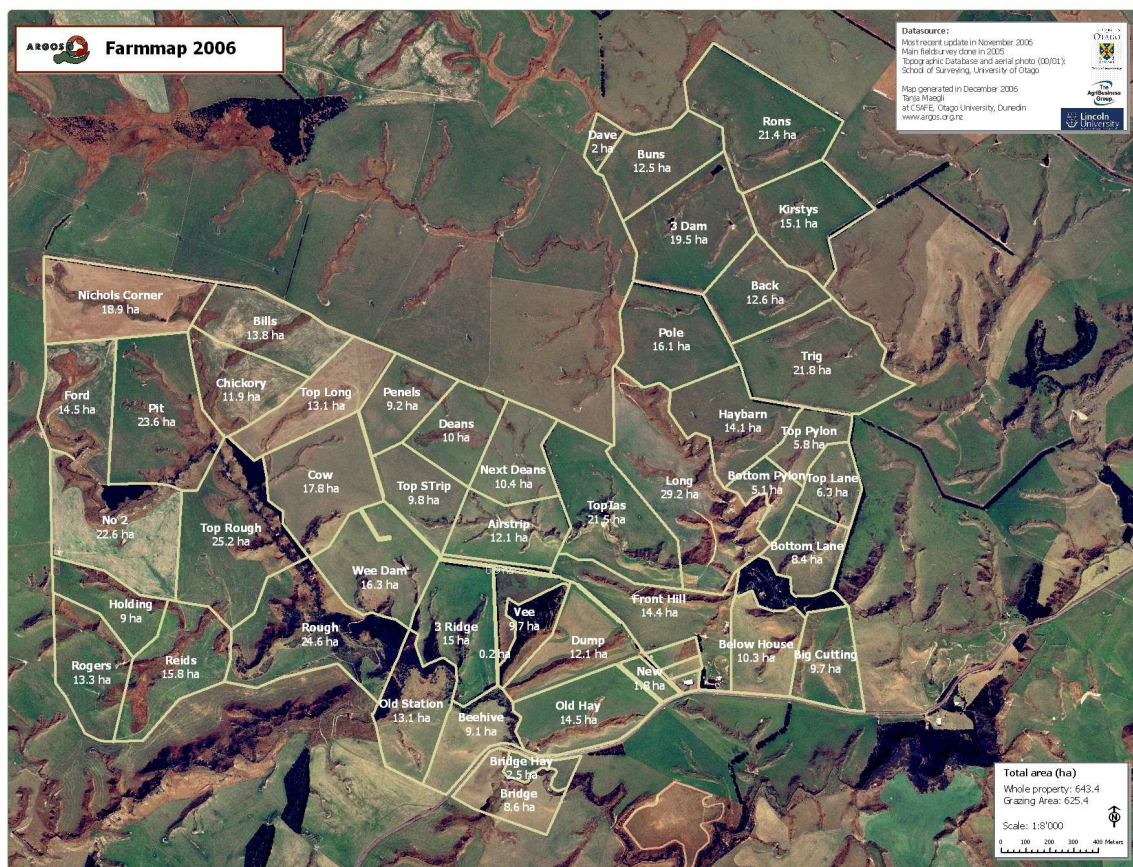


Figure 13. Example of a completed farm map for ARGOS farmers

### 4.2.1 Basic descriptors

A Geographical Information System (GIS) allows to analyse the spatial pattern of a farm and assists researches to statistically analyse differences between management styles. Table 6 shows some of the information that can now be downloaded easily and accurately from the GIS database.

**Table 7** Comparison of paddock and vegetation areas between the panels

Panel	Organic	Integrated	Conventional
Mean total property area (ha)	388.2	468.1	449.4
<b>Pasture</b>			
Mean number of paddocks	52.4	56.2	58.1
Mean pasture area (ha)	357.0	441.1	441.3
Mean paddock size	6.8	8.4	8.1
<b>Woody Vegetation</b>			
Mean number of veg. patches	25.5	18.2	22.3
Mean woody area (ha)	42.3	37.8	52.2
Mean patch size (MPS)	1.6	1.5	1.6
% of woody veg in total	8.9	7.3	9.7

### 4.2.2 Digital Elevation Model

Over the last 12 months, a Digital Elevation Model (DTM) has been generated as a pilot for one ARGOS Sheep & beef farm. Topography is a key variable in a wide range of environmental processes and shapes landscape patterns directly (creating natural breaks in vegetation patterns) and indirectly through influence on disturbance and potential successional pathways. Knowing the topography of a farm helps the understanding of spatial characters in each paddock, its variability and quality. Terrain maps, together with ecological and soil attributes depict principal capabilities and limitations of land to support many activities such as agricultural crop selection, crop management, catchment areas and overall farm planning, both short and long term. Currently the three-dimensional GIS map is the only practical tool available to researchers to process the volume of data required to integrate seasonal changes required – but in the longer run we expect such tools to be accessible to the farmers themselves, or to act as scenario-building tools that allow the farmers to ‘see’ land use choices in ways that any number of tables and graphs could not.

The mapping and three dimensional modeling trial allowed estimation of time and expense to create a full set of DTMs for all the farms. It was sufficiently encouraging that three dimensional maps are now part way through construction for four of the ARGOS sheep-beef ‘clusters’ (12 farms in all). This will allow a sufficiently replicated trial of the value and practicability of the tool for guiding land use choice by June 2011, from when further investment can be considered if the ARGOS project is refunded.

Below are examples of slope, aspect and curvature maps. Whilst slope and aspect is self explanatory, curvature assists in the ability to stratify between crests, flats and slopes. The final map (figure 17) shows the same map from a ‘birds view’ with paddocks and woody vegetation layers activated.

