ARGOS

AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

Annual ARGOS Sheep/Beef <u>Sector</u> Report 2009

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The AgriBusiness Group

Lincoln University

University of Otago

Preface

ARGOS was formed at the end of 2003 with farm recruitment and initial survey work completed in 2004. The first Annual ARGOS Sector Report for sheep/beef was produced in 2005 and contained findings from the first 12 – 18 months of the programme. The following three annual reports presented the results of subsequent research. This fifth instalment includes survey data over the 5 year period. Depending on survey types the results will include 2 to 6 years of data.

The information in this report is designed to illustrate key production differences between ARGOS farms and between management systems. The next step will be to use this data to better understand what might be contributing to these differences. Differences are likely to be due to a combination of environmental, financial and social factors, all of which are addressed in the transdisciplinary approach adopted by the ARGOS programme.

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1 ARGOS Overview

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 2009 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 6 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.

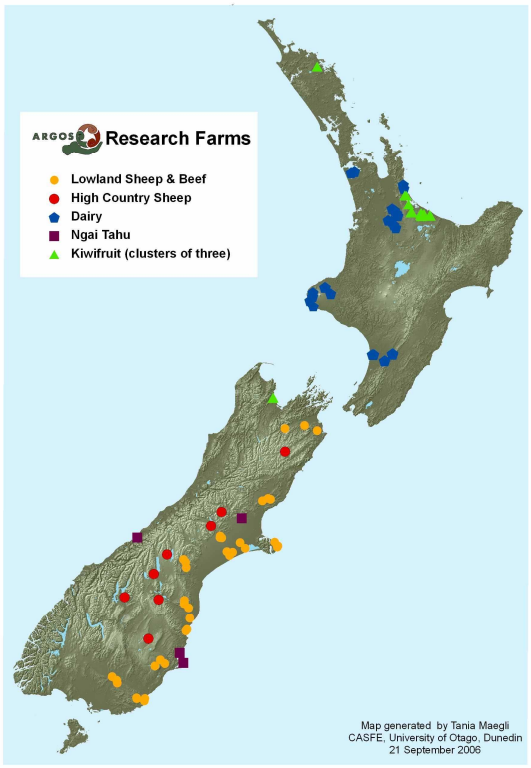


Figure 1 Location of Properties under study by ARGOS

1.1 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 ARGOS work plan

Figure 2 details work completed by various objectives in the ARGOS project during the 2008/2009 year. Planned work for the 2009/2010 can be found in Figure 3. traditionally coloured squares indicated work completed. Now there is a change to solid coloured rows reflecting ongoing analysis and report writing of previous surveys during this transdisciplinary stage of the program.

Figure 2 ARGOS activity 2008/2009

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												
Economic	Trade Modelling	Ongoing work throughout the year											
	Annual financial survey analysis	Ongoing work throughout the year											
	Research reports												
Environment	Further analysis - Birds & soils	Ongoing work throughout the year											
	Research reports												
Social	Analysis of past survey data	Ongoing work throughout the year											
	Research reports												

Figure 3 ARGOS activity 2009/2010

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												
	Productivity report												
	Soil & Biota Sampling												
Economic	Trade Modelling	Ongoing work throughout the year											
Environment	Further analysis - Birds & soils	Ongoing work throughout the year											
Social	Transdisciplinary analysis	Ongoing work throughout the year											

Legend

- Farm Management
- Economic
- Environment
- Social

3 Farm Management

Introduction

Farm Management, in ARGOS, is studied from a management systems approach in 3 main areas; 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.

3.1 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.

3.2 Changes to farms

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.

4 Differences between organic, integrated and conventional farm systems

4.1 Farm size and land use

The change in farm size over the study period was investigated to identify which properties changed substantially. Nine farms had increased in area relative to the first measurement in 2002/03. Five had had doubled or more in size, of which one had grown by 300% and another by 400%. There has been some variation in effective farm area due to land sales and purchases. Farms under integrated management tended to have a higher effective area as a percentage of overall area (Figure 4) possibly because of their belief that every part of the property (such as the office) was an integral part of the business.

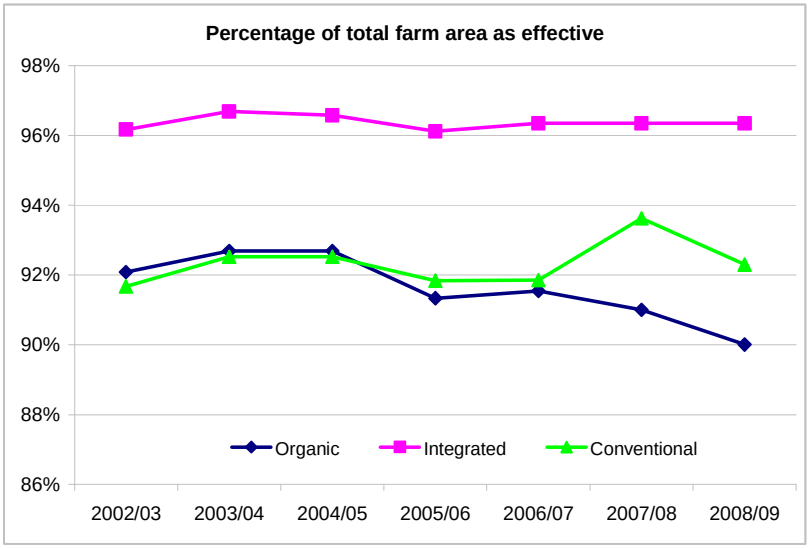


Figure 4 Effective farm area as a percentage of total farm area

4.2 Stocking rate

The average stocking rate per hectare from 2002/03 to 2008/09 for the integrated management (IM) group was 10.2 with the Conventional group being similar to that. The Organic group stocking rate was significantly lighter.

The general temporal trend was for a gradual increase in the IM group which contrasted with gradual decline in the Conventional group (excluding the last year) (Figure 5). The Organic group stocking rate peaked at 9.3 in 2005 – 07 with lower values before and after this period. The lower stocking density on Organic farms will favour their expenditure at a per hectare level in terms of feeds, animal health etc. Per stock unit is in some ways a more level playing field on which to compare the panels.

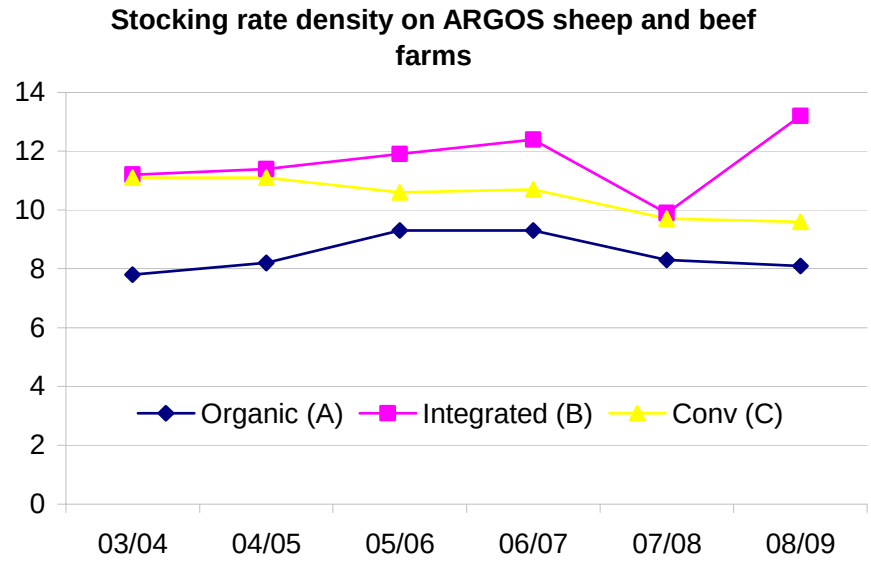


Figure 5 Stocking density on ARGOS sheep and beef farms

4.3 Stock ratios

When considering the 157 property years (number of properties multiplied by the number of years) in which both sheep and cattle were present on a property, the ewe:cattle stock unit ratio was 4.8 on Organic properties, 7.4 on IM properties and 5.0 on Conventional properties (Figure 6). These differences were not statistically significant reflecting large variation between the farms within each management type. Typically we would expect Organic properties to have a lower ratio due to the way they use cattle to 'vacuum' intestinal parasites.

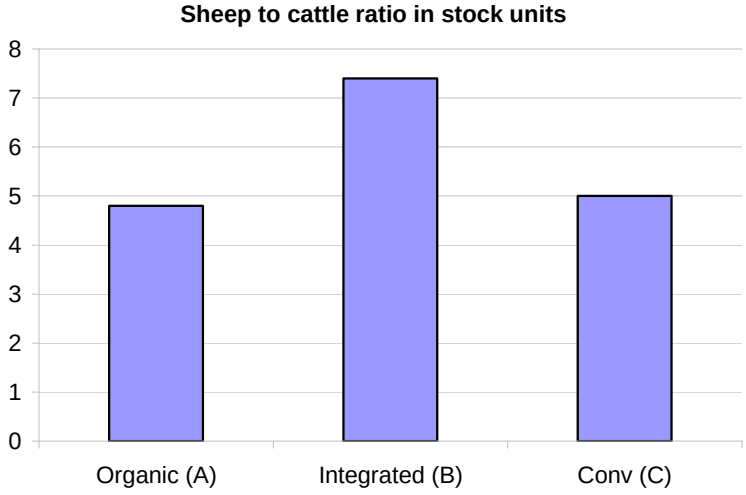


Figure 6 Sheep to cattle ratios (su) between organic, integrated and conventional systems

4.4 Supplement management

The following graph (Figure 7) suggests that Organic farmers used supplement as a buffer for feed storage. This is a typical risk minimisation strategy as Organic farmers have fewer markets for grazing stock off or store stock. This was very noticeable and significant on the per stock unit basis, but less noticeable on a per hectare basis. The conventional farmers stored the least supplement over this 2 year period.

The results did not reach significance in regards to supplement fed out but do suggest a trend that Integrated farmers fed out more supplement per hectare than conventional, which is probably a reflection of their higher carrying capacity (Figure 8). Organic farmers fed out the most supplements per stock unit, on average, over the 2 year period. The conventional farmers fed out the least per hectare and per stock unit suggesting that their management is based on matching animal demand to pasture growth. This will need to be tested for significance once more data comes available.

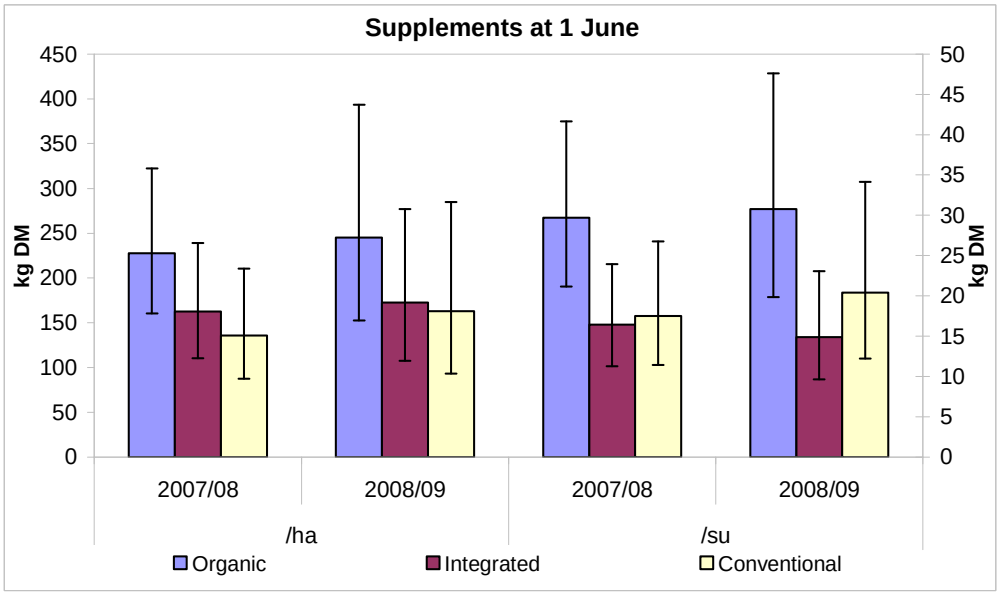


Figure 7 Supplements on hand 1 June on ARGOS sheep and beef farms[1].

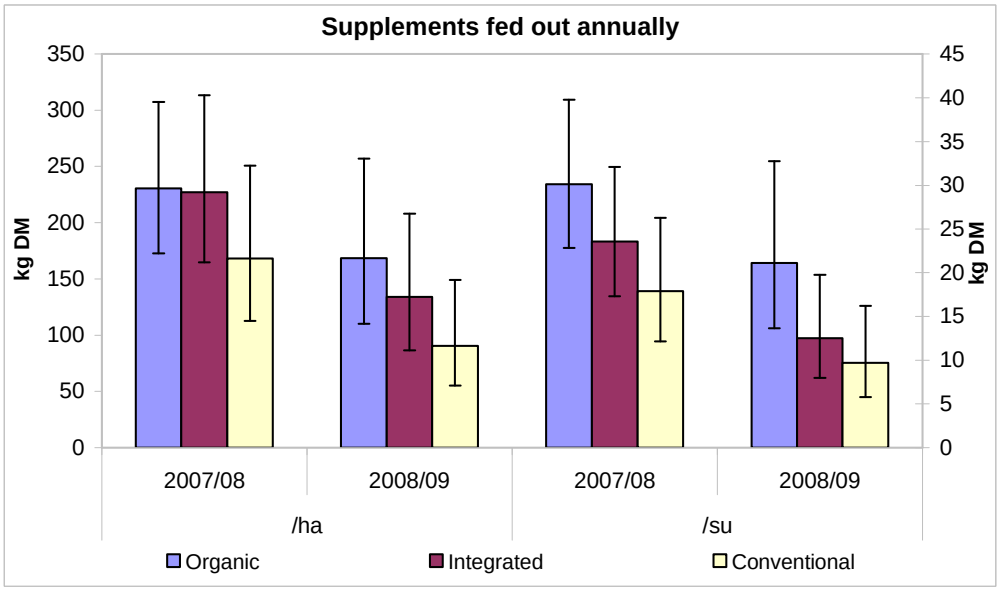


Figure 8 Supplements fed out annually on ARGOS sheep and beef farms[1].

