AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

2009 Annual ARGOS Farmer Report

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Preface

This report has been specially prepared for you. It contains the following sections of information:

1. Farm management report focusing on production intensity
2. A carbon footprint report
3. An environment report on biodiversity
4. Climate change
5. Future survey work

This report will be updated annually and will be complemented with other information gathered by the ARGOS team. It will include information about the social, economic and ecological indicators being measured throughout the course of the research.

Every effort has been made to ensure that all the information is accurate. However, if there are any inaccuracies, please let us know as soon as possible.

Please be assured that this report and its information will remain confidential to the ARGOS team.

Please contact me if you have any questions.

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1 ARGOS

Introduction

The Agricultural Research Group on Sustainability (ARGOS) is an unincorporated joint venture between the AgriBusiness Group, 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 six year research project with the aim to model the economic, environmental, and social differences between organic, 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.

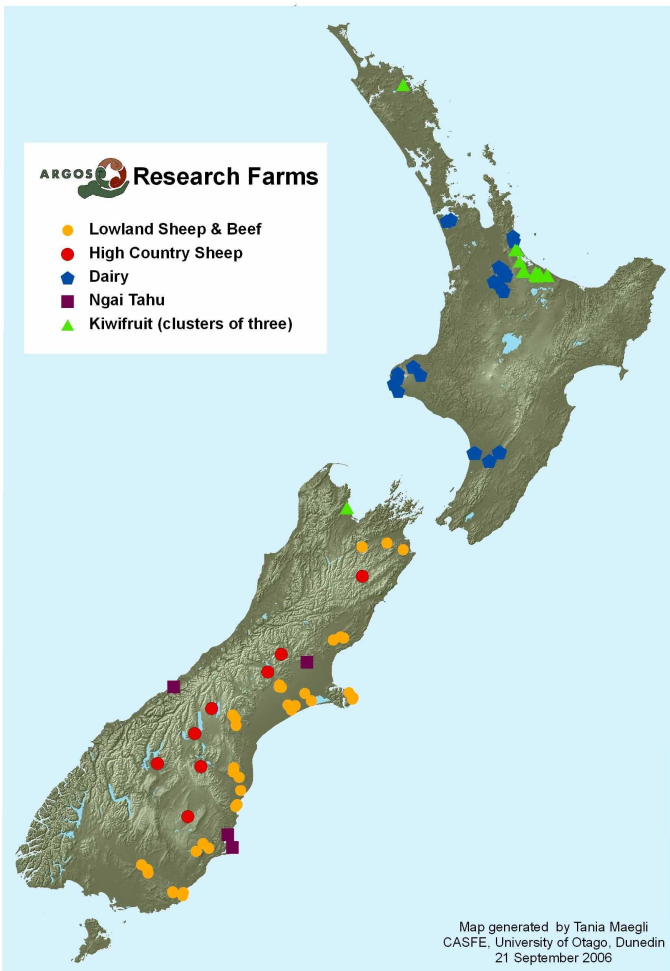


Figure 1 Location of Properties under study by ARGOS

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. Within the management systems, landforms, management units and soil monitoring sites are being studied. These are defined as follows:

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

Management System. For Dairy properties, the two management systems (Panels) are:

- Organic (initially converting to organic)
- Conventional

These 2 management systems may also be referred to as ‘Panels’ i.e. ARGOS is studying a panel of organic farms and a panel of conventional farms.

Cluster. ARGOS farms are arranged in clusters with each one containing two farms i.e. an organic and a conventional farm. The Dairy clusters are spread from South Auckland to the Manawatu. Within each cluster, farms are as close together as possible to minimize differences in background variables like soil type and climate.

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, we only study the two most dominant landforms within each cluster. For flat farms, only the one landform is studied.

Management Unit Management unit (MU) is a paddock. For each landform, three management units (focal paddocks) are monitored.

2 Farm Management

Introduction

Farm Management, in ARGOS, is studied from a management systems approach with three main areas (‘objectives’) of study; economic, social and the ecological environment. The Economics objective looks at production (both financial and non-financial) through to socio-economics of production systems. The Social objective looks at the ‘people’ implications of farm 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 a 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. This objective is responsible for collecting physical and managerial style farm data and the preliminary analysis of this data, where appropriate.

2.1 Inputs

Farm management inputs ranging from time spent farming to soil inputs are recorded annually. Data from the previous two annual management surveys was collated and compared across farms. This section includes information on soil inputs, reproductive management, supplement use, labour and somatic cell counts.

2.1.1 Soil inputs

Compost and Biodynamic Teas were unable to be analysed due to lack of industry standards, however nutrient data was available for the fertiliser applied on the ARGOS dairy farms and was split into N, P, K, S, Ca and Mg nutrient inputs, on a kilogram per hectare (kg/ha) basis for the 2005/2006 to 2007/2008 financial years. Table 1 shows the most common types of organic fertilizers used on organic dairy farms in ARGOS (2008/2009), whilst Figure 2 compares the quantity of nutrients applied for both conventional and organic managements systems for 2005/2006 through to 2007/2008.

Table 1 Types of fertilizers that organic farmers used on 2007/2009

N	P	K	S	Ca	Mg
Osflo	Osflo	Osflo	Osflo	Osflo	Osflo
Revital	RPR	Revital	Revital	Revital	Revital
Biosea	Revital	RPR	RPR	RPR	RPR
		Biosea	Biosea	Lime	Lime
				Serpentine	Serpentine