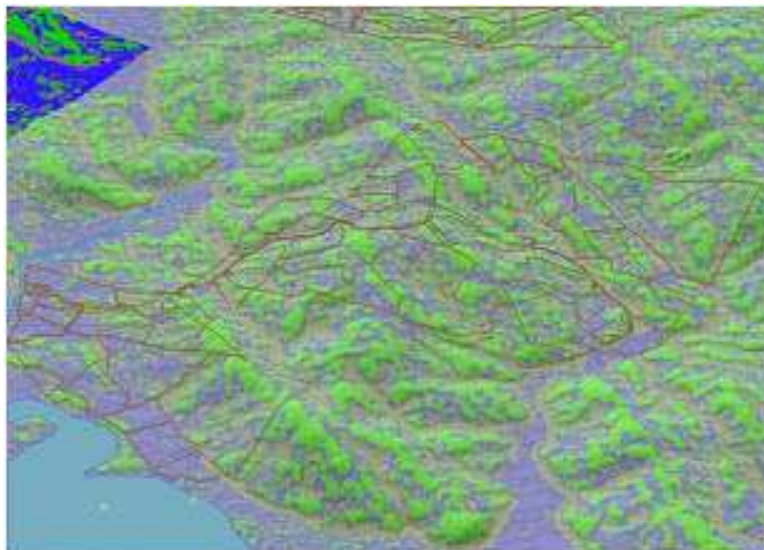




**Figure 14. Spatial depiction of slope degree**



**Figure 15. Spatial depiction of aspect**



**Figure 16. Spatial depiction of curvature**



**Figure 17. Bird's eye view of an ARGOS sheep/beef farm**

## 4.3 Soil Survey

### 4.3.1 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.

### 4.3.2 Definitions

- Soil pH.** Indicates the level of acidity or alkalinity of the soil sample.
- Olsen P.** A measure of the phosphorus readily available to the plant.
- Potentially mineralisable N (AMN).** An indication of the nitrogen that may become available to plants through mineralisation of organic matter. An increased carbon to nitrogen ratio will decrease the availability of nitrogen to plants.

### 4.3.3 Results

Sixty percent of soil raw data was back from the laboratory at the time of print; hence the simplest preliminary analysis is complete. The following charts show the first of 3 dots on a graph to show a trend. Because of the variability in soil surveying (influence of climate etc) it is too early to comment on the significance of the following trends.

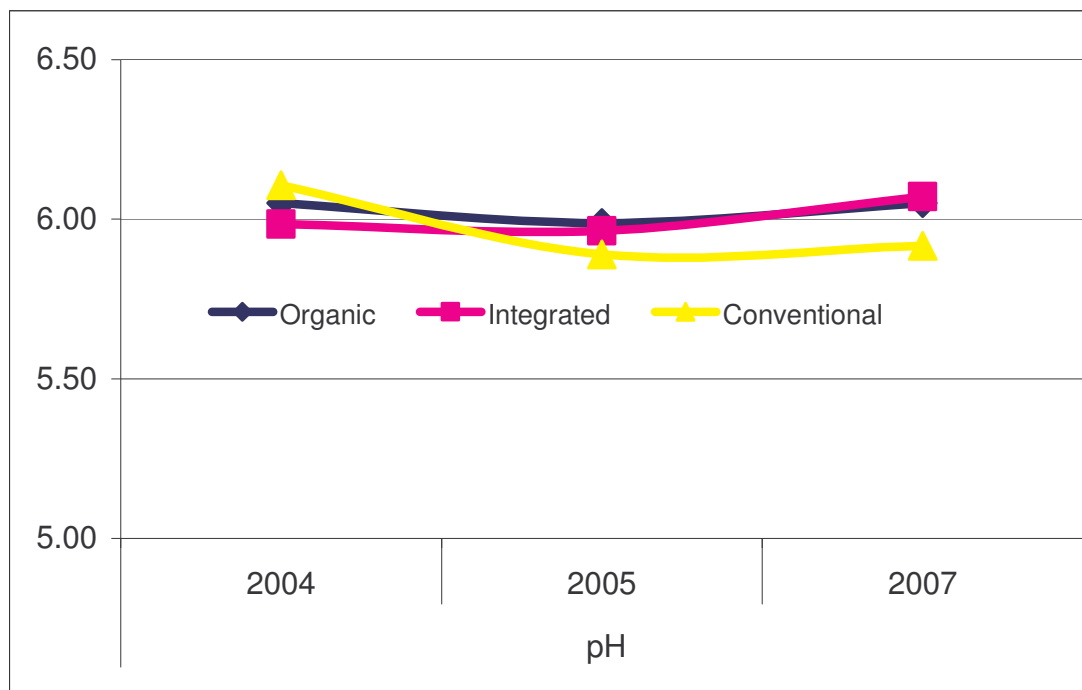
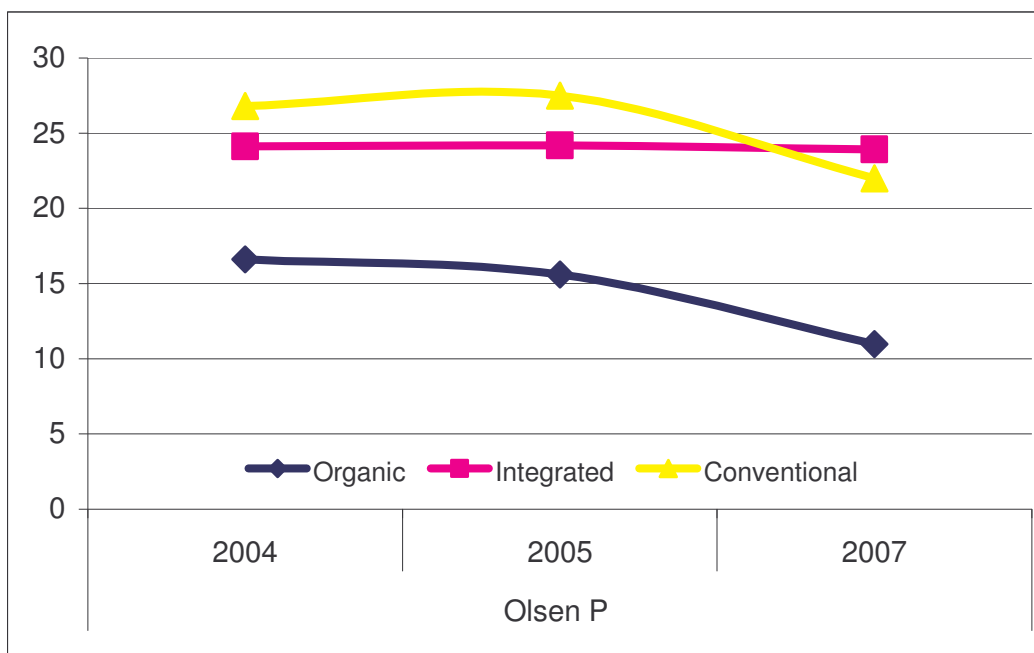
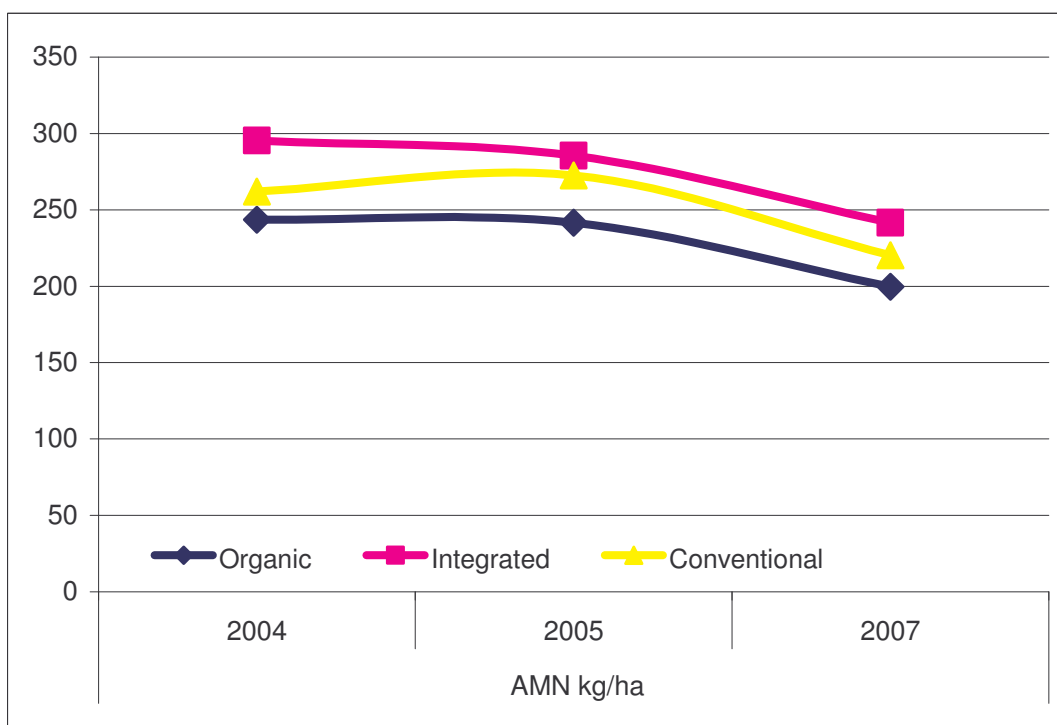