1 The data was log-transformed prior to analysis. Back-transformed predicted values are presented here. Standard error bars are shown.

4.5 Lambing percentage

Lambing percentages were similar on organic and conventional properties, but about 10-20% significantly higher on integrated properties (Figure 9). There was a steady trend of declining lambing percentage across the four years of data in all management groups. The decline was greatest in the organic group (12%) and minor in both the conventional (3%) and integrated groups (1%).

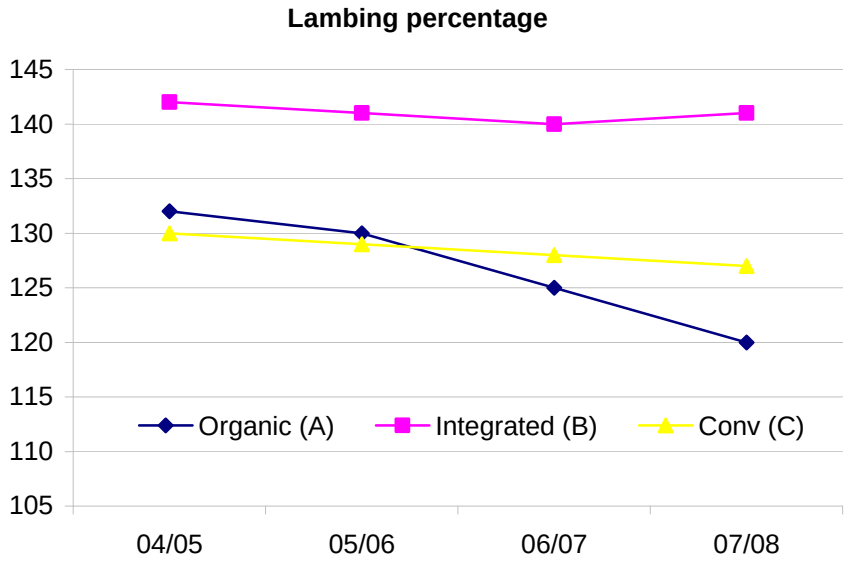


Figure 9 Lambing percentages on ARGOS sheep and beef farms

When outliers are removed (a farm with a very high lambing percentage in the first year from bought in lamb ewes) and then decreased lambing percentages, the decreasing trend suggested in Figure 9 changes to one that is not necessarily decreasing over the long term, but may be experiencing normal seasonal fluctuations (Figure 10).

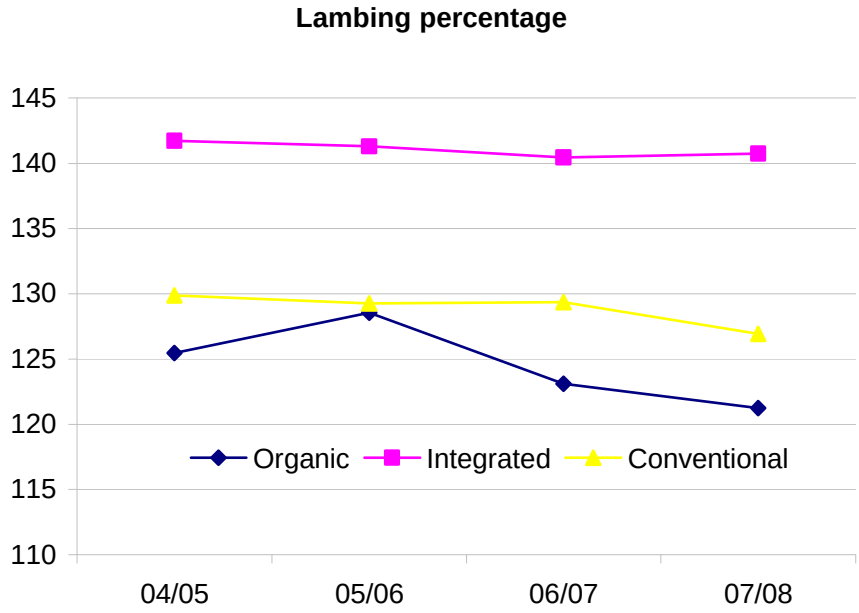


Figure 10 Lambing percentages on ARGOS sheep and beef farms

4.6 Cropping

Two hundred and twenty cropping events involving 63 crops were recorded during the 2007/08 – 2008/09 seasons. In order from largest to smallest area planted, the main crops were rape and wheat (over 400ha each), swedes and barley (over 300ha each), turnips, kale and peas (over 200ha each) and oats and grass seed (over 100ha each). Most crops covered a total of less than 30ha.

Farm SB6C had by far the greatest area in crops at 936ha, while Farms SB6B, SB4A, SB4B and SB7B each had between 200 and 400ha in crop. Only six farms had, on average, more than 25% of their effective area in crop. Fourteen out of twenty six farms (with cropping data) had, on average, less than 10% of their effective area in crop each year.

4.7 Fertiliser use

Tonnage, type of fertiliser purchased, and the application rate has been broken down to a nutrient per hectare basis for six years from 2003/2004 to 2008/2009. Compost and Biodynamic Teas were not included in the analyses due to lack of information on their nutrient content.

The charts (Figures 10 to 15) show that integrated and conventional farmers use on average higher amounts of, phosphate, sulphur, potassium and nitrogen than organic farmers, whereas organic and integrated farmers applied more amounts of calcium than conventional.

Conventional forms of nitrogen were not applied to Organic farms. The vast majority of nitrogen applications were at rates of less than 50 Kg/ha with less than ten applications of 100 - 250 Kg/ha. The majority of both potassium and phosphorus applications were less than 30 Kg/ha and generally less than 10 Kg/ha. Year-to-year consistency of N application was similar between Conventional and IM farms with applications on 75% and 82% of the farm years recorded for these groups respectively. While there seems to be a trend of lower average application rates on the Conventional farms no significant differences were evident.

A similar trend is evident in the application of phosphorus, where relative to the Conventional group the IM group was slightly higher and the Organic group significantly ($P<0.000$) lower.

For potassium, applications by the Conventional group tended to be slightly higher than the IM group and significantly higher than the Organic group

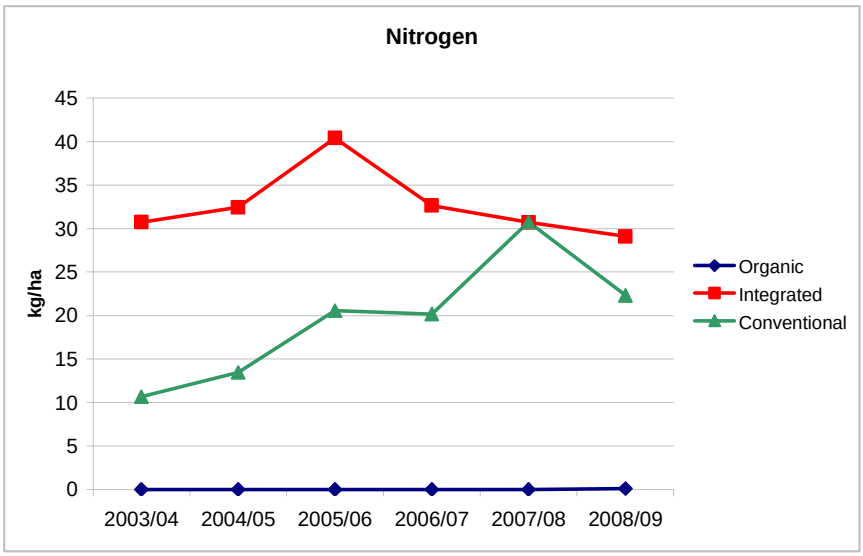


Figure 11 Nitrogen inputs on ARGOS farms over 6 years

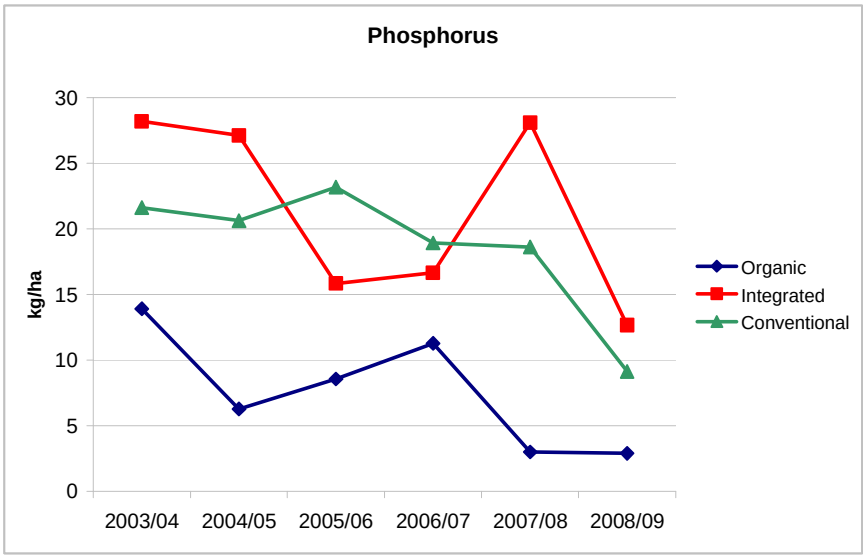


Figure 12 Phosphate inputs on ARGOS farms over 6 years

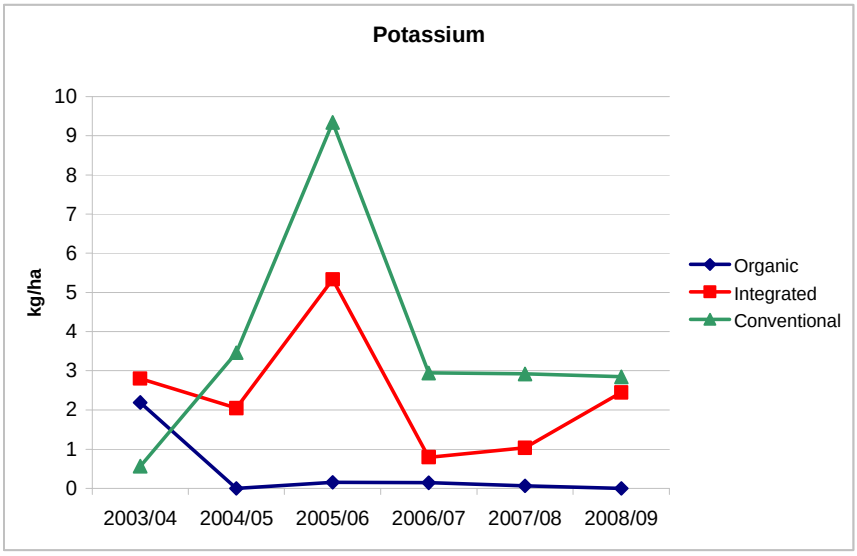


Figure 13 Potassium inputs on ARGOS farms over 6 years

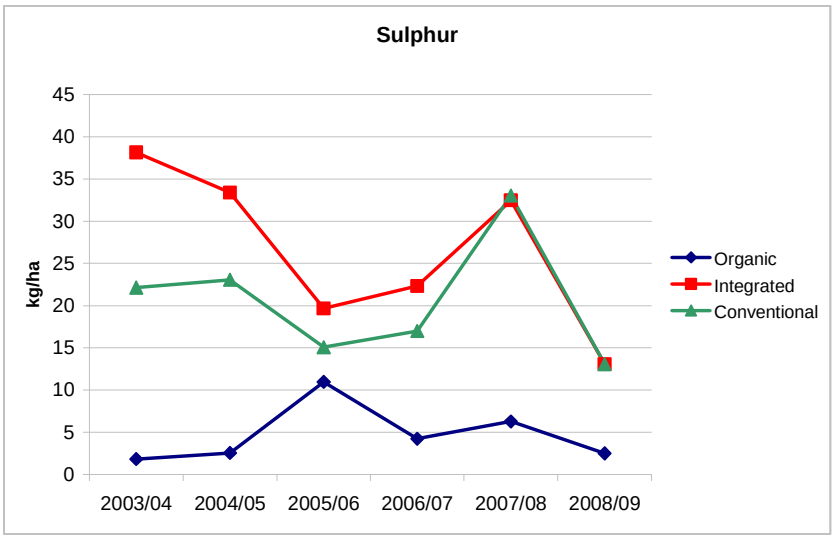


Figure 14 Sulphur inputs on ARGOS farms over 6 years

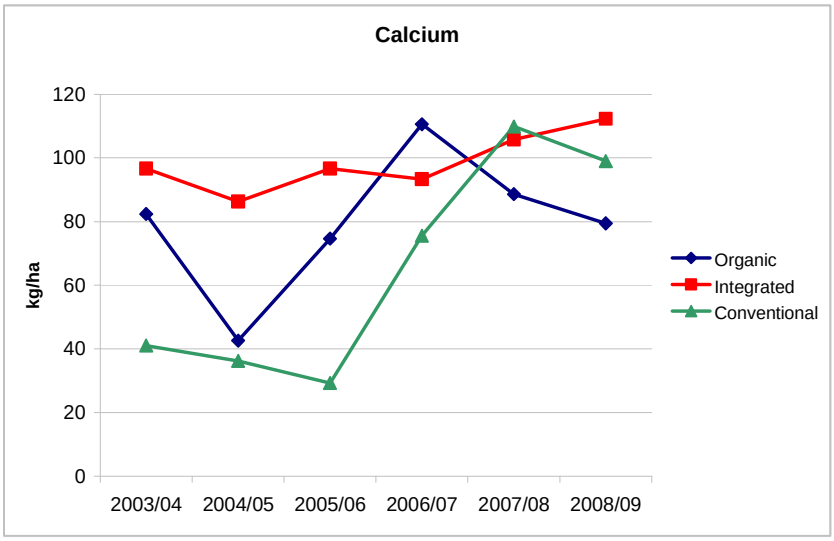


Figure 15 Calcium inputs on ARGOS farms over 6 years

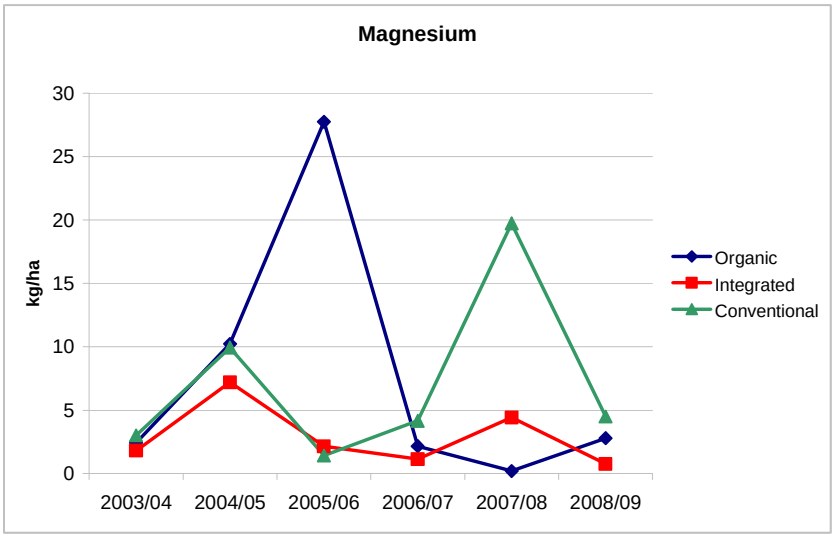


Figure 16 Magnesium inputs on ARGOS farms over 6 years

4.8 Labour

All of the ARGOS properties input labour. This ranges from part time unpaid labour (family members) to fulltime staff. Managing the workload can have a financial impact on the profitability of the business and there is often a balance required between how much time the farm owner can spend working on the farm and social and long term economic consequences if not enough time is spent away from farm work. Therefore, the system that farmers adopt to manage their workload is one that requires careful consideration. Below we quantify the time per stock unit that it takes to run a property and how this varies across properties over 2 years in hours per week per 100 ha and hours per week per 1000 su.