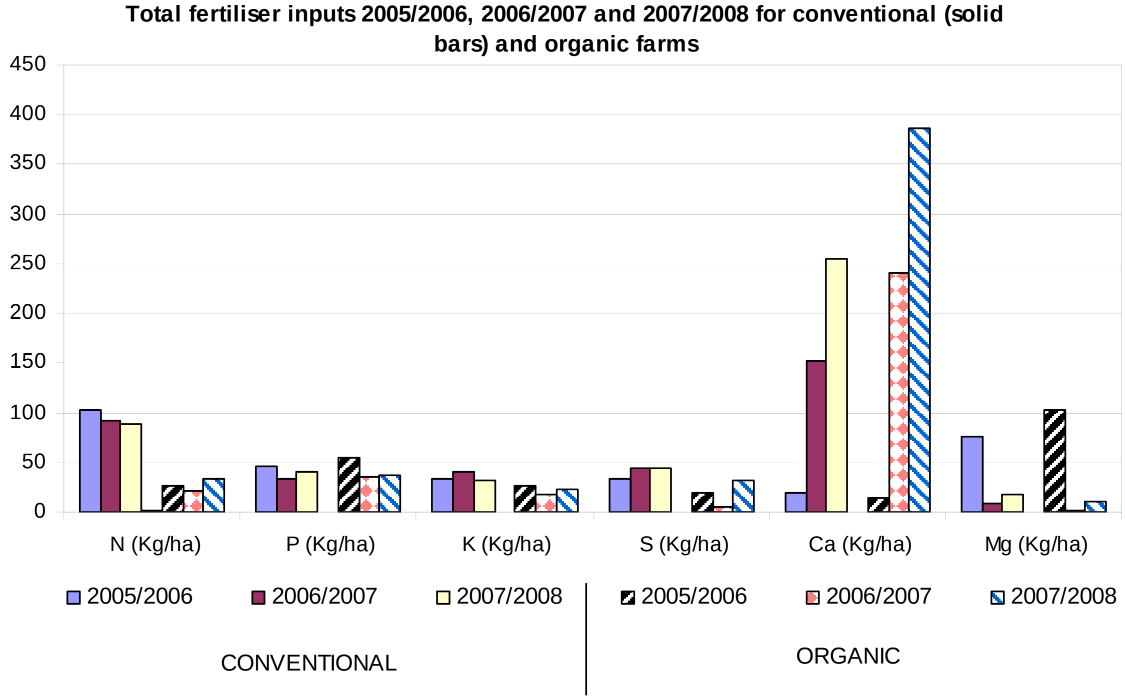
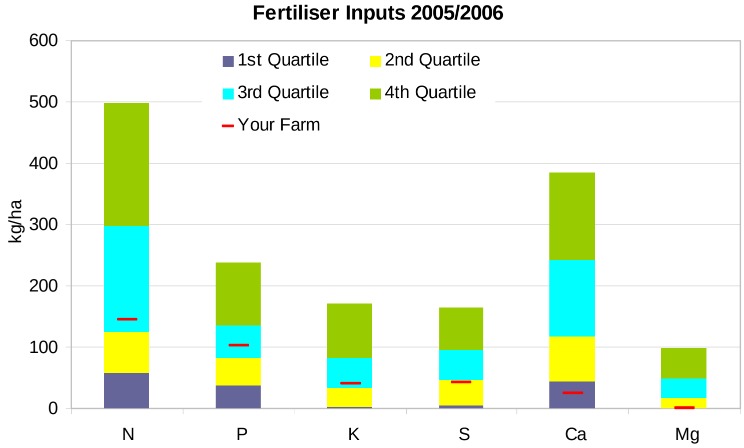
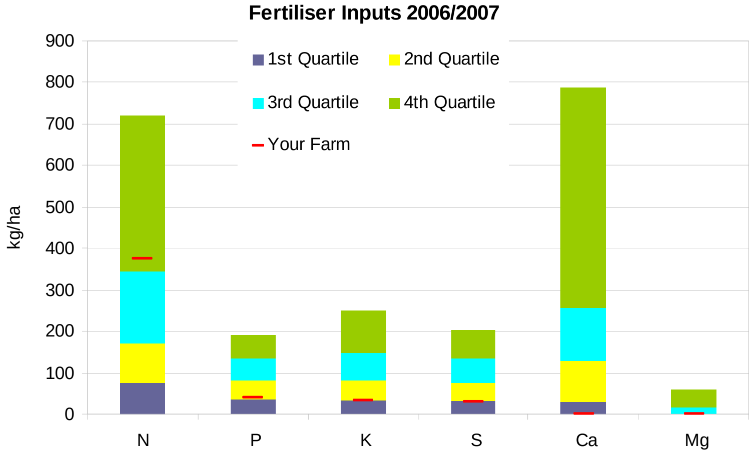


Figure 2 Nutrient inputs as fertiliser over a 3 year period for Organic and Conventional Dairy farms in ARGOS

Figure 3 shows how your fertiliser inputs compare with other dairy farms of your type (conventional or organic) in ARGOS using “quartiles”.

Definition for Quartile
First quartile = bottom 25% of the farms
Second quartile = 25 to 50%
Third quartile = 50 to 75%
Fourth quartile = top 25% of the farms
Note: The “bottom” or “top” does not mean “best” or “worst”. It is purely the range of data.





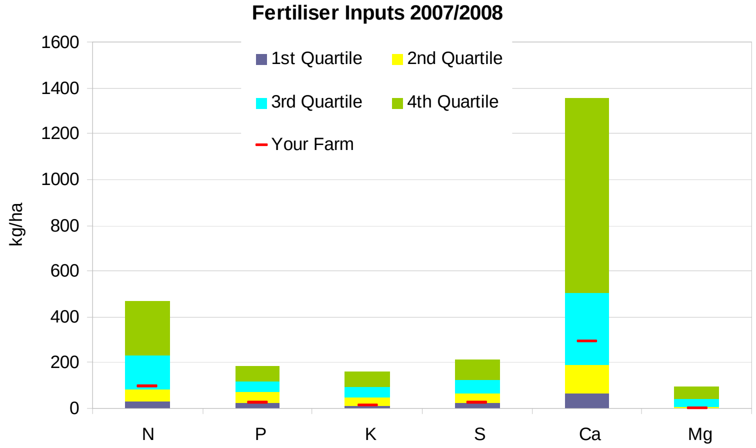


Figure 3 Your fertiliser inputs for 2005/2006 to 2007/2008 compared with other dairy farms of your management system in ARGOS e.g. an organic farm compared with other organic farms

2.1.2 Supplement strategy

Figure 4 compares your farm with Conventional and Organic farms and suggests that Conventional farmers store and use more supplement on a per hectare basis but not on a per cow basis. This reflects the lower stocking rate on the Organic farms (Figure 8) and that Conventional farmers tend to bring in more supplement. These figures are for 2007/2008 so may be distorted due to the drought.