Figure 18. pH values from 2004 to 2007



**Figure 19. Olsen P values from 2004 to 2007**



**Figure 20. AMN kg/ha values from 2004 to 2007**

## 4.4 Streams

### 4.4.1 Introduction

The second stream survey was carried out in the summer of 2007. Physical parameters, periphyton and aquatic macro-invertebrate communities, nutrient and sediment levels, were measured at upstream and downstream sites in streams on 35 South Island sheep/properties. We used the Stream Health Monitoring and Assessment Kit (SHMAK), an assessment tool developed for use by farmers and landholders, as well as additional measures to record relative changes in water quality and stream functioning at the farm scale.

ARGOS performed this study as a continuation of a long term effort to support New Zealand farmers to identify and instigate practical farm management strategies to improve stream health and associated water quality. The study had four specific aims:

1. Provide comparative data on waterway quality and ecosystem function on sheep/beef and dairy farms, from which future trends in stream health can be determined;
2. Identify any relative impacts of organic, integrated management, and conventional farming systems on water quality and aquatic ecosystem function on both sheep/beef and dairy farms; and
3. Assist in customized stream care management strategies for each participating farmer for incorporation into long-term whole-farm management plans.
4. Establish an effective stream health and water quality monitoring process through the evaluation of the Stream Health Monitoring and Assessment Kits (SHMAK) monitoring protocols and additional tests.

#### Definitions

**Periphyton** is a complex matrix of algae, cyanobacteria, heterotrophic microbes, and debris that is attached to submerged substrata in almost all aquatic ecosystems. It serves as an important food source for invertebrates and some fish, and it can be important to absorb contaminants. The periphyton is also an important indicator of water quality

**Aquatic macro-invertebrate** refer to organisms, with no vertebrate, living in or on the water.

The following section describes the data collected followed by a preliminary review of the raw results. More detailed descriptions of the methodology and the survey, in general, can be found in the “Annual ARGOS Sheep/Beef Sector Report 2005/2006”

#### Stream data collected

1. **Ammonia ( $\text{NH}_3$   $\mu\text{g/L}$ ):** Water samples were collected in the main flow of the waterway at the upstream (undisturbed) end of each site.
2. **Total nitrogen (TN  $\mu\text{g/L}$ ) and total phosphate (TP  $\mu\text{g/L}$ ):** Water samples were collected in the main flow of the waterway at the upstream (undisturbed) end of each site.
3. **Dissolved Reactive Phosphate (DRP  $\mu\text{g/L}$ ):** Water samples were collected in the main flow of the waterway at the upstream (undisturbed) end of each site.
4. **Nitrate and Nitrite ( $\text{NO}_3 + \text{NO}_2$   $\mu\text{g/L}$ ):** Water samples were collected in the main flow of the waterway at the upstream (undisturbed) end of each site.



5. **Total organic carbon (TOC):** Water samples were collected in the main flow of the waterway at the upstream (undisturbed) end of each site.
6. **Total suspended solids:** Water samples were collected in the main flow of the waterway at upstream (undisturbed) end of each site.
7. **Total dissolved solids:** Water samples were collected in the main flow of the waterway at upstream (undisturbed) end of each site.

**Additional sampling included**

- **Organic stream deposits** - Suspended sediment samples were collected from each site.
- **Invertebrate samples** – these were collected to allow more detailed assessment of the macro invertebrate community present at each site.