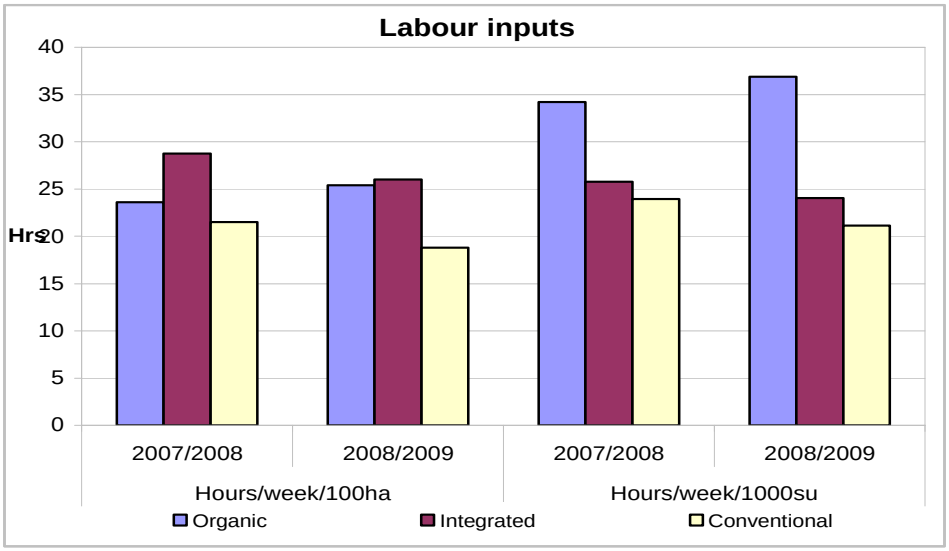


Figure 17 Time quantified to manage ARGOS sheep/beef properties

Hours/week/1000 su only differed at the 10% level and this was because of 3 organic properties. Removing these 3 properties from the analysis would remove all significant differences between management systems. Despite the similarities when the management systems are averaged, the degree of variability within management systems is large as shown in

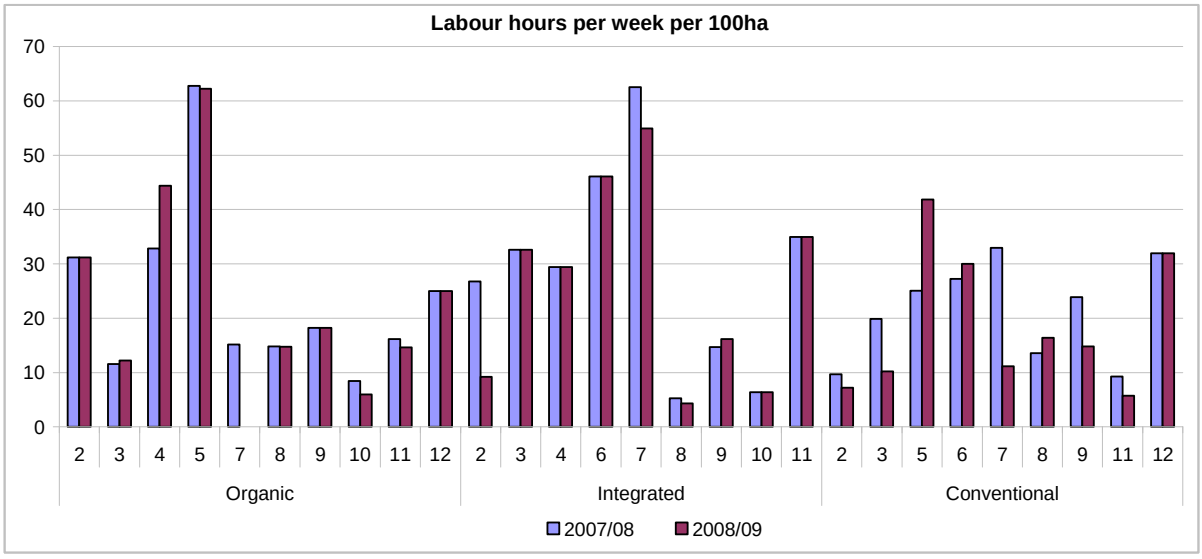


Figure 18 Labour hours per week per 100 hectares

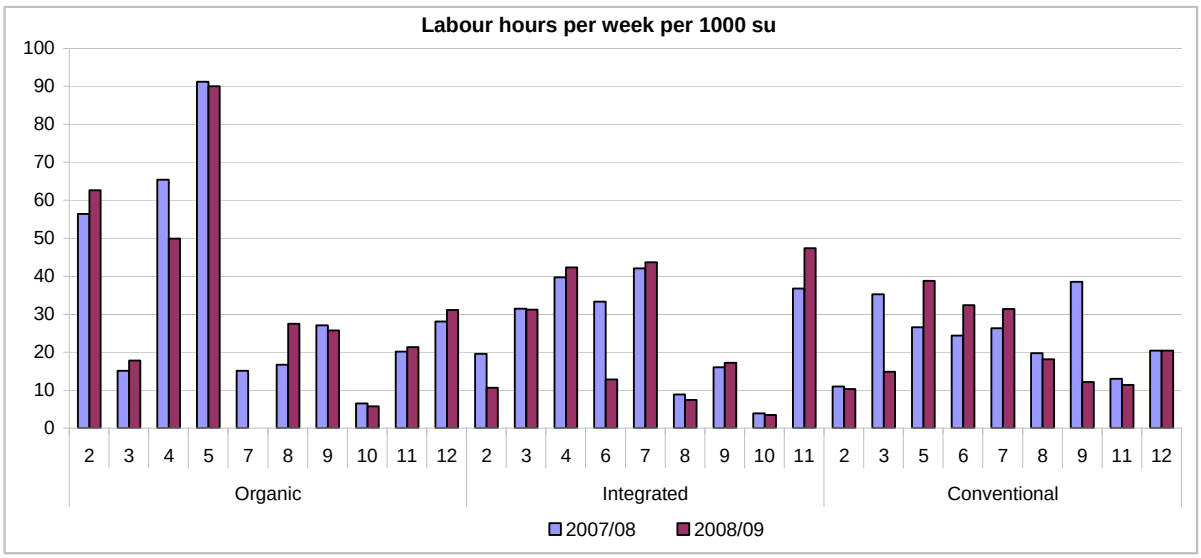


Figure 19 Labour hours per week per 1000 su

Organic properties 2, 3 and 5 have increased labour input due to incorporating further food processing into their businesses**.** Cluster 7, integrated, converted to a dairy farm, which now has an increased labour density and clusters 4, 5 and 6 have a large degree of cropping.

5 Farm Financial Performance

Introduction

Financial data for all six years of the first ARGOS programme are now available on the sheep and beef panel farms analysis. The panels (management systems) are defined as:

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

Additional data have been obtained on some farms during the past year but a number of others have been withdrawn from the programme because of farm sales or changes in land use. Inclusion of another year's data and modification of earlier data has lead to some changes in estimates of the mean financial parameters but few changes in conclusions drawn. In the analysis, data has been converted to 2007/08 (REAL) values to take out the effects of inflation and ensure that the results over time are directly comparable.

5.1 Economic farm surplus

The general trend between groups in the data was for the Organic group to have lower values than the other groups but the difference was not significant. No clear trend over time was evident for any of the groups.

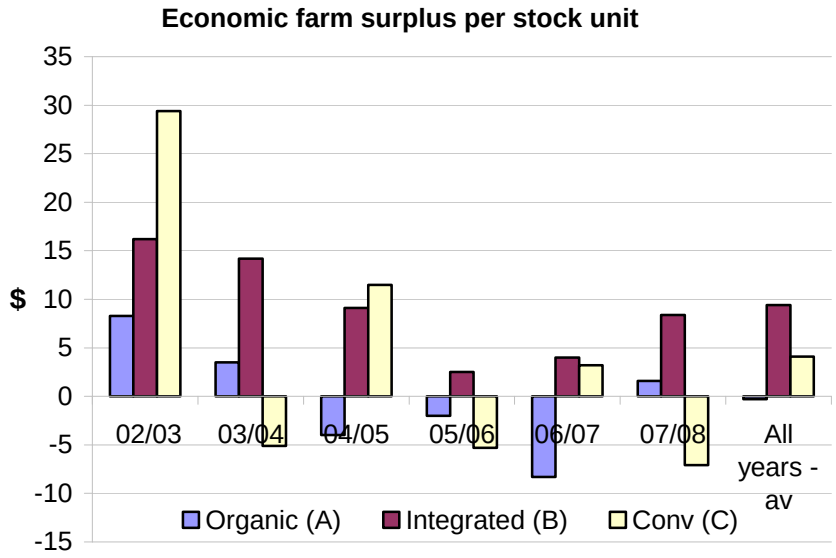


Figure 20 Economic farm surplus/su (efs), on ARGOS sheep and beef farms[2]

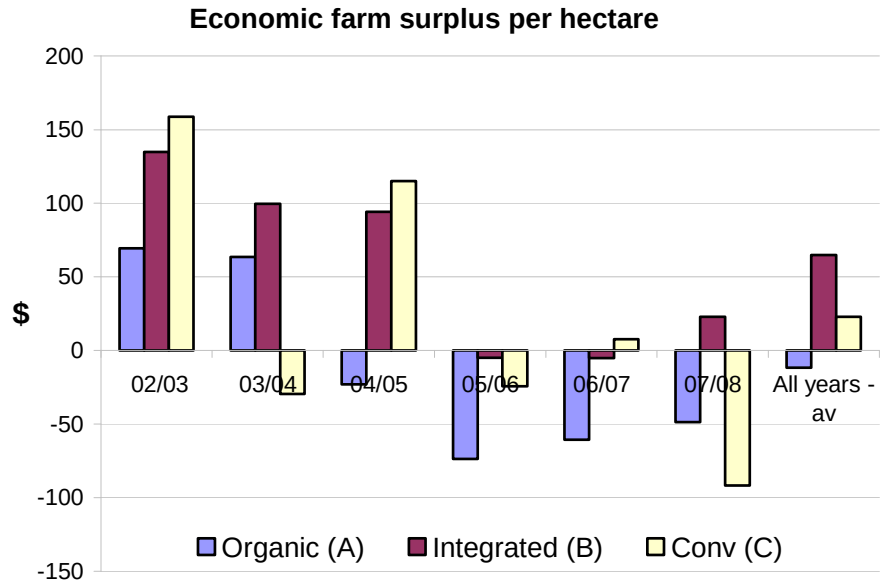


Figure 21 Economic farm surplus/ha (efs), on ARGOS sheep and beef farms

5.2 Animal health expenditure

Breaking the finances down further it was found that the Organic group had significantly lower expenditure on animal health at both the hectare and the SU level. Management type explained a substantial amount of the variation in the animal health expenditure data at both the per hectare level and the per SU level. The higher stocking rate on IM farms may explain why expenditure looks similar to the Conventional group at the per hectare level, but less at the per SU level.

[2] In this analysis Farm SB6A was omitted due to its highly extreme values. The distribution of economic farm surplus values at the stock unit level closely approximated a normal distribution.

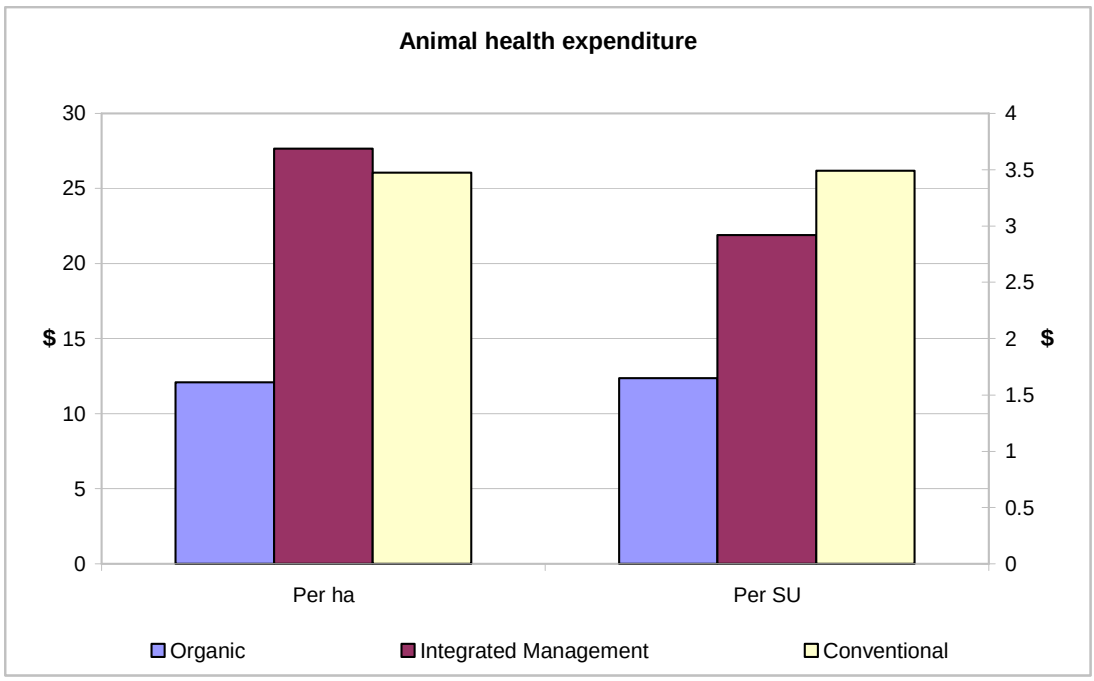


Figure 22 Expenditure ($) on animal health on ARGOS farms

5.3 Stock feed purchases

Expenditure on stock feeds did not differ significantly between management types however the Conventional group was at the high end of the estimates which is consistent with the trend across most of the other variables.