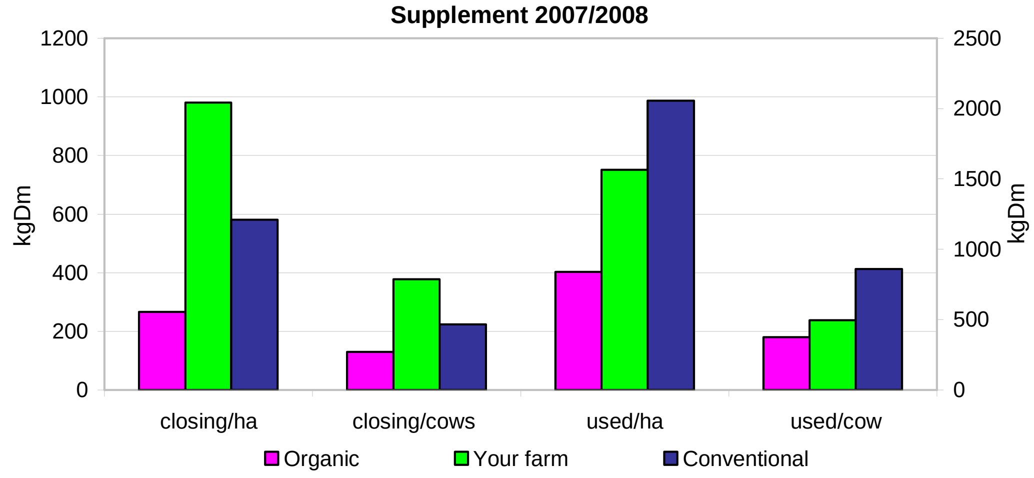


Figure 4 Supplement stored and used annually on ARGOS dairy farms

2.1.3 Labour

All of the ARGOS properties employ 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 hectare and per cow that it takes to run a property and how this varies across properties over 2 years.

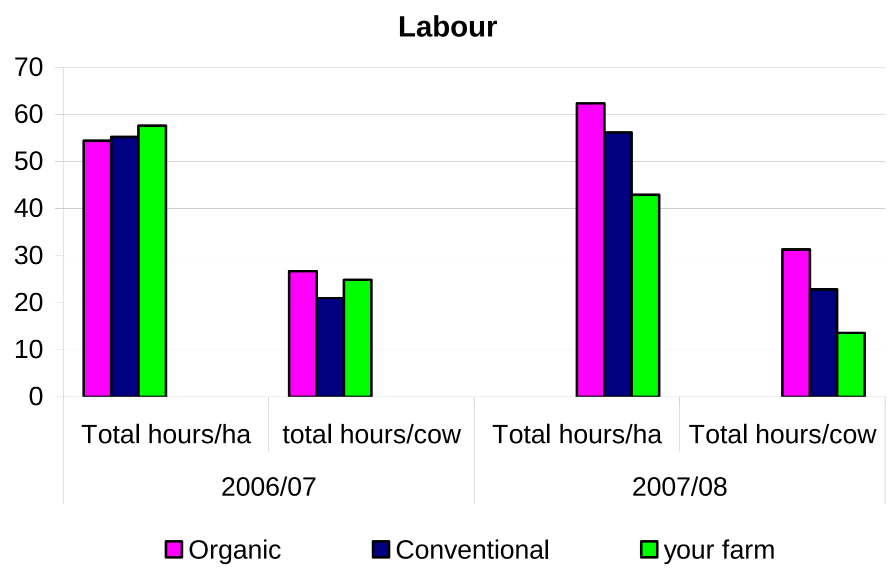


Figure 5 Labour hours to manage the farm, hours per ha and hours per cow

2.1.4 Reproduction

Average date at which calving commenced was only two days different between the panels, being July 19 for the Conventional group and July 21 for the Organic group. The mean number of days between the start of calving and the middle of calving was 19.2 for the Conventional group and 20.0 for the Organic group suggesting that the calving period for the herd was similar between the two groups. Variability in calving period was essentially identical between the two groups. This result is remarkable for the Organic group given that it does not use induction while, on average, a Conventional herd uses it 4.25 times annually**.** There was no difference between organic and conventional systems in regards to the number of weeks of artificial breeding (AB), number of weeks that the bull was out, or the empty rate. Figure 6 shows how your farm compares with all other dairy farms in ARGOS using quartiles (see definition page 8) for 20076/2007 and 2007/2008.

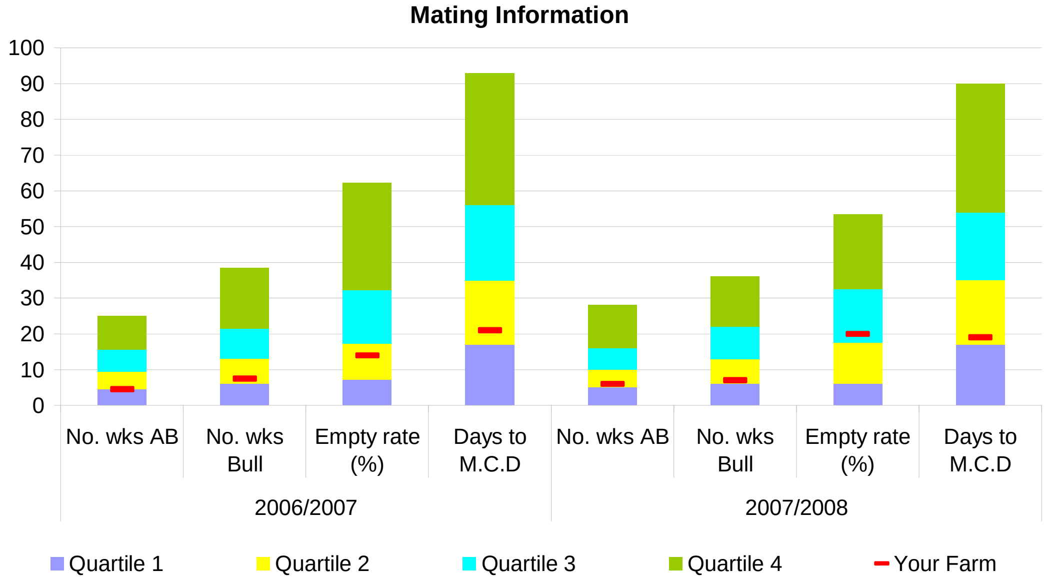


Figure 6 Reproductive indices used to compare your farm with all ARGOS dairy farms

2.1.5 Somatic cell count

Last year we reported on annual differences between Organic and Conventional, in regards to somatic cell counts (SCC). However this tells us little about seasonal variation. Thus, we have started recording monthly average cell counts to further understand seasonal variation.