**Table 8** Stream Health Monitoring and Assessment Kit (SHMAK) Parameters.

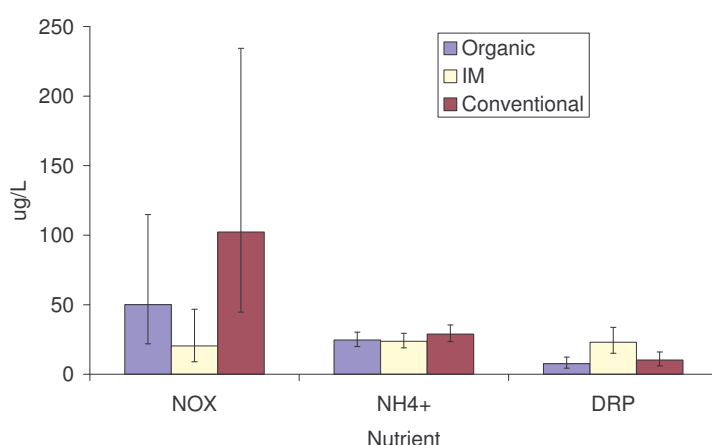
Parameter	Units	How recorded
Stream width	Metres	Average of width at bottom, middle and top of survey site
Stream depth	Metres	Average of depth at true left bank, centre, and true right bank at the bottom, middle and top of the study site
Flow velocity	Metres/second	Average time for a floating object to travel the length of the survey site (three replicates)
Water temperature	Degrees centigrade	Bulb thermometer temperature of water in the middle of the channel at the upstream end.
pH	$-\log_{10}(\text{H}^+ \text{ ion concentration})$	Merck Neutralit pH strips in a container of stream water for 10 minutes
Water conductivity	Microseimens $\text{cm}^{-1}$	EUTECH Cybernetics TDScan 3 hand-held conductivity meters in a container of stream water
Water clarity	Detection distance (metres)	Distance at which a black disc can be detected along a 1-metre length clear acrylic tube filled with stream water
Stream bed	Index between -20 - +20	Percentage cover of different substrate types, weighted by their ecological function (see text)
Riparian vegetation	Index between -10 - +10	Percentage cover of different vegetation types, weighted by their ecological function (see text)
Deposits	Index between -10 - +10	Qualitative assessment of the extent of substrate covered by sediment and other deposits
Invertebrates	Index between 0 - 10	Abundance of different stream invertebrates weighted by their ecological requirements and sensitivity to stream modification
Periphyton	Index between 0 - 10	Percentage cover of different algae taxa weighted by their ecological requirements and sensitivity to enrichment

#### 4.4.2 Results

Note these are predicted average values from the statistical analyses. This means that they are the estimated average value for each nutrient once variability between years and clusters have been accounted for. To help in interpreting the graphs, the vertical lines on each bar give an indication of how variable the levels on each farm are (longer lines indicate greater variability and less confidence in the estimated average value – shorter lines are better!)

##### Sheep/beef average values

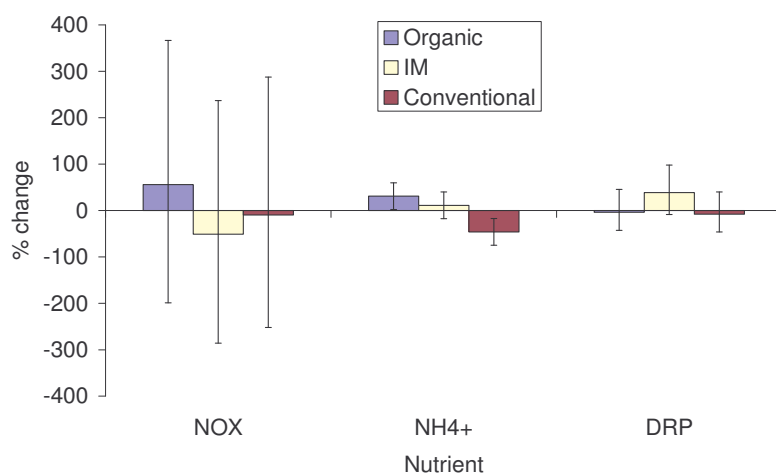
1. Nitrates (NOX) are significantly higher in Conventional than Integrated (IM) –
  - a. Organic and IM, and Organic and Conventional not significantly different from each other
2. Dissolved Rock Phosphate (DRP) significantly higher in IM than either Organic or Conventional,
  - a. Organic and Conventional not significantly different from each other



**Figure 21. Nitrates (NOX), ammonium (NH4) and dissolved rock phosphate (DRP) values.**

##### Sheep/beef percent change across each farm

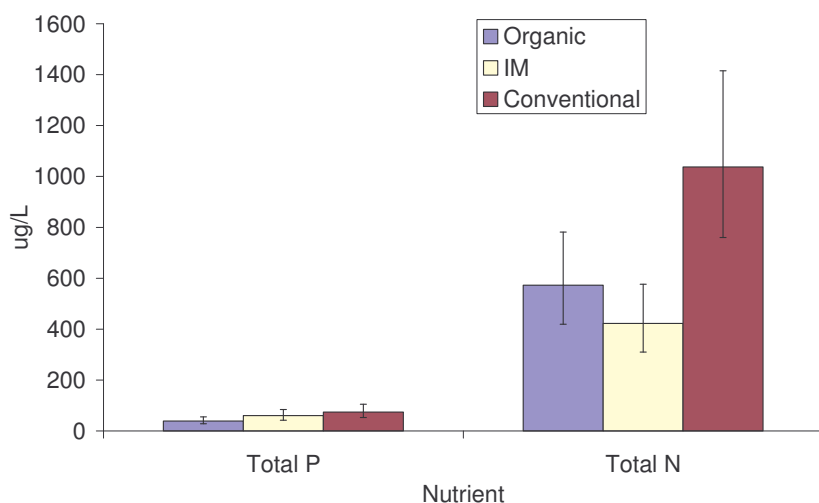
1. Significantly greater percentage decrease in NH4+ on IM farms than either Organic or Conventional, Organic and Conventional not sig different from each other



**Figure 22. Variance across farms for nitrates (NOX), ammonium (NH4) and dissolved rock phosphate (DRP)**

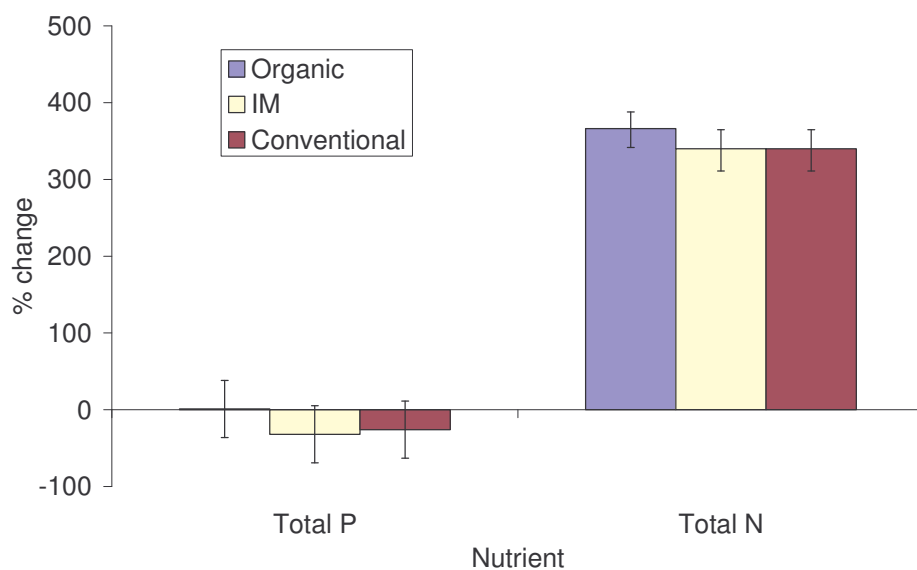
### Sheep/beef total P and N

2. Total P Organic sig lower than Conventional, no differences between IM and the others
3. Total N Conventional sig higher than IM, Organic not diff to either