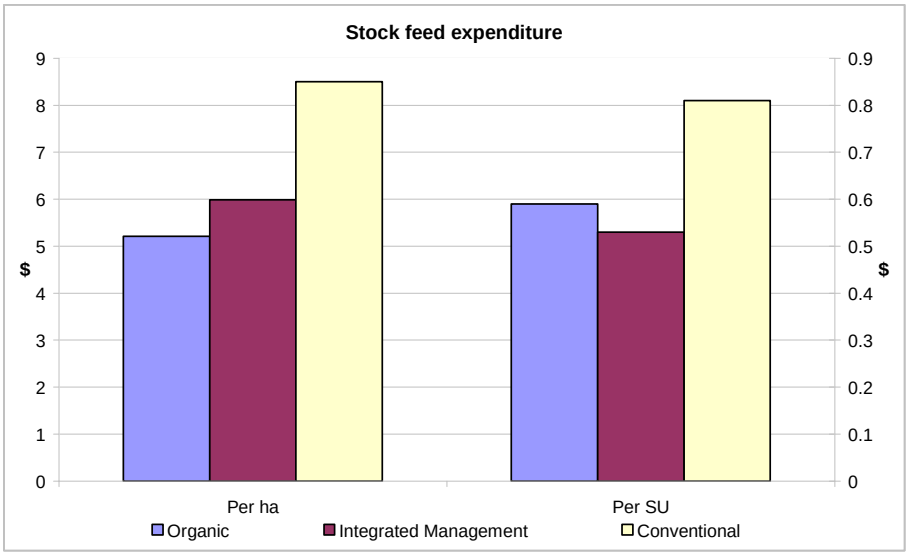


Figure 23 Expenditure ($) on stock feeds on ARGOS farms

5.4 Expenditure on plantings and shelter

Expenditure on plantings and shelter during the study period was higher for the Organic group ($0.25/su or $2.31/ha) than both the other groups ($0.21/su or $2.25/ha for IM and $0.10/su or $0.86/ha for Conventional) but significantly so only relative to the Conventional group (P=0.003 at the per hectare level). While the trend for expenditure to be highest in

Canterbury was consistent across all regions, the significant difference was driven by ARGOS farms in the Marlborough region. It may be that the very low expenditure in this region, which has only conventional ARGOS farms was distorting the estimate for the Conventional group.

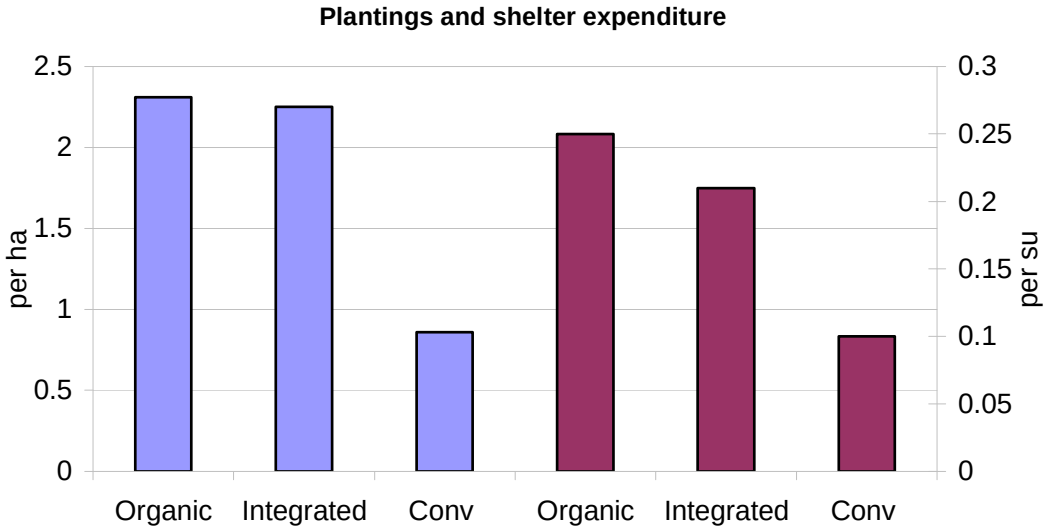


Figure 24 Expenditure ($) on plantings and shelter on ARGOS farms

5.5 Financial aggregates

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 carried out and on the levels of costs and returns. If farmers compare the values presented in this report with those in individual farm reports they will notice some differences as the individual farm reports present simple averages of all the farms in the ARGOS programme, not the estimated values from the statistical analysis. Figure 25 shows the estimated mean values of several of the major financial variables over the six year period.

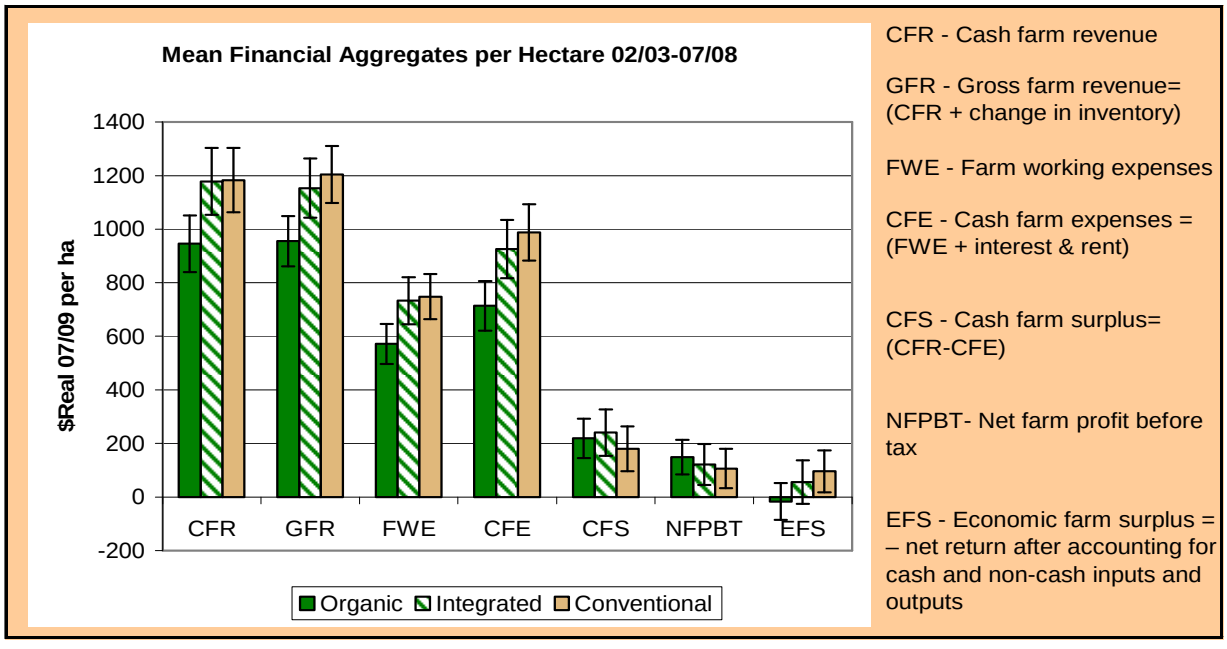


Figure 25 Sheep/Beef panels financial aggregate measures over six years

The Organic sheep and beef farms in the programme had lower total costs and revenues over the period as a whole than Conventional and Integrated farms, but were not shown to have significantly different financial "bottom-lines". Stocking rates over the period were also significantly lower on Organic farms. The mean stocking rate on Organic farms has been 8.3 stock units per hectare, whilst both Conventional and Integrated farms have been stocked at over ten stock units per hectare. The small differences observed between Conventional and Integrated farms were not significant. Statistically significant differences between Organic and other farms were found in:

- Cash Farm Revenue (CFR),
- Gross Farm Revenue (GFR),
- Farm Working Expenses (FWE) and
- Cash Farm Expenditure (CFE).

None of the "bottom-line" estimates of farm profitability - Cash Farm Surplus (CFS); Net Farm Profitability before Tax (NFPBT) and Economic Farm Surplus (EFS) - differed significantly (although differences in EFS approached significance (F=0.101)). However, there are doubts over the validity of some EFS data where farmer estimates of unpaid labour appear high for the size and nature of their properties.

The absence of between-panel differences in profitability reflects the high level of variability amongst farms within panels and is consistent with both the international literature and with New Zealand farm management understanding. The extent of the within-panel variation on ARGOS farms in 2007/08 is shown in Figure 26 which shows the CFS of the farms remaining in the programme during the last season. There is less variability within the Organic panel, but the CFS range is encompassed by the ranges of the other two farming systems. This is true also for the other "bottom-line" variables, EFS and NFPBT and for the total cost and revenue variables CFR, GFR, FWE and CFE.

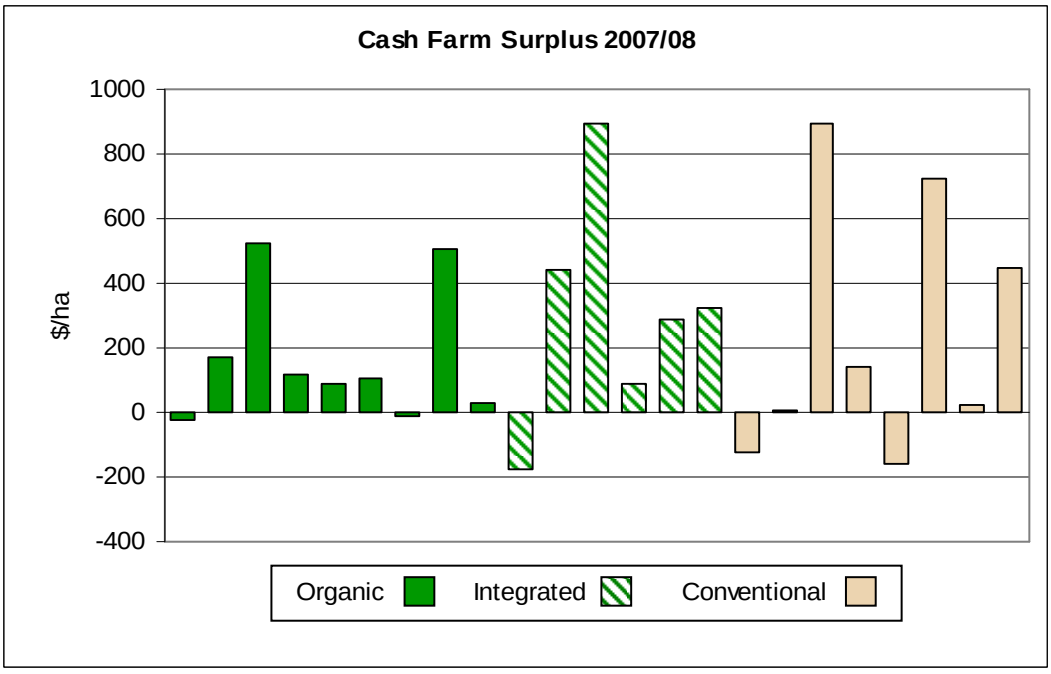


Figure 26 Sheep/Beef farms cash farm surplus 2007/08

There are several factors which may contribute to the lack of between-panel differences.

- 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 may be adapted for inclusion into conventional systems by others.
- Six 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.

As the Ministry of Agriculture and Forestry Farm Monitoring reports, the financial position of the average New Zealand sheep and beef farm has deteriorated during the six years of the ARGOS programme. Figure 27 shows a similar trend in all of the ARGOS Panels.

For each panel the difference between the real ($2007/08) mean values of GFR and CFE has declined over the period, although the dramatic decrease in estimates for the Integrated panel largely reflects a change in panel composition from 2005-06 when two farms were sold and there was major structural change on two more.