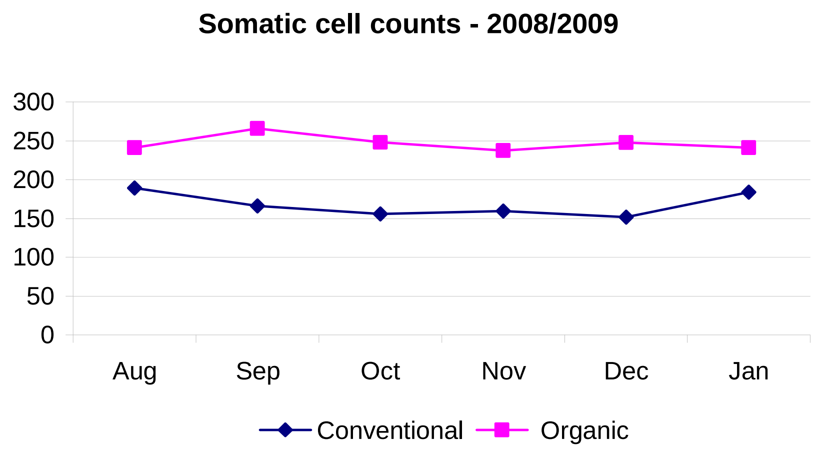


Figure 7 shows very little variation from the start of milk collection to January, when the drought was felt.

Figure 7 Somatic cell count variation from August to January

2.2 Intensity of production on Organic and Conventional dairy herds.

Introduction

This section compares the intensity of production between the ARGOS 12 Organic and 12 Conventional groups of dairy farms using data from 2005/06 – 2007/08. Typical descriptors for carrying capacity (cows/ha), financial ($$/cow or $$/ha), and production (milksolids per cow or per ha) have been used as well as energy (MJ/ha/yr or MJ/cow/yr) to describe fertilizer, electricity and supplement use. A calculated ratio of energy out to energy in shows a fairly similar bottom line when comparing Organic with Conventional.

2.2.1 Farm total size

Most farms were less than 200ha. 12C, 4C and 6D were 300ha, 244ha, and 289ha respectively while the largest farm was 12D it expanded from 573ha to 665ha between 2005/06 and 2006/07.

Five farms increased in total size between 2005/06 and 2007/08, four of which were Organic and one Conventional while one Organic farm shrank from 100ha to 85ha. Three farms increased in size by less than 25%, one farm increased by 50% and one by 205%. In 2007/08, excluding the unusually large farm, the averages for Organic (144ha) and Conventional (139ha) farm total sizes did not differ significantly.

2.2.2 Stocking rate

The average annual stocking rate was determined using the total farm hectares, which includes runoff area. Organic farms (1.70 cows/ha) had a significantly lower stocking rate than the Conventional group (2.62 cows/ha).

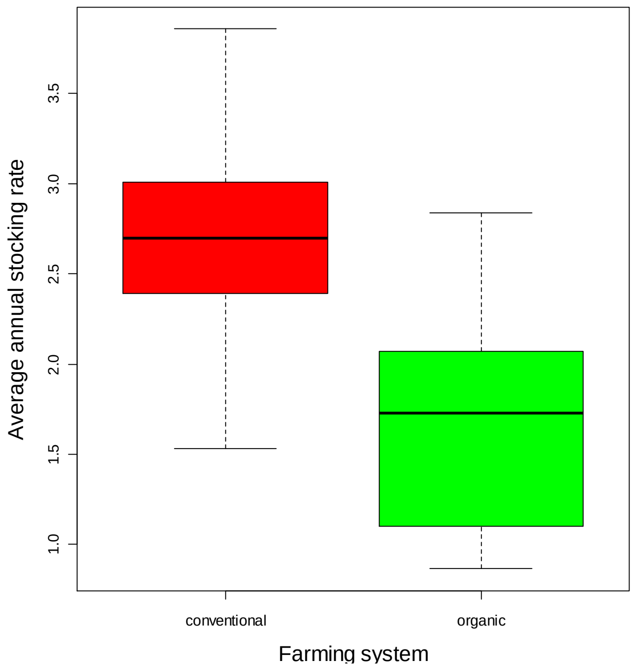


Figure 8 Average annual stocking rate calculated using total farm hectares for Organic and Conventional groups of dairy farms

The national average stocking rate during the study period was around 2.7 cows/ha, but caution should be used when comparing this figure and the ARGOS results as methodology for determining farm area was not given on the dairy statistics website.

2.2.3 Milk yield

During 2005/06 – 2007/08, overall milksolids production for the Organic group was 453.7 kgMS/ha, only 54% of the Conventional group (844 kgMS/ha). On a per cow basis the gap was a little smaller, 274 kgMS/cow, 86.5% of the Conventional group (317 kgMS/cow). These results indicate that of the lower production on Organic farms, around one third is attributable to the cows while around two thirds is attributable to farm factors such as lower stocking rate.

Milk yield was 10% lower for the Organic group during the season prior to their transition and declined further with each passing year such that in 2007/08 production the difference was 31% of Conventional production. The difference was statistically significant in each year. There was evidence that the rate of decline by the Organic group was slowing, as the decline was 9% in the first year following transition, but only 3% in the fourth year. The impact of the 2007/2008 drought has undoubtedly effected production as managers enforced various drought management strategies and this may have skewed figures.