**Figure 23. Total P and Total N values.**

Average percent change across each farm total N and P – nothing significant



**Figure 24. Average percent change for Total P and Total N values**

### 4.4.3 Discussion

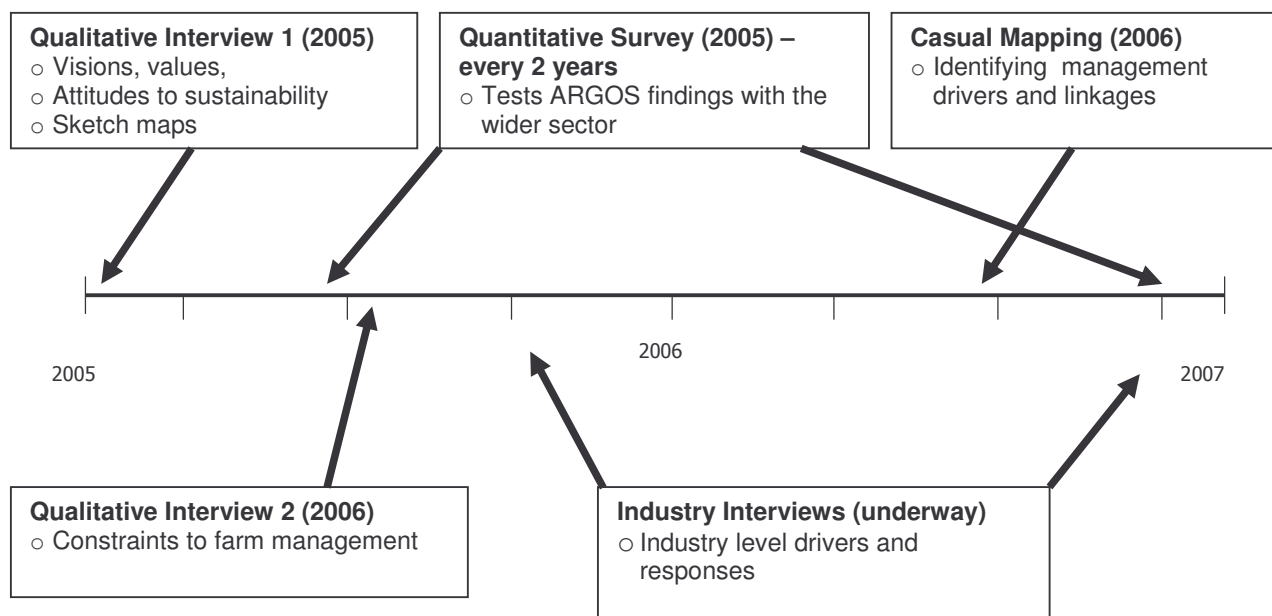
Because this is raw data 'hot off the press', discussion and interpretation of these results will be part of an independent report at a later stage. However, the fact that we are now starting to detect significant differences between panels, when none were detected with only one survey, highlights the value of our repeated survey.

## 5 Social

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, including those identified above, that have been shown to impact the way in which farmers approach farm management and engage with issues of sustainability.

Table 8 outlines the range of information gathering tools that the Social team are deploying and from this a more comprehensive understanding of the social dimensions of agricultural production. This knowledge, in turn, will contribute to our assessment of the means by which sustainable farm management will be established in New Zealand.

**Table 9 ARGOS Social Research Information Collection**



### 5.1 Understanding sheep/beef management using causal maps

#### 5.1.1 Introduction

A type of cognitive mapping, called causal mapping, was used to develop a better understanding of farm management, broadly defined to include economic, environmental and social factors, as seen by farmers.

#### 5.1.2 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. We used a score from 1 to 10 to show how strongly the factors were causally linked. Each farmer completed a map, and data from each map was then used to prepare an aggregated or group map for all ARGOS farmers, plus one for each panel of farmers (those using a distinct management system).

### 5.1.3 Results

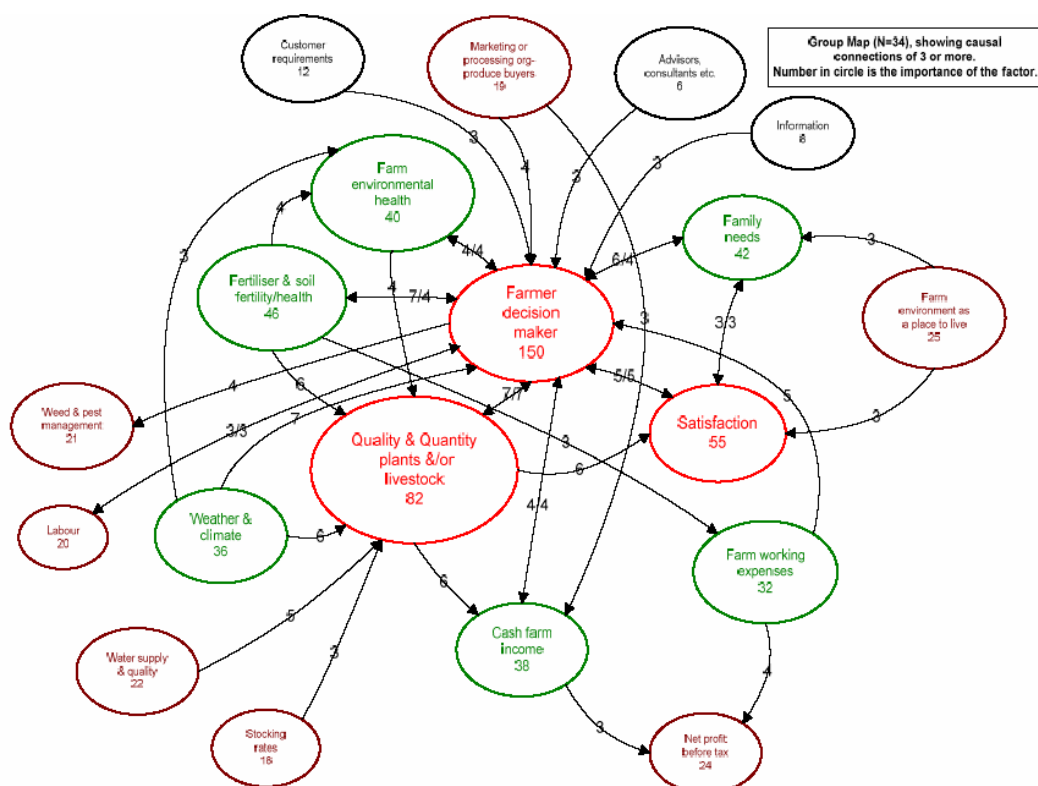
The group map is shown in Figure 25. It shows all the factors linked by average scores of three or more. Group map data provide a measure of the overall importance of each factor using the sum of the weights of linkages to and from the factors. The most important factors, shown in red, include: farmer as decision maker, quality and quantity of production and satisfaction. Next in importance are those factors in green including financial aspects (cash farm income, farm working expenses), farm environmental health, fertiliser and soil fertility health, weather and climate and family needs.