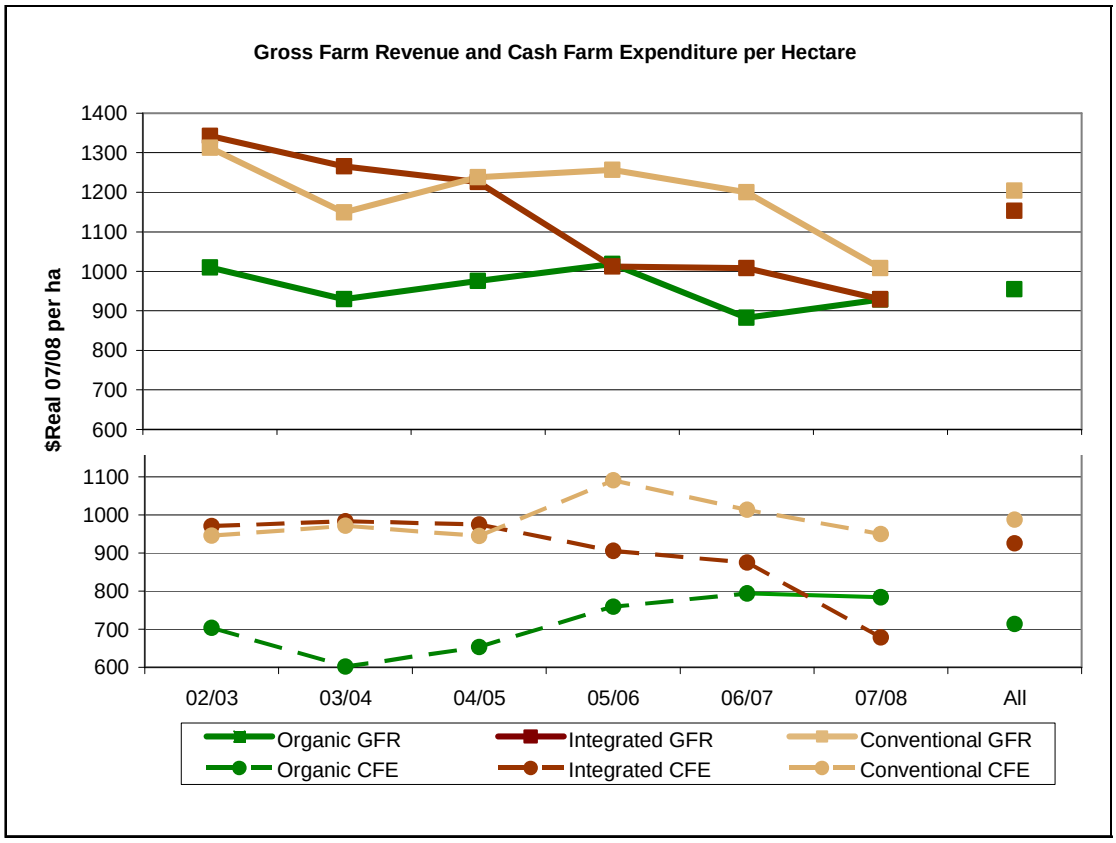


Figure 27 Sheep/Beef panels mean GFE and CFE 2002/03 to 2007/08

5.6 Individual cost elements

Most of individual cost elements analysed differed significantly between the panels, or the differences approached significance. In particular, animal health, cash feed costs (which includes not only purchased feed but also the costs of hay and silage making and fodder crop production), pasture maintenance and fertiliser costs have been very much lower on Organic farms than on Conventional and Integrated farms. The lower animal health and fertiliser costs reflect the restrictions on the use of these products under organic certification schemes. The lower costs of pasture maintenance and cash feed may reflect the significantly lower stocking rates on organic farms (8.3 stock units per hectare on average over the period compared with over ten on other farm types). The fact that Organic farms incur the costs of maintaining organic certification has not resulted in total overhead costs that are significantly higher. No explanation has been found for the lower repairs and maintenance costs on Integrated farms. 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, with "Other Working Costs" close behind. Figure 28 shows the mean real values of individual cost elements for each of the panels.

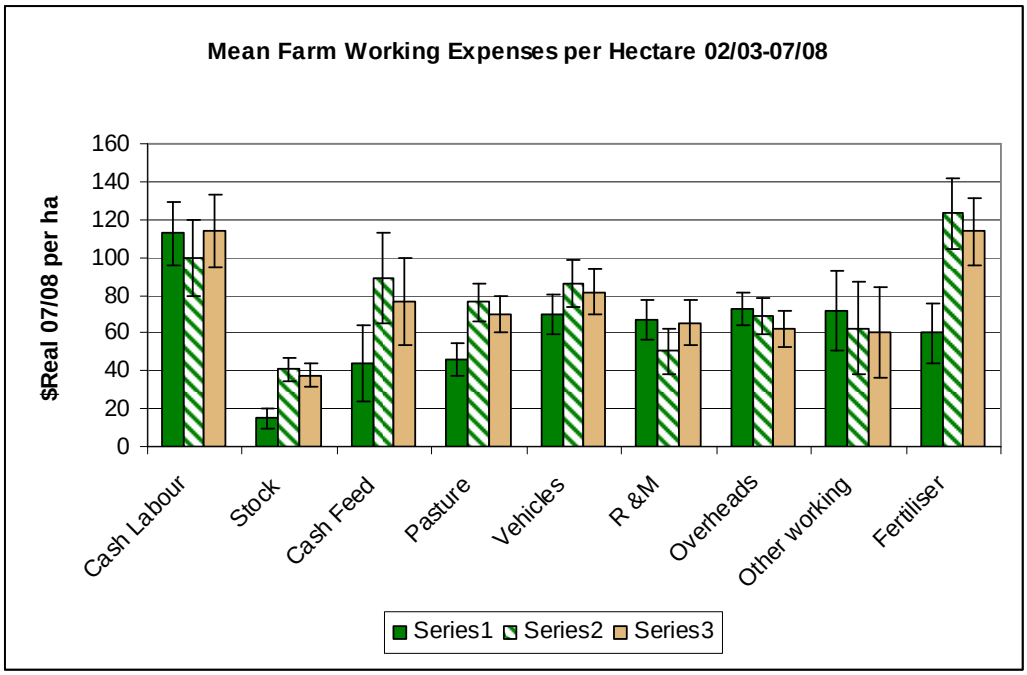


Figure 28 Sheep/Beef panels mean farm working expenses over five years

5.7 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 have, in the more recent years, been well above the farm management guidelines for financial sustainability as Figure 29 shows. This is consistent with the position of the average sheep and beef farm according to MAF and MWNZ data.

The only significant difference among the panels is that on average, the debt servicing ratio (interest and rent as a proportion of GFR) is significantly higher on Conventional farms than others and has deteriorated throughout the period for all panels.

FWE = Farm working expenses GFR = Gross farm revenue CFE = Cash farm expenses

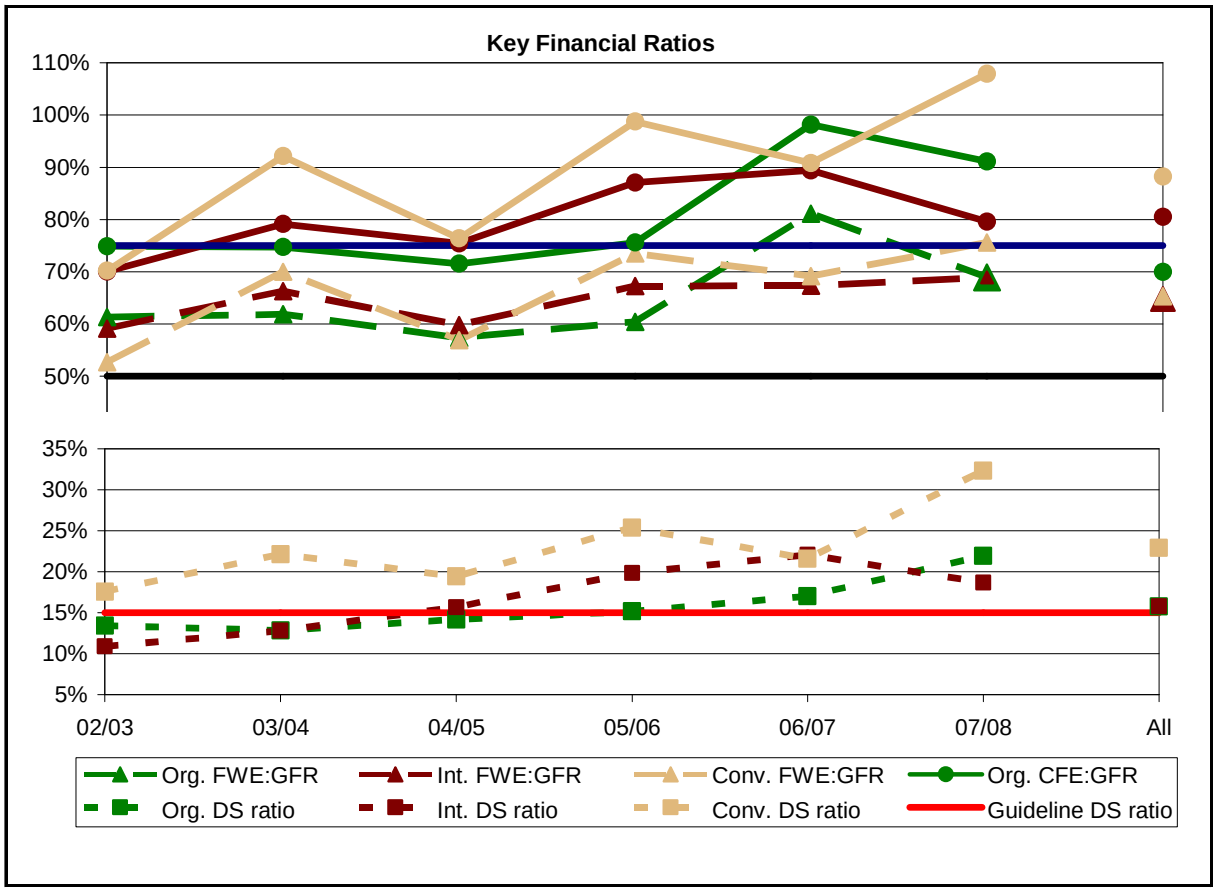


Figure 29 Key financial ratios over six years

5.8 Farmer Type Differences

The absence of statistically significant differences between management systems panels has prompted ARGOS researchers to consider other groupings of farmers that may better capture or explain differences in farm performance. Under the social objective of the ARGOS project a type of cognitive mapping was used to show how sheep/beef farmers integrated the economic, social and environmental factors important to their farming systems in the form of a map.

From these maps we were able to classify farmers into two types, type A and type B. Type B farmers placed more emphasis:

- in their decision-making processes on off-farm themes such as customer requirements,
- on social factors such as family needs, succession and satisfaction and
- on environmental factors

than Type A farmers. Type A causal maps emphasised on-farm factors. Three of the farmers for whom financial data are available were unable to be classified into farmer types.

The properties farmed by these two groups do not differ in average size, although the difference in stocking rate is approaching statistical significance. Separation of farms by analysis derived from the causal maps drawn by farmers, (rather than by management systems) created groups that differ significantly with respect to farm profitability and costs,

although no significant differences were found in total revenues. Farmers who have a narrower, more farm/business-oriented focus (Type A) have achieved greater profitability

than those who base their decisions on a wider range of factors. They do so through tighter cost control rather than by generating significantly higher revenues as Figure 30 shows.

Farmers who have a narrower, more farm/business-oriented focus (Type A) have achieved greater profitability than those who base their decisions on a wider range of factors.

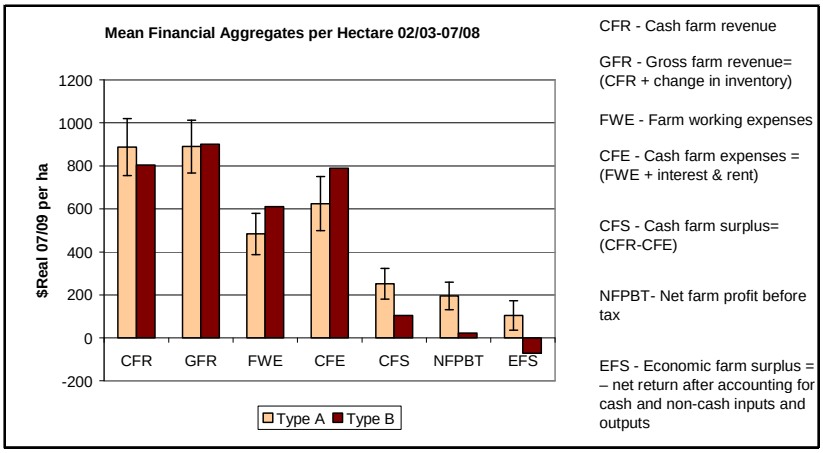


Figure 30 Sheep/Beef farmer types financial aggregate measures over six years

Regarding expenses

- Cash and total labour costs do not differ by farmer type
- Pasture and fertiliser costs are lower for Type B farmers
- All other working expenses are significantly lower (or the difference is approaching significance) for Type A farmers

It is surprising that, despite the fact that the Type B group includes almost all of the Organic farms, whose operators comprise 53 percent of all Type B farmers, on average, Type A farmers incur lower stock and feed costs as shown in Figure 31

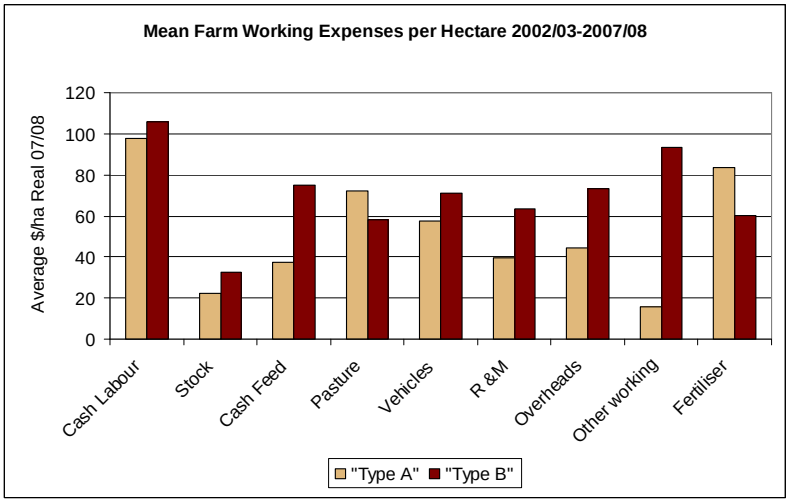


Figure 31 Sheep/Beef panels mean farm working expenses over five years

5.9 Agricultural Environmental Indicators

Why have them?

The state of the natural environment is important for producers and consumers. For agricultural producers, degraded environments are by definition less able to produce output and are less resilient to negative shocks. Consumers demonstrate concern for the environment, for example, by buying organically grown food that they believe has been produced with less environmental harm. Furthermore, New Zealand depends on its natural environment for agriculture and tourism, which are key economic sectors.

It is possible to measure the state of the environment, and changes to its state, using environmental indicators that describe the health of the natural environment and the impacts on it of economic activities such as agriculture and tourism. Recent emphasis on the need for a more sustainable agriculture has required that agricultural practices minimise negative effects while maintaining positive contributions. Consequently, Agri-Environmental Indicators (AEIs) have been developed to detect the risks and benefits resulting from agriculture and to improve the monitoring, evaluation and directing of agricultural programmes (Parris, 1999).

Two issues arise from this development. The first concerns the accuracy of the perceptions of producers and consumers that they are helping the environment. For example, one cornerstone of the organic foods industry is its perceived lower environmental impact than the conventional food system. By using a standard set of indicators, it may be possible to determine whether there is empirical evidence to support this perception. The second issue concerns the set of indicators to be used. Several sets have been developed, but their usefulness for describing on-farming environmental impacts is uncertain.