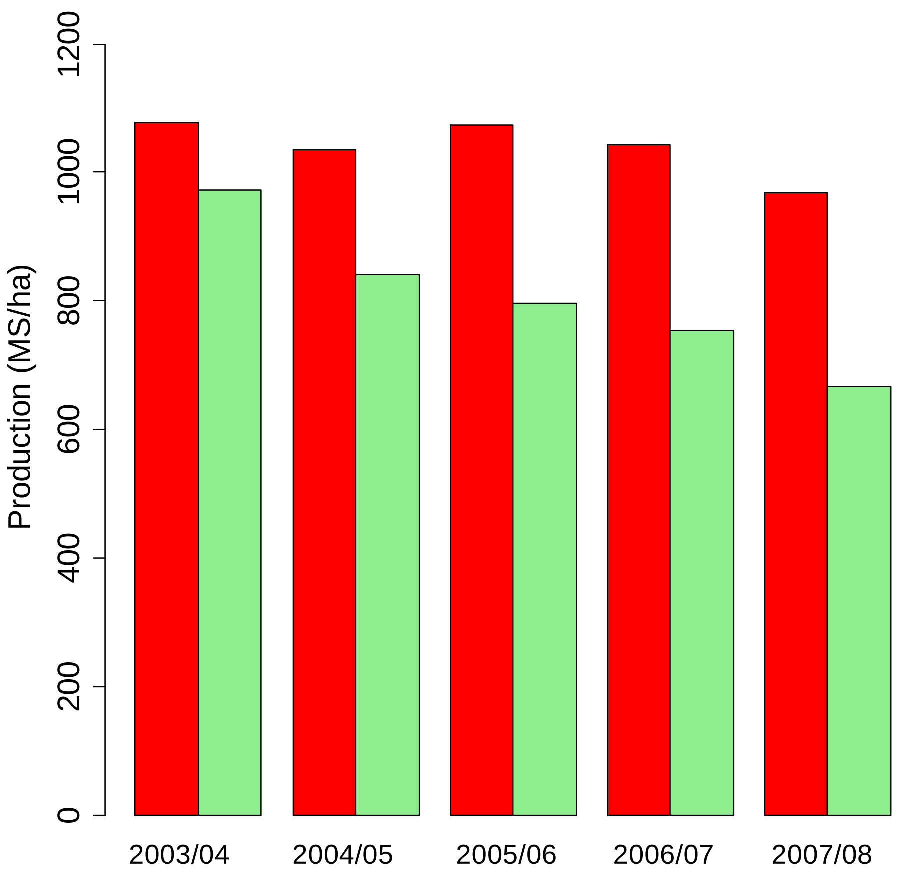


Figure 9 Milk production by the Conventional (red) and Organic (green) group of farms in the seasons from 2003/04 – 2007/08

2.2.4 Financial

Cash farm income per total hectare was $3702 for the Organic group and $4244 for the Conventional group. After transforming the data to more closely approximate a normal distribution, this difference of $542/ha was not significant.

Cash farm expenditure per total hectare was almost identical between the groups with $2764 for the Organic group, and $2881 for the Conventional group.

Annual average cash farm surplus per total hectare, after removing one outlier from each of the groups (see plot below), was $1291/ha for the Organic group, $744 (LM, P=0.010) less than for the Conventional group ($2036/ha).

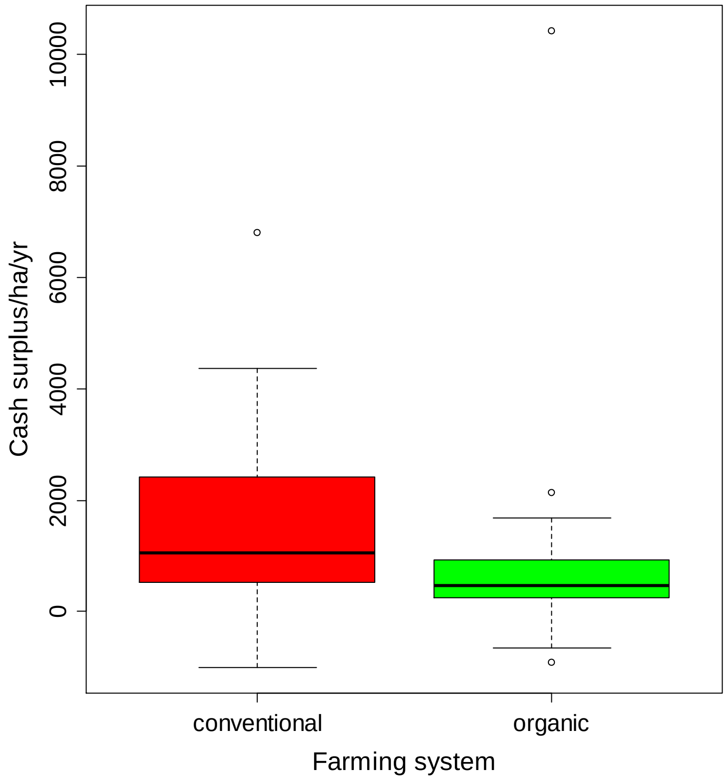


Figure 10 Annual cash farm surplus per total hectare for Organic and Conventional dairy farms

When cash farm surplus was calculated at the per cow level the difference between the two groups was not significant although the average for the Organic group ($541/cow) was $212 less than for the Conventional group ($753/cow).

2.2.5 Labour

Data describing labour input is limited to wages, casual, permanent, or total, recorded in the economic tables. The distribution of each of these variables was erratic and normality could not be achieved through transformation, so average values should be interpreted with some caution.

Average annual expenditure on casual wages per total hectare was $27.84 for the Organic group and $39.26 for the Conventional group. Using a Mann-Whitney test, this difference was not significant.

Average annual expenditure on permanent wages per total hectare was $368.60 for the Organic group and $307.30 for the Conventional group.

Average annual expenditure on wages in total was $396.40 for the Organic group and $346.50 for the Conventional group. The plot below shows the similarity between the groups, further supported by no significant difference when tested using a Mann-Whitney similar.

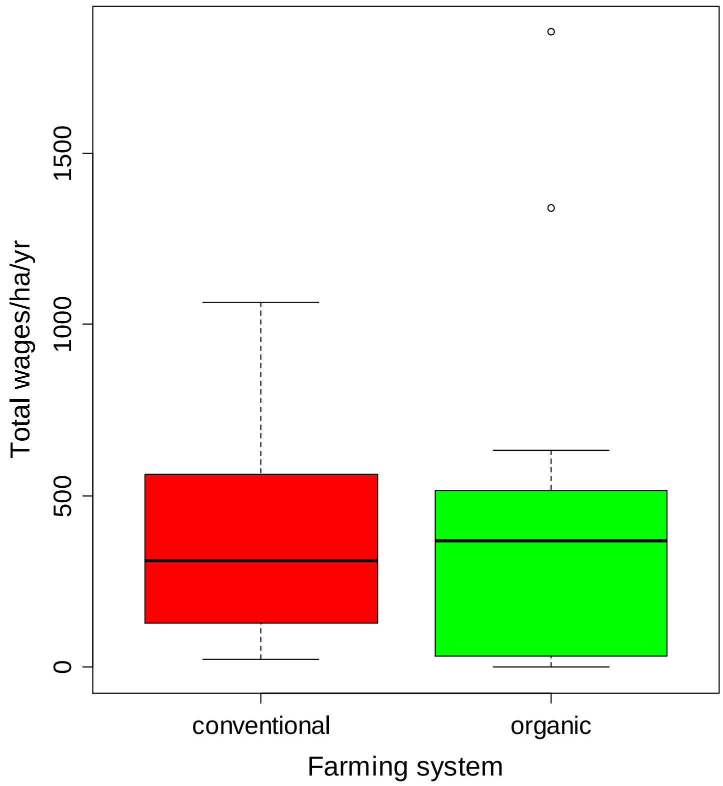


Figure 11 Total expenditure on wages for the Organic (green) and Conventional (red) groups of dairy farms

When attempting to answer the question of whether Organic farms offset lower inputs by utilising higher hours of labour, our data is constrained through the pay rates remaining unknown. The assumption that pay rates would be broadly similar between farms seems justified in that the type of work being conducted would not vary greatly between properties, but if ‘mates rates’ were being used in some wage situations and not others, the extrapolation from wages to hours worked could be very inaccurate. Another unusual aspect of this data was that in 16 cases, the annual expenditure on permanent wages for a farm was zero dollars.