Key features of the group map are:

- At the core of the map are personal and production factors.
- There is a strong production orientation.
- The environment is very important.
- Satisfaction is derived from varied factors.

There were some differences in the maps for the three panels. The key themes were:

- Conventional: importance of weed and pest management, and customers and marketing, while the environment was less of an issue.
- Integrated: high quality and quantity of production and managing expenses to meet family needs and gain satisfaction.
- Organic: farm health to achieve off-farm product quality with lower expenses.



**Figure 25. Group causal map for ARGOS sheep/beef farms.**

There were also differences among farmers based on further analysis of the data which identified four types (to be described more fully later in this report). The key themes for each were:

- Type 1, Conventional, external influences important

- Type 2, off-farm work
- Type 3, external orientation
- Type 4, ecological concern

#### **5.1.4 Conclusions**

Many of the core factors in the map are connected with bidirectional arrows so they are in a dynamic and complex relationship with each other. Changes in one factor would necessitate changes in nearby factors. Sheep/beef farmers are juggling many factors in the day-to-day and longer term planning and management of their farms. The farmers develop strategies or approaches that make sense to them and allow them to negotiate this complexity of factors in a manner that is expected to meet their needs. These different strategies mean that there are distinctive and unique ways that farmers combine and relate factors despite having some core similarities. The results of this research for the panels and the types illustrate these different strategies.

## **5.2 Four types of sheep/beef farmers across the ARGOS panels**

### **5.2.1 Introduction**

The causal maps helped improve our understanding of sheep/beef farm management. The analysis showed how the maps varied for farmers in each panel. In addition, it also identified four other types of farmers. The following describes the four different types of farmer as defined by the “Q” method.

### **5.2.2 Q method**

The mapping method asked farmers to first identify the factors important in the management of their farm system. This involved the farmers sorting 41 factors into a distribution from the most important to the least important. Q method uses this distribution to find groups, or Q-sort types, of people who sort the factors in a similar way.

## **Results**

Results are presented in order from the smallest to the largest number of farmers.

### **Type 2 - Off-farm work important**

- Has an off-farm work orientation where the work is related to improving the financial situation of the household
- Gave less emphasis to environment, weather and climate, and satisfaction.
- Is trying to build up the farm financial situation and improve equity.
- Has a map with fewer connections suggesting that this type sees farming as less complex compared with other types.

The key theme of Q-sort type 2 is lower emphasis on environment, production, farmer as decision maker and family, and higher emphasis on farm profits to increase equity, facilitated by a greater role of hired labour and advisors. Customer requirements are unimportant to this type.

### **Type 3 - External orientation**

- Particularly important were off-farm activities, contractors, fertiliser and soil fertility/health, and marketing or processing organisation.
- Markets and customers are paramount, paralleled by the importance given to off-farm work and off-farm activities.
- Labour has a strong influence on production. This type of farmer delegates farm work to labour and contractors while they meet off-farm work commitments.

The key theme of Q-sort type 3 is an external orientation focused on markets, customers, off-farm activities, delegation of work to labour and contractors, and maintaining fertiliser and soil fertility/health.

### **Type 1 - Conventional, external influences important**

- Does not emphasise the farm environment as much as other types and sees the weather and climate, and exchange rate/macro economy, as having a greater influence.
- Has only some subtle differences from the overall average and believes that some external factors, which are hard to control, have a greater impact on their farm system.
- Like Q-sort type 2 this type has a map with fewer connections suggesting that this type sees farming as less complex compared with other types.

The key theme for Q-sort type 1 is the lack of emphasis on the farm environment and the importance given to two external factors – the weather and the exchange rate/macro-economy.

### **Type 4 - Ecological concern**

- Emphasises farm environmental health, farm environment as a place to live, customer requirements, fertiliser and soil fertility/health, satisfaction, and weather and climate. Off-farm product quality is an additional factor on the map.
- Farm environmental health, fertiliser and soil fertility/health, family needs and production all have stronger connections to farmer as decision maker.
- Farm environmental health is linked strongly to production, and fertiliser and soil fertility/health has a strong effect on farm environmental health.
- Q-sort type 4 gets greater satisfaction from meeting family needs, farm environment as a place to live and farm environmental health.

The key theme of Q-sort type 4 is the importance given to the farm environment, fertiliser and soil fertility/health, satisfaction and future generations/succession.

Results from the Q-sort types can be simplified by combining types 1 and 2 (Group A), and combining 3 and 4 (Group B). Group B farmers emphasise:

- An off-farm theme of customer requirements, customer satisfaction and off farm product quality, a social theme reflected in family needs, future generations/succession and satisfaction, and an environmental theme represented by farm environment as a place to live, farm environmental health and stream health. Group B farmers have significantly more connections on their maps and significantly more connections per variable.

### **5.2.3 Conclusion**

ARGOS sheep/beef farmers belong to a panel depending on what management system they use. However, this is not the only way that the farmers can be grouped. The results presented here show another classification. It has some connection to management system but not exclusively. Some conventional farmers fall into the ecological category and one organic farmer fell into the conventional category.

The defining characteristics of Group B are associated with potential indicators of resilience. While production is still important (as it is for all types), there are more sources of satisfaction for Group B and this could imply greater wellbeing.

The types have identified important characteristics of farmers that we were not aware of and which may prove to be important in understanding farm management and in finding ways to improve the sustainability of farming in New Zealand.

## **5.3 Audit Schemes**

### **5.3.1 Introduction**

The ARGOS project seeks to enhance understanding of the condition of sustainable agriculture in New Zealand. Whereas the project as a whole is dedicated to a transdisciplinary approach comparing existing management practices in three principal commodity systems, this section focuses exclusively on the analysis of the sheep/beef sector

developed within the ARGOS social research objective. In this case, the farmers' relationships with the processing industry, especially their emerging response to increasing demands for audited best practice, were of particular interest.