Who developed them?

Indicators of the health of agri-environments have been developed in specific countries and internationally that are in various stages of completion. In New Zealand, environmental indicators have been developed by a number of agencies. The Ministry for the Environment, for example, has developed an Environmental Performance Indicators programme that includes national environmental indicators which are broader than AEIs, but relevant to agriculture. Aspects of the environment measured include water quality, biodiversity, greenhouse gas emissions, and soil health, among others. The Growing for Good report (PCE, 2004) proposed a list of indicators that could be used to assess the state of New Zealand's natural environment and thus to evaluate the sustainability of the country's agriculture. Finally, New Zealand also reports on environmental farm plans (Manderson et al. 2007).

Internationally, one important set of AEIs has been developed by the OECD (2008), the basis of which is the OECD Driving Force-State-Response (DSR) Model (Parris, 1999) (OECD, 2008). These have then been used to assess countries' agri-environmental performances on a consistent set of criteria, which allows for international comparisons. Therefore ARGOS looked at applying these criteria to the ARGOS kiwifruit orchards.

ARGOS Findings from Applying AEIs to the ARGOS kiwifruit orchards

The results do provide some indication of the sustainability of New Zealand orchards. For two-thirds of the indicators, sustainability appears to relate to the performance of the kiwifruit industry as a whole or to the agricultural sector, not to practices that vary from farm to farm. Thus, sustainability in a general sense as measured by the OECD AEIs may not be a farm-level issue in New Zealand. Sustainability, as measured by these indicators, may have little to do with whether a farm is conventional or organic. This division is based on adherence to

a market audit scheme that prescribes and proscribes specific inputs and practices. Adherence to the scheme allows an orchardist to claim organic status and receive a price premium through ZESPRI. For the 11 of the 36 indicators for which practices or values did vary by farm, only one showed a significant relationship to whether an orchard was organic.

For the other indicators, whether farms scored better or worse was not related to organic status. This result suggests that the “organic” label does not provide an indication of sustainability that is related to the OECD AEIs.

The OECD indicators were designed to compare sustainability internationally. It may therefore be unfair to attempt to compare individual farms using them. However, the attempt to use these AEIs in the ARGOS programme has led to the conclusions that firstly, sustainability may not be a function of farm level practices, but rather may be a function of the industry or national initiatives and secondly, that a different set of AEIs may be necessary to capture farm-level variation in sustainability.

6 Environment

Introduction

The Environment Objective of the ARGOS research programme has been determining the impacts of different production systems on biodiversity and ecological processes on farms which until now have received little research attention. Environmental monitoring of the ARGOS farms began with baseline ecological surveys to understand what was present on each farm and how land-use varied.

Following the completion of the baseline surveys of landforms and habitats, the environment team focused on supplementing this information with surveys of soil ecosystems, birds, bats, lizards, frogs, fish, insects, and plants across the different farming sectors. These surveys have been used to test monitoring methods to allow appropriate selection of a small group of 'focal species' to be used as indicators in repeated surveys for efficient long-term monitoring. Because the ARGOS project researches a wide diversity of habitats, landscapes and ecological processes operating on a wide range of spatial and temporal scales, the appropriate selection of the focal species was crucial.

Subsequently, the main investment by the environment team has been in the areas of terrestrial biodiversity (birds and invertebrates), stream health, landcover (especially weeds) and soil quality (nutrient and soil biota). The main findings of ARGOS' environmental monitoring for sheep/beef are given below.

6.1 Main findings

- Soil quality differences were few with Organic being the most different in terms of soil chemistry and microbial populations.
- Stream health, measured once in 2005/06, was highly variable between farms, clusters (location) and systems. Consequently, very few significant differences were detected in measured parameters between systems.
- No bats or lizards were found on farms.
- Bird communities did not differ between systems.
- No significant difference was detected in the abundance of weeds between systems. This is contrary to anecdotal evidence of a higher level of weed infestation on organic farms. Evidence collected in this study suggests that difference in weed abundance is impacted more by geographical location, as opposed to management style.

6.2 Between farming systems

As summarised above, some significant differences have been identified between farming systems, especially in soil indicators where most of the research investment has been focused. Other differences may exist but the sample sizes may not have been large enough to detect them and we are currently running analyses to find out if this is the case. Nevertheless, the design of the ARGOS study has successfully provided enough power to detect average differences between farming systems for some important indicators.

6.3 Future priorities

Now that differences have been observed between farming systems, the ARGOS environmental team must adjust its focus to dig deeper and to investigate the cause of these differences. This is necessary to disentangle cause from simple correlation of indicators resulting from prior inherent qualities of the farmers or their land. In other words, are the

observed differences due to management practices or the farms being inherently different to start with? Enlisting the help of the social and economic objective teams in ARGOS will be crucial in this quest, because they can help test causation by examining why farmers have chosen to manage their farms the way that they do, and how farmers' views about their farm environment have changed through being associated with particular management systems and practices.

The ARGOS environment team has identified the following priorities as being important for enhancing the sustainability of agriculture in NZ:

- Habitats on farms. Our broad recommendation is to increase the amount and connectivity of woody vegetation on New Zealand's pastoral landscape, and to do this in ways that capture multiple benefits for biodiversity, soil and water retention, maximising profit, securing animal welfare and easing the day to day burdens of farmers.
- Focal species to brand eco-verification and incentivise sustainability. While this would have potentially valuable marketing and on-farm benefits, we do not wish to recommend a key focal species until (i) we can bring a more transdisciplinary lens to our choice, (ii) we are sure that it is a reliable indicator of ecological wellbeing, and (iii) that its numbers can be managed effectively.
- Biological processes in soils. This is ascertained as key to successful primary production especially in the organic and 'biological farming' sectors. Future work will look to concentrate on measuring a wider range of soil biological indices to see what differences exist between management systems for each sector and whether these reflect the intensity of operation and impact on biological activity and diversity.
- Stream care. ARGOS research will aim to help farmers best maximize the health of their waterways and the resilience of their farming operations, particularly sheep/beef farmers where less information is available and the potential impacts of new accreditation schemes may be relatively greater.
- Increased links across sectors. There is an excellent opportunity to cross-reference the environmental monitoring across the difference sectors in the ARGOS project.

In order to address these priorities with the resources available, the ARGOS environment has been working in collaboration with post doc students researching into PHD or Masterate theses. Florian Weller and Sara Meadows are a good example of adjunct research adding richness to the ARGOS project, and their studies are described next:

6.4 Monitoring and modelling bird abundance on ARGOS farms

This project revolved around a two-year case study monitoring the densities of four species of common farmland birds on ARGOS sheep/beef farms. The main objectives of the study were

- to establish baseline population abundance estimates, and investigate the seasonal dynamics and habitat associations of the birds in order to add to the understanding of their ecology and ecosystem roles
- to test the performance of a particular bird monitoring method (line transect distance sampling) for bird monitoring on farmlands, and evaluate its suitability in a potential national New Zealand bird monitoring programme.

Population densities of Skylark (*Alauda arvensis)*, Common Blackbird (*Turdus merula)*, Song Thrush (*Turdus philomelos)*, and Australian Magpie (*Gymnorhina tibicen)* were monitored on twelve farms located between the Banks Peninsula and Owaka (Catlins) - these bird species were chosen because they are common on almost every sheep/beef farm, so we could be sure that there would be data to compare between properties. Each farm was visited nine to ten times between November 2005 and August 2007. Birds were counted on ten randomly placed 500m line transects per visit, and these counts were used to arrive at reliable estimates of bird numbers per farm.

The average densities for skylarks, blackbirds, thrushes and magpies were 0.53, 0.41, 0.23 and 0.18 birds per hectare respectively. There was particular interest in finding out if the monitoring method used was equally well suited to finding differences between the different management systems in ARGOS. It turned out that there were several factors that influenced the accuracy of estimating population sizes:

- the amount of woody vegetation on a farm (had the greatest influence)
- the time of day and wind speed
- management sytem type was not one of them.

It made no detectable difference whether a farm was Organic, IM, or Conventional, and the most important factor lay in the amount of available nesting and feeding spaces provided by woody vegetation. This is in strong contrast to recent results from the United Kingdom, where organic farms were shown to generally support notably larger numbers of these birds (although absolute population sizes on ARGOS farms, regardless of panel, were generally much larger than in the UK).

The results of this case study were combined with the findings of two earlier workshops to make recommendations for the setup of a national bird monitoring programme. Comprehensive nationwide monitoring schemes are in place in several countries, but none yet exist in New Zealand. Longitudinal monitoring of farmland bird abundance would be a valuable component of a national scheme. It could provide effective long-term population trends, early warning of species declines or pest eruptions, insights into ecosystem health, and would benefit conservation interests. Judging from the results of this case study, distance sampling would be the recommended and reliable method to use in this context.

7 Social

7.1 Climate Change Survey:

In March, members of the ARGOS research team received funding to conduct a survey of 4000 New Zealand pastoral farmers and their understanding of and response to climate change. This survey was designed in response to interviews conducted with ARGOS sheep/beef and dairy farmers during the previous year. In doing the interviews we were surprised by the extent to which understandings of climate change had become overly politicized. On the other hand, there remained a diversity of response from farmers. Some strongly expressed their doubt regarding the reality of climate change – particularly the claims that global warming trends were the result of human action. Others showed some level of concern about the potential implications of climate change for their farming practice. The most consistent finding, however, was the relatively low level of knowledge about the processes underlying arguments about the potential contribution of agriculture to the changing climate.

In order to provide us with a broader sense of the extent to which our interviews indicated the perspectives of the broader pastoral farming population, the survey included sets of questions to gauge:

- belief in climate change and its causes;
- the level of responsibility farmers held for mitigation of greenhouse gas emissions;
- level of knowledge about climate change process; and
- desirability of potential mitigation practices.

We are currently in the process of recording and analysing the more than 1000 responses that were returned. Initial findings suggest that, while there is a moderate level of responsibility for and concern about climate change, the great majority of pastoral farmers perceives the current attempts at regulation (including the Kyoto Protocol and the emissions trading scheme) as patently unfair to the agriculture sector. The findings from the survey will allow ARGOS to make stronger statements about the current attitudes toward climate change in the pastoral sector, especially in regard to the need for policy makers to pursue greater engagement with farmers in the development of New Zealand's position climate change negotiations. We expect to have a more comprehensive report on the survey by March 2010. (Please note that not all of the ARGOS farmers returned their surveys. We hope to get a response from each participant so that we can incorporate this data in the larger ARGOS project and will provide a further copy of the survey for those who have yet to respond.)

The findings from the survey will allow ARGOS to make stronger statements about the current attitudes toward climate change in the pastoral sector, especially in regard to the need for policy makers to pursue greater engagement with farmers in the development of New Zealand's position climate change negotiations.

7.1.1 Examining historical management changes – retrospective survey

During the coming year, members of the ARGOS social research team are planning to interview each of the participant farmers. The interview will consist of a discussion of changes in management that have occurred since the farms were first managed by the current farmer. Essentially, we will be asking farmers to tell us the story of how they have developed their farm. Through the interviews, we hope to gain a better understanding of both the factors that initiate or cause change as well as the pathways that lead to viable management responses. We believe that the historical aspects of changes can provide insight to the future adaptation and resilience of farms in the face of shocks. Our existing interview data has, however, focused almost exclusively on current conditions of management. The additional information is also expected to inform policy recommendations for promoting more sustainable agriculture into the future.

We intend to conduct these interviews from late February into March on the kiwifruit orchards, with interviews in the sheep/beef and dairy sectors in early winter. The interviews are expected to take 60-90 minutes and will be recorded as in the past. We will contact individuals 10-15 days prior to interviews in order to set times that are convenient.

7.2 Farmers and their farming systems - cutting the pie various ways

Introduction

ARGOS commenced in October 2003 with the task to model the economic, environmental, and social differences between organic, environmentally friendly and conventional systems of production. There are commonly hypotheses in this type of project and in this case the hypothesis was flipped around to become a null hypothesis stating:

> *"That environmental, economic and social characteristics do not differ significantly between different management systems on the participating farms and orchards*."

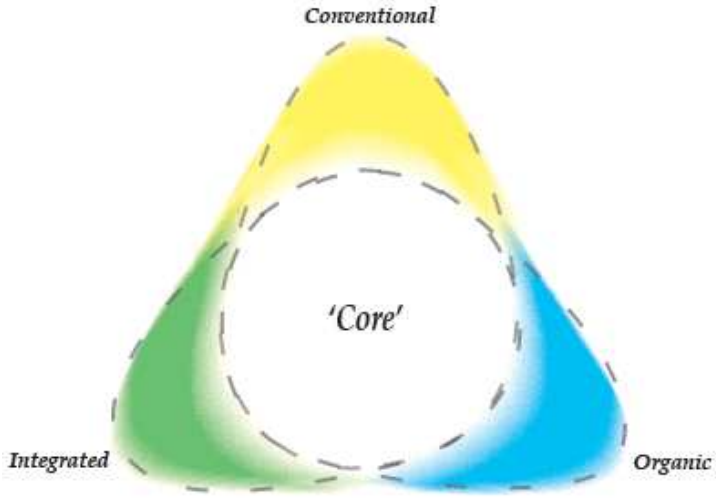
The aim of this hypothesis was to detail the impact of these systems and develop indicators which reflected the interactions across these social, economic and environmental factors Differences observed amongst farmers can be also described as groupings or orientations. Do certain groups have orientations towards productivity, farm tidiness and does 'stage of life' influence what happens on a farm? At this stage of the study the social team are beginning to understand how the various farmer groups are different but not the why. This section gives an overview of findings from the first 6 years of data collection and is divided to 4 parts. Part 1 illustrates the relative positioning of the 3 management types in ARGOS sheep/beef. Part 2 gives an introduction to farmer orientation, whilst part 3 discusses the various types of orientation analysed so far. Hence part 3 is divided into 'sub' orientation parts titled:

1. Life cycle stages
2. Association between breadth of view, economic focus and innovation
3. Orientations to tidiness and productivity

7.3 Social differences between farmers in the three management systems

7.3.1 The ovoid diagram

The social team developed the idea of the 'ovoid' types of ARGOS farmers in which they all share a common 'core' (see figure below) but are dragged/stretched in different ways according to their different management systems hence producing the 'bumps'. The common core could be regarded as the elements of shared practices relevant to farmers' agricultural sector. The bumps could relate to the elements of their practice and the rewards of that practice that relate to their particular management system types that are different to the core (for example, conventional, integrated or organic farming). What has reinforced something that has enabled/encouraged them to be different or to change their practices? What constrains the possibility of change?