To best address this pertinent question, accurate data describing hours worked would be valuable. An indicator that could possibly be related to this question is the vehicle running costs.

2.2.6 Vehicle costs

Vehicle running costs, which included fuel costs, were very similar between the two groups, $148/ha for the Organic group and $126 for the Conventional group.

2.2.7 Animal health

Animal health costs have embedded in them several potentially confounding factors. These include the level of animal health maintained on each farm, the number of products available to purchase, the limitations of the products available to each group and the availability of replacement stock. One longitudinal study in New Zealand found higher levels of mastitis on the Massey University organic dairy farm relative to the conventional unit. After removing the zero value from the Conventional group, annual expenditure on animal health per cow for the Organic group was $90.77 was significantly lower than for the Conventional group ($112.04).

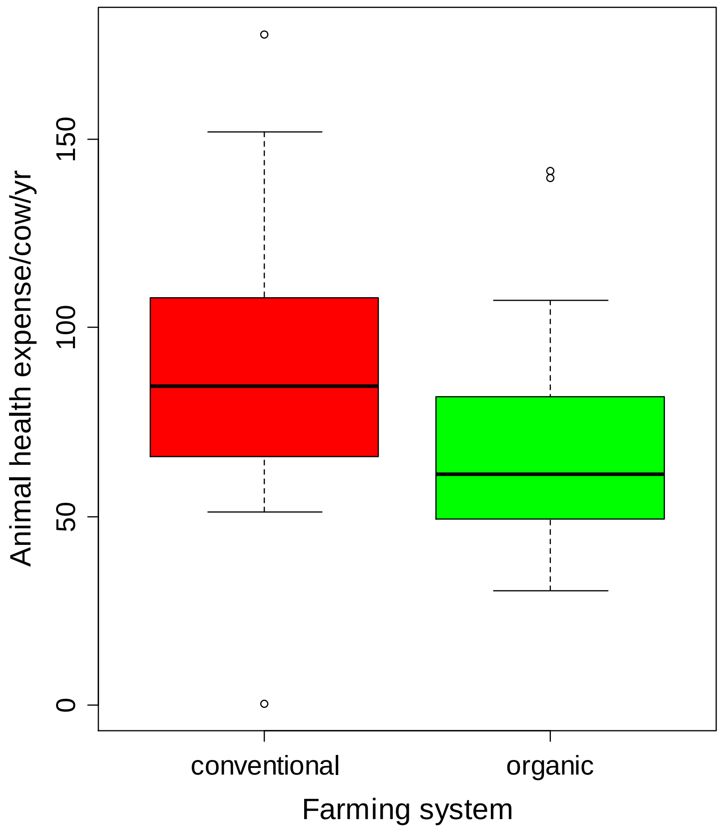


Figure 12 Annual expenditure on animal health per cow for Conventional (red) and Organic (green) groups of dairy farms

2.2.8 Fertiliser

A key difference between Organic and Conventional farming systems is that Organic farms do not apply the energy intensive forms of nitrogen commonly used elsewhere. The average annual amount of energy embodied in fertilisers applied during 2005/06 – 2007/08 was almost half on Organic farms (4210 MJ/ha) compared with Conventional (8002 MJ/ha). But on a per cow basis, the difference was much smaller, 3000 MJ/cow for Organics and 3321 MJ/cow for Conventional

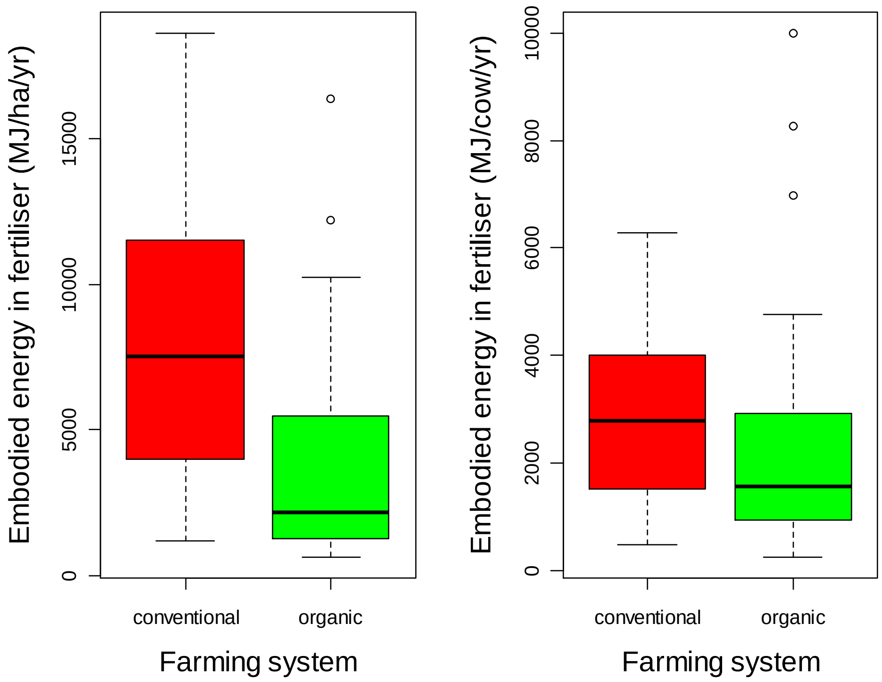


Figure 13 Annual amount of energy embodied in fertiliser applied to Organic and Conventional dairy farms during 2005/06 – 2007/08 on a per hectare (left) and per cow (right) basis

Figure 14 shows the biggest contributor to this difference was the energy related to nitrogen which was, on average, 6126 MJ/ha annually for Conventional farms and just 288 MJ/ha for Organic farms. Phosphate fertiliser use was similar between the groups, while less potassium, sulphur, and magnesium were applied on Organic properties, but more calcium. The 'bubbles' in the figures represent outliers (those farms that do not fit in with the norm)