Based on our analysis of farmer interviews, we draw several conclusions regarding the role of audit schemes in the New Zealand sheep/beef sector:

- Audit schemes are pervasive in agri-food systems over the near term at the very least.
- New Zealand farmers show varying capacities to comply with audit schemes reflecting their ability to accept external appraisal of good practice.
- The acceptability of a given audit scheme is influenced by farmers' perceptions of several characteristics:
  - the source of scheme (local vs. external)
  - their ability to challenge excessive demands
  - the emphasis on paperwork vs. management practice
  - the 'real' rewards for compliance

The auditing of management practice (as a feature of market competition for agricultural commodities) acts as a way of establishing trust between the producers and consumers of a commodity. The emergence of global sourcing in agri-food markets limits reliance on face-to-face encounters as a means to develop consumer confidence in products and management practice. Mutual trust can, however, be established by audit practices that both gain consumer confidence in audited qualities and retain an understanding of the limitations faced by producers.

There are also potential side effects of the formalising of best practice within an audit scheme:

- Acting as technical barriers to trade;
- Privileging of producers able to comply with or promote audit claims; or
- Promotion of practices of greater benefit to processing and marketing efficiencies than to the well being of producers or consumers.

The role of audit schemes in the New Zealand sheep/beef industry is distinguished by two phases:

- The shift from carcass to cuts and higher price markets in response to sectoral crisis in the 1980s; and
- The more recent emergence of 'quality assurance' schemes introduced by British supermarket chains.

The former phase, and the general adoption of industry demands on the weight, fat coverage, delivery timing, and appearance of stock, demonstrates the potential success of market driven change in commodity production. The existing positive representations of these changes reflect current perceptions that these were locally initiated, had positive impact on market conditions, and demonstrated financial rewards without severely challenging existing understandings of 'good farming' within the sector. The more recent emergence of supermarket driven quality assurance schemes has met with less uniform approval. Among the ARGOS farmers, one group of farmers recognised the capacity of consumers to distinguish among management practices as product qualities. A second group was much less likely to accept the limitations imposed by the external gaze of an audit scheme on the attributes of independence and craftsmanship that they associated with farming. Consequently, an individual's willingness to accept external oversight appeared more influential to compliance with audit schemes than other factors such as the relative emphasis on production or profit, the relative importance of quality or quantity, or attitudes towards nature or innovation.



## 6 2007/08 Plan

Table 10 ARGOS Planned Activity 2007/08

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

### 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)  
Claire Mulcock (Merino NZ Inc)  
Mark Stevenson (ARGOS High Country Field Officer/NZ Merino Company)  
Jon Manhire ( ARGOS Programme Manager)

Thank you for your support and input.

### 7.2 References

#### **Social**

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

New Zealand Farmer and Grower Attitude and Opinion Survey: Sustainability in Primary Production (2006), by John Fairweather, Lesley Hunt, Andrew Cook, Chris Rosin, Hugh Campbell

The Representativeness of ARGOS Panels and Between Panel Comparisons (2006), by John Fairweather, Lesley Hunt, Andrew Cook, Chris Rosin, Hugh Campbell

#### **Environment**

Cleaner streams and improved stream health on North Island dairy and South Island sheep/beef farms (2006), by Grant Blackwell, Mark Haggerty, Suzanne Burns, Louise Davidson, Gaia Gnanalingam and Henrik Moller

A Survey of Herbaceous Plant Management on South Island Sheep and Beef Farms (2006) Henrik Moller, Richard Hill, and Dave Lucock

Herbaceous plants on ARGOS sheep and beef farms (2006), by Martin Emanuelsson and Dave Lucock

## **PUBLIC REPORTS**

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

### **Research Reports**

05/01 Understanding Approaches to Kiwifruit Production in New Zealand : Report on First Qualitative Interviews of ARGOS Kiwifruit Participants, by Lesley Hunt, Chris Rosin, Carmen McLeod, Marion Read, John Fairweather and Hugh Campbell, June 2005

05/02 Soil quality on ARGOS kiwifruit orchards, 2004-2005, by Andrea Pearson, Jeff Reid , Jayson Benge and Henrik Moller, June 2005

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

05/06 Bird community composition and relative abundance in production and natural habitats of New Zealand, by Grant Blackwell, Erin O'Neill, Francesca Buzzi, Dean Clarke, Tracey Dearlove, Marcia Green, Henrik Moller, Stephen Rate and Joanna Wright, June 2005

05/07 Interspecific interaction and habitat use by Australian magpies (*Gymnorhina tibicen*) on sheep and beef farms, South Island, New Zealand, by Marcia Green, Erin O'Neill, Joanna Wright, Grant Blackwell and Henrik Moller, July 2005

05/08 to be published

05/09 to be published

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

06/02 Weed survey to be published, Henrik Moller et al

06/03 Cleaner streams and improved stream health on North Island dairy and South Island sheep/beef farms, by Grant Blackwell, Mark Haggerty, Suzanne Burns, Louise Davidson, Gaia Gnanalingam and Henrik Moller, June 2006

06/04 to be published

06/05 Prevalence and diversity of non-forage herbaceous plants on sheep/beef pastures in the South Island, by Grant Blackwell, Dave Lucock, Henrik Moller, Richard Hill, Jon Manhire and Martin Emanuelsson

06/06 to be published

06/07 Total Energy Indicators: Benchmarking Organic, Integrated and Conventional Sheep and Beef Farms, by Andrew Barber and Dave Lucock, September 2006

06/08 Kiwifruit energy budgets to be published, Andrew Barber and Jayson Bengé

06/09 Understanding kiwifruit management using causal mapping, by John Fairweather, Lesley Hunt, Chris Rosin, Hugh Campbell, Jayson Bengé and Mike Watts, September 2006

06/10 New Zealand Farmers and Wetlands, by Carmen McLeod, Lesley Hunt, Chris Rosin, John Fairweather, Andrew Cook, Hugh Campbell, November 2006

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

07/03 The Representativeness of ARGOS Panels and Between Panel Comparisons, John Fairweather, Lesley Hunt, Andrew Cook, Chris Rosin, Hugh Campbell

### **ARGOS High Country Environmental Report**

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

### **Working Papers**

Working Paper 1: Social Dimensions of Sustainable Agriculture: a Rationale for Social Research in ARGOS by Hugh Campbell, John Fairweather, Lesley Hunt, Carmen McLeod and Chris Rosin