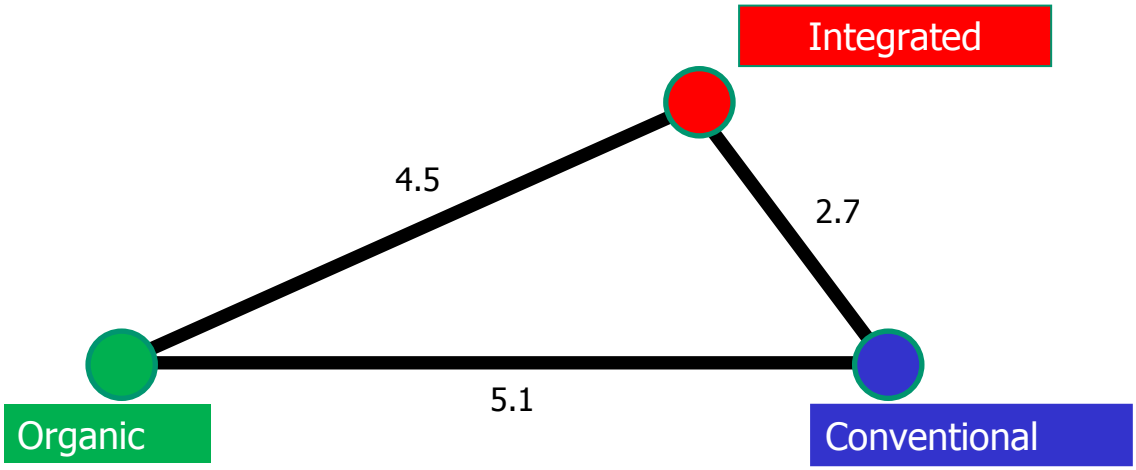
7.3.2 Using triangles to show relative positioning by management system

Another method shows the relative positioning of organic, integrated and conventional farmers by using a statistical model to quantify similarities depicted as a triangle. These triangles show the farming groups' attitudinal differences/similarities in the importance they place on indicators of:

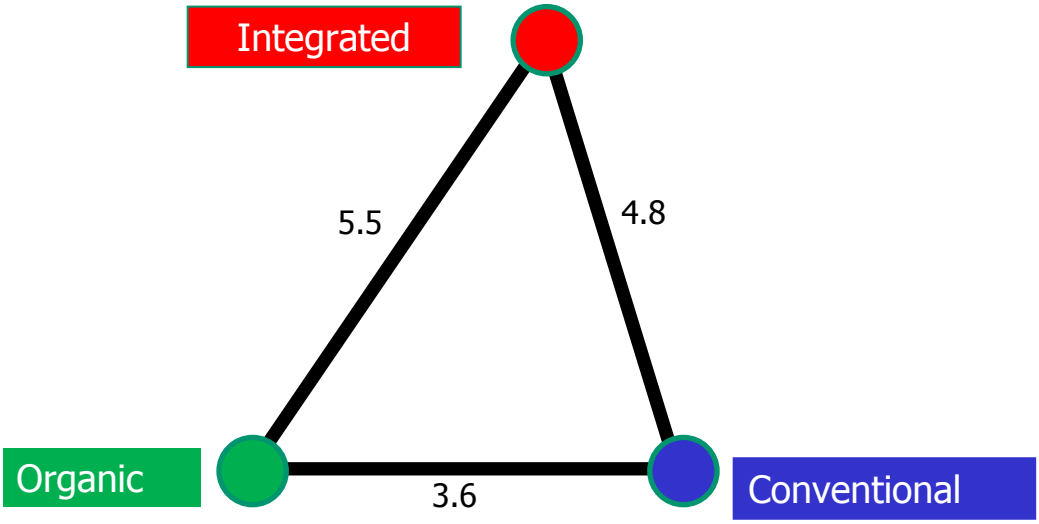
1. Production performance
2. Financial performance
3. Environmental performance and
4. Social performance

The triangles show that the three systems are not on a straight line with conventional at one end, integrated in the middle and organics at the other end but are 3 unique systems that share degrees of similarity with the other 2. Our assumption was that integrated was somewhere between organic and conventional, but closer to conventional.

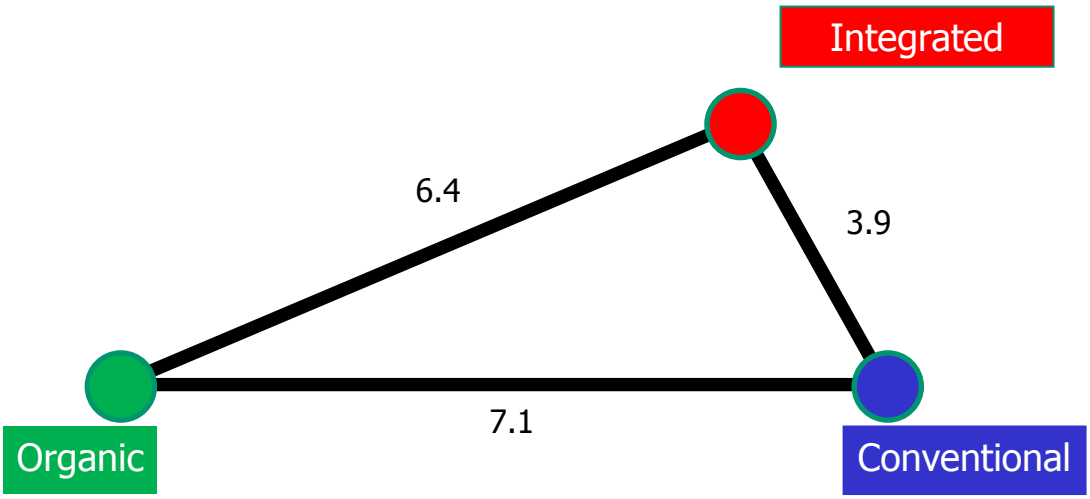
Production performance



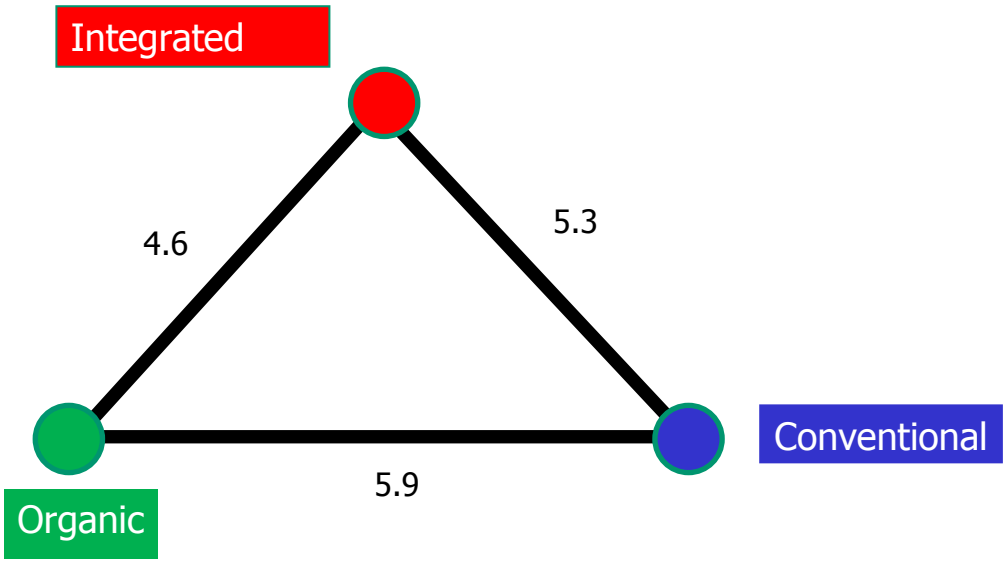
Economics - Financial indicators



Environmental performance



Social indicators



7.3.3 Some thoughts around farmer orientations

A problem with hypotheses is that they invite yes/no answers rather than more interesting questions like how much do they differ by and why? The social team have started looking into the how and why and this involves the study of farmer orientations.

Through revealing the ways in which “nature and social practices and values are inextricably interlinked, ARGOS hopes to contribute to the growing body of knowledge that aims to find

ways of supporting and enhancing environmentally friendly practices and attitudes. Buell (2001: 1) has stated,

"……The success of all environmentalist efforts finally hinges not on 'some highly developed technology or some arcane new science' but on 'a state of mind': on attitudes, feelings, images, narratives".

If farmers' practices are not solely in order to gain materially, incentives for good environmental management need to be based on more than financial rewards.

There is much discussion about whether changed attitudes to environmental care result in changed practices, or whether it matters if attitudes change as long as practices do. Our transdisciplinary approach in ARGOS provides a way of measuring both that has not been available to other researchers.

At the same time the social team in ARGOS wishes to focus on what farmers and their farms are like, rather than what they *should* be like! For us there is no one right way to farm, or one right way of 'being' a farmer. If there was only one 'correct', thinkable way of shaping a farm then there would be no choices for taking up other options which may be more environmentally sustainable. This also presents us with the question, are we looking for resilient farms, resilient farmers or a resilient farming industry? Choice builds resilience into an industry. If there are different ways of doing things when one practice is not successful another is able to continue.

The concept of the 'good' farmer has arisen as production-oriented roles came to symbolise, (both to farmers and the country), the idea that good farming practice enabled farmers to claim a high social position as caretakers of the nation's food supply. This status is now being contested by concerns about the environmental impact of intensive, production-oriented farming. While this is true as well in New Zealand, farmers here are also facing the challenge to their identities in a society placing an increasing emphasis on a knowledge economy not on an economy based on production of agricultural commodities.

The notion of the good farmer is well explained in the following quote:

"… for many farmers it [the landscape] represents a picture of good farming practice, displayed in a manner that enables the farmer to obtain social status and recognition within the community as a 'good farmer' and to judge the credentials of others. The farm is not simply an object, it is consubstantial (at one) with the farmer and, importantly, it is the very part of the farmer that is used to express his/her and his/her family's identities, both to other members of the farming community and to the world in general" (Burton, 2004b: 207).

For example, if we take 'hard work', something mentioned frequently in our farmer interviews. A tidy farm can be a symbol of the hard work required to tame a wild landscape. To a farmer this may be a symbol of their care for the environment. Whereas, for some other farmers, a tidy farm is a not a symbol of care or hard work at all.

Some current literature employing the concepts of the 'good farmer' as a way to explain why farmers do not change, suggests that the social context of farming is important. Good farming cannot be practiced in isolation. Farmers strive to be seen as 'good' farmers and practice in ways that reinforce and maintain their identities in particular ways. As behavioural and attitudinal assessments have failed to provide successful methods for influencing change this research will use alternative theories understand how farming practices change and how to support and encourage future change.

7.4 Different farmer orientations

Introduction

Farmers in the pastoral sector have had a history as representatives of NZ identity. Are they experiencing a loss as this is no longer so? Are they seeking new identities? Autonomy is of over-riding importance to those in this sector (e.g., Federated Farmers responses to issues). How does this work in with a resilient industry?

Types of farmers we have found:

- Those who are retaining these 'older' values – importance of community, succession etc.;
- Those who are prepared to be part of audit scheme and therefore willing to subject themselves to greater oversight as they become associated with a particular company, have time constraints on production; and
- Those who accept and gain enjoyment from being 'different', have a different 'tradition', belong to a 'wider community', have a closer association with 'customers'/meat company, but who are often resistant to having a 'greenie' image.

7.4.1 Life cycle stages

To attempt to gain a better understanding of farmer differences, we grouped farmers into 'life cycle stages' with the expectation that we would find the following:

- A farmer with teenagers would be expected to push their farm harder because they face greater financial demands. Hence, we would expect them to have higher stocking rates, put on more of certain fertilisers (which ones?) thus also having an impact on soil measurements, make more financially etc.
- Younger farmers are likely to have a higher number of motor bikes, quad bikes etc.
- Older farmers are likely to carry less debt and so are able to sustain a loss in hard times.
- Older farmers are likely to preparing for succession by: buying up more land to make viable units for more than one member of the family who may wish to continue farming, arranging means to cater for all members of the family whether the farm itself continues in the family or not.

7.4.2 Definition of life cycle stage

We assigned the farmers to different life cycle stages dependent on the stage of their family and, after much discussion, the following stages were chosen

1. Single (as in young?)
2. In a relationship (no children).
3. In a relationship with young children.
4. In a relationship with teenagers still at home.
5. In a relationship with children left home (or on farm) – late teens, early 20s.
6. In retirement planning stage, grandchildren
7. Retired – doing limited on-farm/on-orchard work.

7.4.3 Attitudes associated with life cycle stage

<u>Environment</u>

Those in category 6 (planning for retirement) placed more importance on things associated with environmental biodiversity – the diversity of birds and plants whether native or introduced/exotic – and see trees as making for a more attractive farm while providing for

carbon credits in the future, than those at all other stages of life cycle. They are also place greater importance on nutrient budgeting. However, they were the most negative about things associated with responsibility for climate change and placed a greater importance on farm succession. Caution has to be exercised here because this group is only represented by two people and they may be exceptions to the general population of older farmers

Those in categories 2 and 3 (with no children of young children) place less importance than all others on the health of soil, livestock, plants, streams and hence of the farm environment in general. They do not see it as their responsibility to encourage native birds and place less importance on tidiness.

There was increasing emphasis placed on a large number of variables as farmers moved through the life cycle stages. These variables were more frequently associated with the 'lived' environment of the farm (as in the things that matter to them because they 'live' there) and encompassed such things as the importance placed on the look of the landscape and the farm through its neatness, tidiness and well maintained appearance as an attractive place to live. Related to this is an increasing sympathy in the attitudes towards birds both native and introduced. Also related are the increasing importance placed on participation in the community (as they progress through the life stages) and the need for farm workers to be treated well. It could be that young farmers do not employ others on their farm anyway and at this stage are not so interested in the home environment.