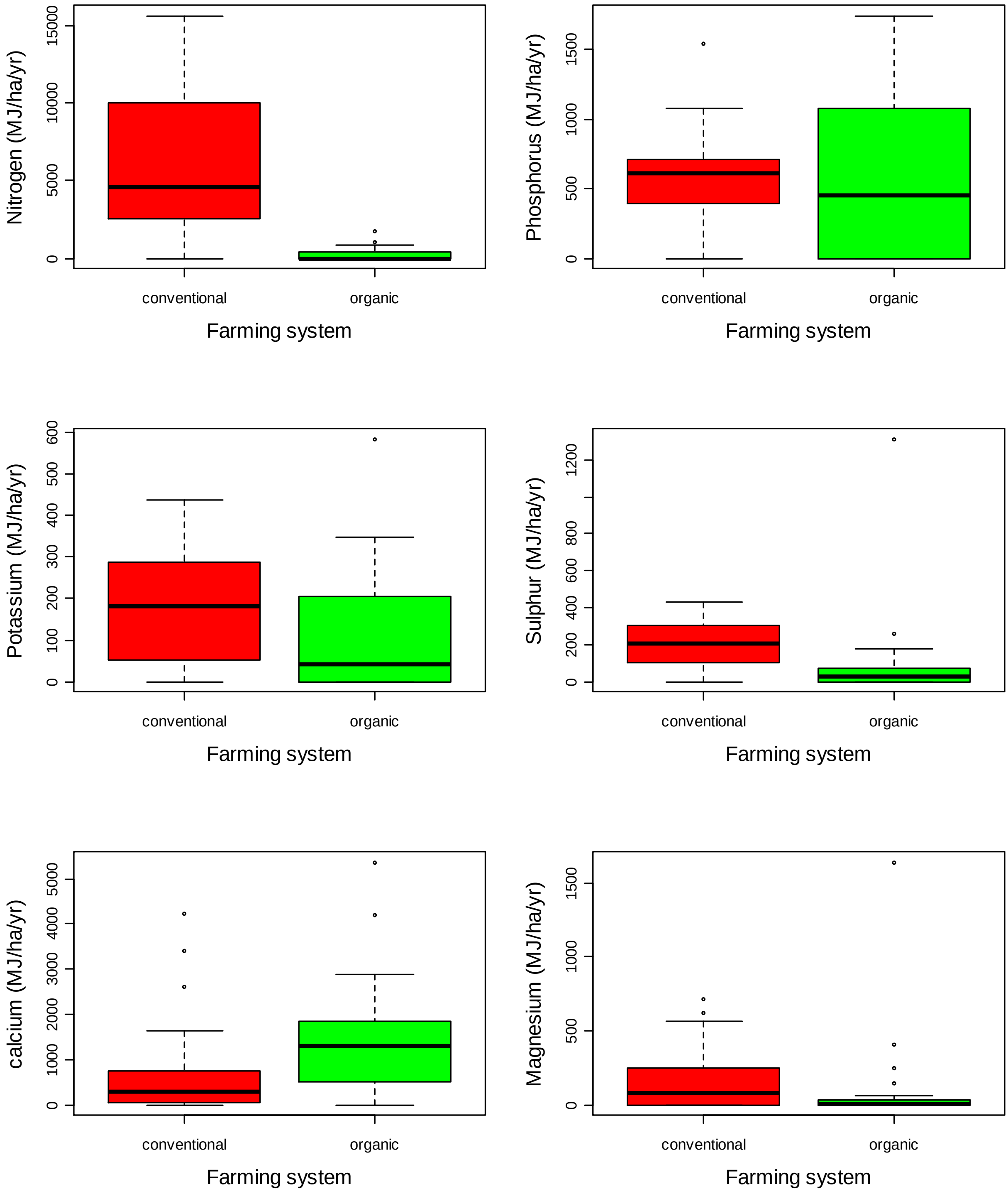


Figure 14 Annual amount of energy embodied in fertiliser applied to Organic and Conventional dairy farms during 2005/06 – 2007/08 on a per hectare basis for 6 types of fertilisers

2.2.9 Supplements

Average annual consumption of energy in the form of supplementary feed was 814 MJ/ha for Conventional farms and 421 MJ/ha for Organic farms and this difference was highly significant It may be more sensible to compare this quantity on a per cow scale however in which case the values were 305 MJ/cow for Conventional and 228 MJ/cow for Organic and after transforming the data the difference was borderline significant

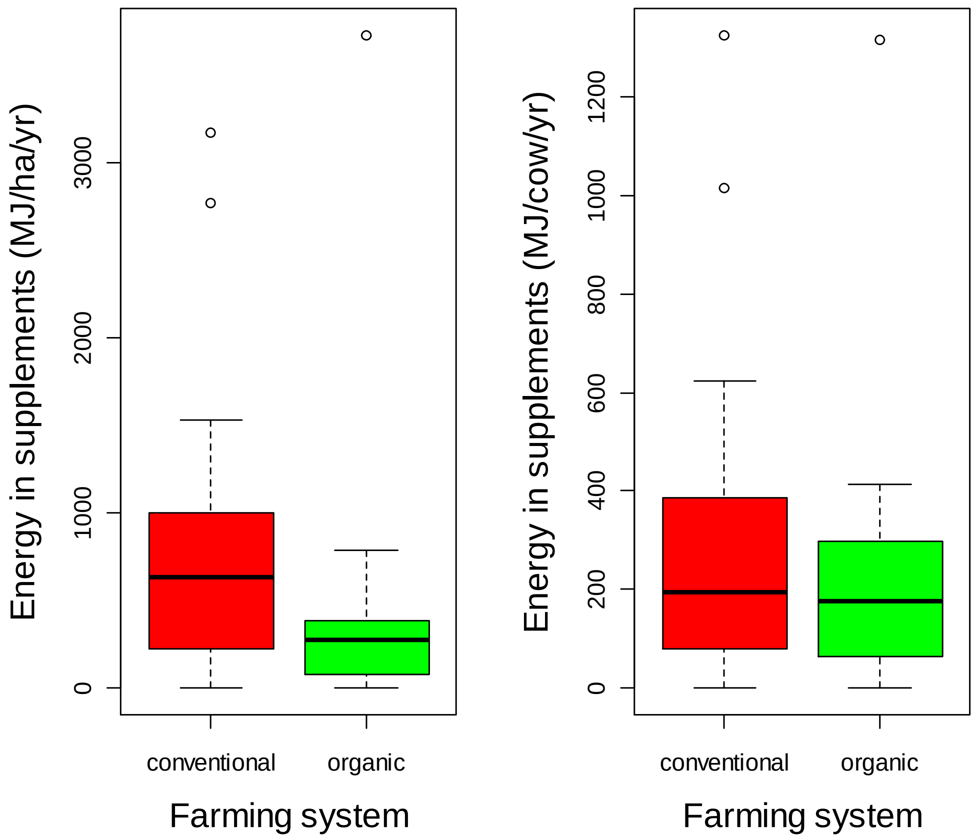


Figure 15 Average annual consumption of energy in the form of supplementary feeds per hectare (right) and per cow (left)