Working Paper 2: Social Research Compendium: Key Questions on Social Dimensions of Agricultural Sustainability (The Corpse) by Hugh Campbell, John Fairweather, Lesley Hunt, Carmen McLeod and Chris Rosin

Working Paper 3: Economics Rationale for ARGOS by Caroline Saunders and Martin Emanuelsson

Working Paper 4: He Whenua Whakatipu Rationale for ARGOS by John Reid

Working Paper 5: Scoping Report for monitoring and evaluation processes within ARGOS by Esther Water (Members only)

Working Paper 6: Environmental Monitoring and Research for Improved Resilience on ARGOS Farms by Henrik Moller, Alex Wearing, Andrea Pearson, Chris Perley, David Steven, Grant Blackwell, Jeff Reid and Marion Johnson (Appendix 3: Visual Soil Assessment)

## Research Notes (short research summaries)

1. Background to the ARGOS Programme
2. Transdisciplinary Research
3. Cicadas in Kiwifruit 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. Wellbeing 1: Sheep/Beef Sector
13. Wellbeing 2: Sheep/Beef Sector
14. Wellbeing 3: Sheep/Beef Sector
15. Soil nematodes in kiwifruit orchards
16. Understanding kiwifruit management using causal maps
17. Bird Sampling Methods
18. Birds on sheep/beef farms
19. Birds on kiwifruit orchards
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

## 8 Appendices

The following tables summarise research collected, to date, by the environment, social and economic objectives in ARGOS.

### Environment Objective

**Table 11** Differences between sheep/beef management systems

	Sub-element	Indicator	Significant difference?	Comment
Soil	Chemistry	P retention, Olsen P and Sulphate-S; total carbon and nitrogen	✓	Sig. lower for Organic
		pH, exchangeable cations, total and calcium base saturation; potentially mineralisable N	✓	Sig. higher for Organic
	Biology	Microbial C & N	✓	Sig. higher for Organic
		Basal respiration	✓	Significantly higher for Organic
		Nematodes	X	No difference between systems
		Soil invertebrates	X	No difference between systems
		Earthworm abundance	X	Not significantly different between systems.
	Structure	Porosity, aggregation and mottles	X	No differences between systems
		Bulk density	X	No differences between systems
Terrestrial invertebrates	Pests	Porina	?	Data not yet analysed
		Grass grub	?	Data not yet analysed
Terrestrial vertebrates	Bird communities	Total abundance	X	No differences between systems
		Species richness	X	No differences between systems
		Native species proportion	X	No differences between systems
	Lizards	Lizard abundance	X	None found
	Bats	Bat abundance	X	No confirmed sightings
	Stream management	Fencing to exclude stock	X	No differences between systems

	Sub-element	Indicator	Comment
Aquatic ecosystems	Physical properties – average values	Width, depth, temperature, pH, velocity, conductivity	No differences between systems
		Turbidity	Sig. higher on conventional
	Physical properties - % change across farm	Width, depth, temperature, pH, velocity, conductivity, sediment	No differences between systems
	Nutrients - averages	Ammonium, nitrate + nitrite, dissolved reactive phosphorous, total P, N	No differences between systems
		Total organic carbon (TOC)	Sig. higher on Organic
	Nutrients - % change	Nitrate + nitrite, dissolved reactive phosphorous, total P, N	No differences between systems
		Ammonium	Sig. greater on Conventional
	Periphyton	Overall community structure	No differences between systems
		Individual species differences	Sig. more thin black algae on Conventional
	Invertebrates	Total individuals	Sig. lower on IM
		Species richness, proportion of insects, abundance of mayflies, stoneflies and caddis flies	No differences between systems
	Streamside vegetation	Overall composition	No differences between systems
		Cover of trees, scrub, pasture	No differences between systems

**Table 12** Status of GIS mapping

Feature	Types / Classes	Additional attributes
Management Units	Paddocks, utility area, house & garden area, laneways etc	Property ID, paddock name, area(ha), status
Landcover	Pasture, woody vegetation, wetland area, water	Property ID, area (ha), vegetation-element ID, status
Boundaries	Fences, natural boundaries along vegetation or streams...	Property ID, status
Waterways	Streams	Property ID, focal streams (Y/N)
Transport	Roads, tracks	Property ID, status
Monitoring sites	Soil monitoring sites, stream survey points	Property ID, status
Monitoring transects	Bird survey transects, pasture survey transects	Property ID, status
Buildings	House, shed, milkshed, woolshed	Property ID, status



## Social Objective

**Table 13** Differences between sheep/beef management systems

<b>SHEEP/BEEF</b>	<b>Conventional</b>	<b>Integrated</b>	<b>Organic</b>
<b>Survey</b>			
Intentions			Stronger intention to use organic methods, integrated methods, any of the listed management systems and not to use GMO's
Farming position (Committed Conventional to committed Organic)			Agree/disagree with appropriate farming position
Dependency			Less dependence on chemicals, manufactured fertilisers, more dependence on org. remedies
Evaluation of environment			Lower rating of condition of native species five years ago
Organic practices			More importance to two organic practices
Total number of differences	0	0	14
<b>Other surveyed data</b>	Not available yet		
<b>Sketch maps</b>	No panel difference	Location differences	
<b>Causal maps</b>			
Emphasise in farm systems:	Customer requirements, marketing and processing organisation, weed & pest management	Advisors/consultants, farm working expenses, Quality and quantity of production	Customer requirements, off-farm product quality, farm environment health, fertiliser and soil fertility health. Higher map density (connections/variables <sup>2</sup> ) (cf. Integrated only)
Location differences			Higher hierarchy (cf. Integrated only)
<b>Qual 1 (all comparisons)</b>			
Environmental pro-activity	Active	Active	Proactive
Identity, stress and coping	Feel more trapped	More likely to take time off	
Emphasis on succession	More	Less	Less
Sense of place	Farm as lifestyle	Farm as space	Farm as space
Sense of distinction (elite)	Lower	Higher	Lower
Urban-rural tensions	Concerned about deterioration	Public service commitment	Broader sense of community, stronger commitment
Emphasis on environmental indicators of good farming	Low	Medium	High
Economic indicators of good farming (non strong)	High	Medium	Low
<b>Qual 2 (all comparisons)</b>			
Incorporation of paperwork into idea of good farming	Low	High	High
Coping with contracts	(Medium)	High	(Medium)
Soil			Greater emphasis on soil and soil biota
Attitude to other orgs, connections	Stronger references to community	Better than conventional	Cognisant of consumer preferences
Risk/challenge	Familiarity of practice	Pursuit of challenge	Pursuit of challenge