Those in category 4 (teenagers at home) had a wider environmental awareness than those at other stages, indicating that what happened on their farm had an environmental impact at a global level. This particular showed up in relation to climate change as they placed a greater importance on energy use and sequestered carbon, and felt that NZ farmers do contribute to climate change and should take responsibility for that. However, they did not want more introduced birds on their farm.

Those in categories 5 (children left home) placed a greater importance on water quality, having a good family reputation but placed less emphasis on succession. They were also more likely to adopt proven practices rather than do their own experiments.

There were in fact a lot fewer differences (12) between those in life cycles stages 4 and 5. Those in category 4 placed a greater importance on:

- having available cash
- things to do with the environmental awareness – energy use, sequestered carbon, awareness that their farm affected the environment on a global scale, taking responsibility of climate change, using exotic trees commercially
- things to do with their community and family - succession, developing a connection to the place of their farm, contributing to local traditions.

They had actually spent longer associated with their current farm. They gave lower scores to adopting proven practice rather than doing own experiments and to two things which seemed logical responses:

- using native shrubs and trees to generate carbon credits
- using exotic tress to increase native birds.

Financial

Both those at the beginning of their life cycle and those at the end were rather more disapproving of those who allowed the financial things to take care of themselves while perhaps those in the middle were more neutral. Those in the middle of their life cycle appeared to have place more importance on diversity of income, placing greater importance on their farm having a mixture of productive uses.

One thing that tied those at stages 2 and 3, and stage 5, which may be an artefact of the ARGOS selection, was that these people had less time associated with their current farm and so were less attached to the area where they lived. They also placed less importance on having available cash. They showed less appreciation for how their farming helped them develop a connection to their local area and placed less importance on contributing to local traditions, compared with those at stages 4 and 6.

Farm size

For ARGOS farmers it would appear that both the early life cycle stage and the later life cycle stage farmers have larger farms. For those later in their life cycle, they have probably accumulated land over the years in preparation for succession – either buying up land to spread around offspring or to sell off to divide in some equitable manner between those who will continue to farm and those who will not. The younger farmers are probably working on farms that have been accumulated in this way, rather than starting out on their own farm. This may be true for the farmers chosen for the ARGOS programme and is unlikely to be so for the larger population which may well be more represented by the groups of farmers in their middle life cycle stage who here have smaller farms. The size of the farm is related to the woolshed size – so the farmers in life cycle 6 with the larger farms, which have the potential to have more sheep, have the larger woolsheds. This does not hold, however, when actual stocking units are considered, because the younger farmers have more stock and the smallest woolsheds! The number of paddocks is probably related to farm size too. The raw data averages do not show any differences but when corrected for cluster, crop and area the larger farms have equivalently fewer paddocks.

Hours in work

Farmers with young families claim to work a lot fewer hours per hectare and per stock unit than those further on in their life cycles. This may be because farmers claim increasing hours are worked by their wives as they move through their life cycle stages, and as they get older they employ more labour. They may record going to meetings etc. in their labour hours. Also the younger farmers have a higher stocking rate and more stock overall and so spend less time per ha and per stocking unit than the older farmers.

Oddities

Younger farmers have more quad bikes than their older counterparts possibly because the older ones are more likely to drive a vehicle about as their bodies start to feel the aches and pains of aging, and the quad bike may be a more recent innovation on farms and more attractive to young farmers.

Lamb production

Older farmers had lower lambing percentages.

Soils

As many of the contrasts are between those at the earliest life cycle stage and those at the last they are not necessarily representative of such differences between all farmers. Those at the earliest stages of their life cycle compared to those in the later stages, look as if they have put on more fertiliser recently with particular ingredients – sulphur and phosphates (though there were no differences in inputs over the past 6 years) – with a higher Olsen P and higher organic sulphur to organic carbon ratio. They also had more earthworms both by number and weight. (However, earthworms are notoriously variable and their numbers relate more to soil moisture and other factors.) More of interest are the differences between life cycle stages 4 and 5. Those with teenagers at home and probably under the greatest financial stress, had higher AMN (which is good for their pastures) but a lower soluble carbon to carbon ratio, and their soils were working much harder as indicated by the respiration rate over weight of soil biomass compared to their colleagues whose children were that bit older. They, along with their colleagues in the next life cycle stage also had higher measurements for CEC, Mg and the base saturation of Mg, Ca and percentage of nitrogen than the farms of their oldest and youngest colleagues. These may indicate both the particular fertilisers they are putting on and the greater pressure to produce that they are putting on their farming systems.

Stream and water quality

Many of the variables associated with streams and water ways on farms differed over life cycle stage but this data was only from one year and was limited to ten clusters and 21 farms or less. We do not know how to interpret many of these variables but it would appear that those farms in life cycle stage 4 which are possibly under the greatest production stress, have higher indications of more ammonia and nitrates.

Pasture composition and weeds

Data for pasture composition was limited to 9 clusters. It indicates that the farmers at life cycle stage 4 had a higher percentage of grass in their paddocks and therefore less clover, than older farmers. They also had more Californian thistles but fewer docks. (This could be to do with taking less time to manage thistles and a greater grass cover.) Those in the youngest group had fewest dandelions but the most scotch thistles.

7.4.4 Association between breadth of view, economic focus and likelihood of innovating

The social team observed from a number of their qualitative interviews that farmers had differing interest in what was going on around them and a differing breadth of view in regards to sources of information. Because of this the social team surveyed a large number of farmers on a national scale to get a better understanding of these differences. Their survey data analysis identified 4 measures as follows:

- Economic focus – A measure of the importance people placed on financial measures of their (and their farms) performance.
- Social breadth of view - Differing awareness of how widely the farm impacted on social wellbeing – family → local community → nation → world
- Environmental breadth of view - Awareness of how far afield farm practices impact on the environment – within farm → locally → regionally → nationally → globally

- Innovation likelihood –
    - I do my own experiments rather than adopt proven practices
    - I often deviate from established farm plans.
    - I learn new things by talking to a variety of people.

This is summarised in the table below that shows while organic practitioners have a higher measure for everything except economic focus this may indicate that though innovative, they may be less likely to want their innovations to be turned into financial gain. Arguably making more money is not their primary motivational driver.

Are organic practitioners different from the others? (Hunt et al. 2009)

Index	Non-organic	Organic	t-Test significance
Economic Focus	+0.07	-0.15	0.034
Social BoV	-0.17	+0.37	0.000
Environmental BoV	-0.16	+0.35	0.000
Innovation likelihood	-0.21	+0.45	0.000

7.4.5 Orientations to tidiness and productivity

Production focus results

The group of farmers that is more focused on production produces more and makes more from that production – that is, the members of this group:

- produce heavier lambs – both liveweight and when dressed
- make more in terms of Gross Farm Revenue (GFR) and Cash Farm Revenue (CFR).
- have on average more tractors,
- less conventional fencing,
- more native birds as percentage of all birds
- put less potassium on in their fertiliser.
- their soils are higher in sodium and have to work less per weight of carbon (have a lower respiration rate).

Apart from having a greater production focus (place more importance on yield, volume and not wasting land), they are slightly less negative about climate change issues, and less concerned about children participating on the farm and succession. Obviously, for the lower production group the opposite holds.

Group with greatest focus on tidiness (distinctive attributes)
The members of this group:

- place a great importance on broader financial issues – net profit/loss, changes in equity, return on capital and farm having a mixture of productive uses but they also paid close attention to money in the bank.
- environmentally they placed more importance on soil fertility and the contribution of birds.
- socially they placed greater importance on their contribution to the local community, treating workers well, stream health, and paying attention to what is going on in NZ and the world – in other words, on being 'good' citizens.
- liked to make their farms attractive places.
- were the oldest farmer group.

In practice these attitudes played out on the farm in ways that could be expected. They had the lowest percentage of electric fencing, lowest stocking rate/ha, took longer to get lambs ready to leave the farm (lowest weight gain) but had the lowest percentage of lambs with disease. Possibly as a result of their less efficient production they made less (both CFR and NFPBT). However, they spent more on pasture (making it look good?). There were more sulphate ions for sulphate in their soils, and lowest percentage of potassium ions as part of their base saturation levels

Group with lowest focus on tidiness (distinctive attributes)
The members of this group placed the lowest importance on return on capital, and customer requirements and satisfaction.
Contradictorily, they placed less importance on their farm having a mixture of productive uses/activities while saying that they did not focus on a limited number of income sources. They also placed less importance on stream health and water budgeting. They did not agree that they had too many birds on their farm. Though they saw anything to do with soil as less important than the more tidiness focused groups, these things were still important to them.

In terms of social indicators they placed less importance on family needs and their contribution to the community and disagreed more that their farm impacted on the wellbeing of the nation and the world. This group had, on average, been associated with their farms for less and were the youngest farmers.

Group with middle focus on tidiness
At times this group took on the characteristics of the 'more tidy' focused group and at other times it was like the less tidy focused group. It was like the 'more tidy' group in the importance its members placed on health of stock, plants and soils, the tidiness of the farm and the landscape, customer requirements and satisfaction, and the years they had been associated with their farms. It was more like the 'less tidy' group in the lower importance placed on financial indicators, weeds, stream health, their farm as attractive and the attention they paid to what is going on in NZ and the world.

In practice this group was like the 'more tidy' group in terms of having less electric fencing, fewer birds, a lower ratio of organic sulphur to organic matter (OS/C), and higher magnesium in applied fertilisers and a higher Net Farm Profit Before Tax (NFPBT). It was more like the

'less tidy' group in taking less time to fatten lambs and therefore having them gain more weight per day.
In terms of distinctive characteristics, the 'middle' group showed a greater acknowledgement of climate change and importance of energy use than those in the other groups, they were neutral about the contribution of birds and placed least importance on their contribution to the community. They had the highest level of debt.

When these attitudes were compared with farm practices and their associated measures, this group of farmers had the lowest percentage of electric fencing that was more than 20 years old, they put on more magnesium per hectare, had the highest stocking units per hectare and the highest percentage of lamb disease. Financially they had the highest Cash Farm Revenue (CFR) and spent the least on pasture. Their soils had the lowest sulphates to sulphur and carbon to nitrogen ratios, and highest percentage of potassium ions to base saturation level.

Tidiness (2 clusters based on tidiness variables alone)
Comparing these two groups may not be a very robust exercise because there are so few in the group less focused on tidiness, which is, in itself, a finding that indicates the emphasis on tidy farms is a very important part of NZ pastoral farmers psyche/make up. It also indicates how organic sheep/beef farmers might well have a thing about being compared with 'greenies' etc. and the associated lack of importance placed on 'tidiness'.

The group with the greater focus on tidiness differed from the other group across what seems a rather random collection of variables – that is, it is difficult to group the variables in any meaningful way. The members of this 'tidy' focused group were more concerned about soil fertility, the number of trees or plants on their farm, the treatment of farm workers and personal satisfaction that those in the other 'less tidy' focused group. They expressed less agreement about their farm management practices only affecting the environment primarily within the productive areas of the property, and were more prepared to agree that birds provided important services. Overall they had fewer people in their households.

In practice these attitudes played out in interesting ways. The 'tidy' group had older offspring than the other group even though there were no differences in farmer's, or their partner's ages, indicating that these folk had their children at a younger age than the others. (This may well be associated with the removal of subsidies in the 1980s and the financial difficulties that went on into the 1990s. It is thought that some people delayed having children at this time.) They (the tidy group) worked longer hours had fewer quad bikes and a more recent electric fences. They put on more sulphur fertiliser, took longer to fatten their lambs and therefore, their lambs put on less weight per day. However, they had a greater percentage of lamb disease. This probably translated into their lower GFR and CFR. However, they also had lower Cash Farm Expenses (CFE). They had more species of birds on their farms (both native and overall). Their soils had a higher mineralisable carbon to mineralisable nitrogen (MC:MN) ratio[3] and Resin P, and a lower sodium measurement and earthworm weight.

Conclusions

- Life cycle stage can be a useful framework
- Families can be used as an important predictor of what happens on a farm rather than just the farmer?
- Financial drivers are an important aspect of what happens on farm rather than attitudes
- Exploring farmer orientation and life cycle stage adds an important dimension to understanding a farm by its management system alone.
- Having a mix of quantitative and qualitative data increases our understanding of what is going on, on a farm.

8 Acknowledgments and References

8.1 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 past and present projects. Also thanks to Jayson Benge who efficiently populated the corresponding personal reports.

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
Alan Mc Dermott (Canterbury Meat Packers)
David 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 hardcopy.

Research Reports

09/03 New Zealand Farmer Attitude and Opinion Survey 2008: Management systems and farming sustainability, by John Fairweather, Lesley Hunt, Chris Rosin, Henrik Moller and Solis Norton

09/02 New Zealand Farmer and Orchardist Attitude and Opinion Survey 2008: Characteristics of organic, modified conventional (integrated) and organic management, and of the sheep/beef, horticulture and dairy sectors, by John Fairweather, Lesley Hunt, Jayson Benge, Hugh Campbell, Glen Greer, Dave Lucock, Jon Manhire, Sarah Meadows, Henrik Moller, Chris Rosin, Caroline Saunders and Yuki Fukuda

09/01 Kiwifruit causal mapping in 2008: Comparisons to 2005 and to other sectors, by John Fairweather, Lesley Hunt, Chris Rosin, Jayson Benge and Hugh Campbell

08/04 Soil Properties on ARGOS Dairy and Sheep & Beef Farms 2007, by Peter Carey, Dave Lucock and Jayson Benge

08/03 Linking farmer wellbeing and environmentally sustainable land use: a comparison between converting organic and conventional dairy farmers, by Belinda Mortlock and Lesley Hunt

08/02 Causal mapping of ARGOS high country farms and comparisons to sheep/beef and dairy farms, by John Fairweather, Lesley Hunt, DaveLucock, Chris Rosin

08/01 Causal mapping of ARGOS dairy farms and comparisons to sheep/beef farms, by John Fairweather, Lesley Hunt, Chris Rosin and Hugh Campbell

07/14 Transdisciplinary synthesis, by ARGOS

07/13 Social Objective Synthesis Report: Differentiation among Participant Farmers/Orchardists in the ARGOS Research Programme, by Chris Rosin, Lesley Hunt, John Fairweather and Hugh Campbell

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ARGOS High Country Environmental Report

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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
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
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
44. Differences in soil quality within kiwifruit orchards
45. Differences in soil quality between organic and conventional kiwifruit orchards
46. Strong production focus shown in kiwifruit causal mapping