2.2.10 Electricity

The average annual consumption of primary energy in the form of electricity was 1052 MJ/ha for the Conventional group and 959 MJ/ha for the Organic group. On a per cow basis, energy invested as electricity was 562MJ/cow for the Organic group, significantly higher than for the Conventional group (420 MJ/cow).

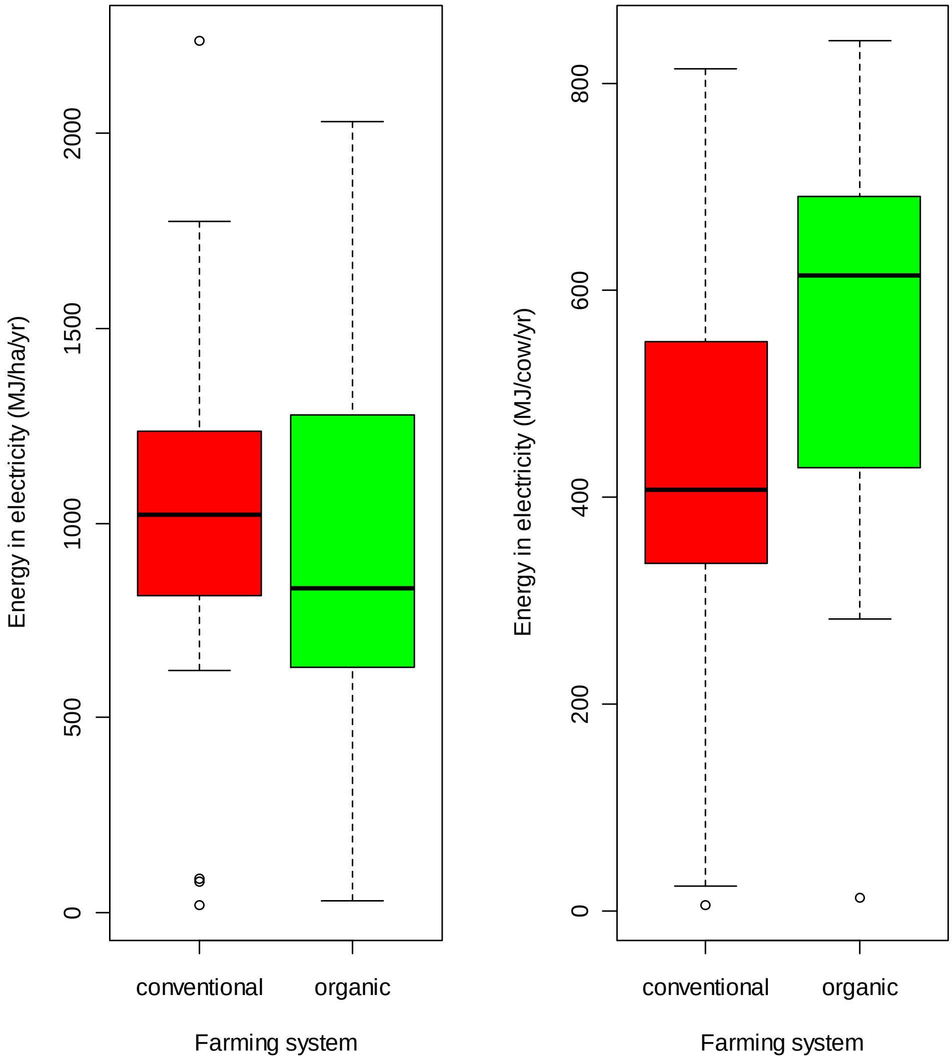


Figure 16 Primary energy in electricity used per hectare and per cow for Organic (green) and Conventional (red) groups of dairy farms

2.2.11 Ratio of energy data available

A ratio was created describing the amount of energy (MJ) in milksolids produced per MJ of electricity, fertiliser, and supplementary feed. The distribution of the values for this ratio was not normal and so a non parametric test was used to compare the ratios between the Organic and Conventional groups.

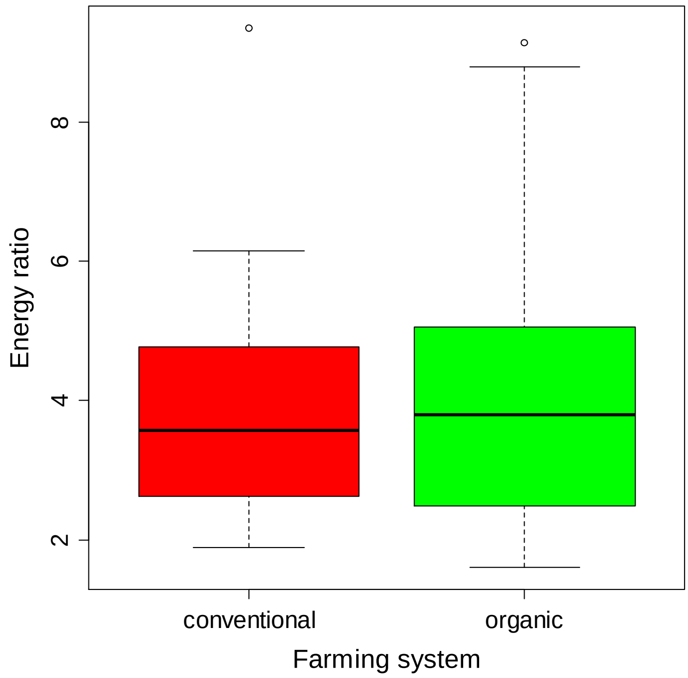


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Figure 17 Ratio of energy out (in milksolids) to energy in (electrical, fertiliser, and supplementary feed) for Organic (green) and Conventional (red) groups of dairy farms

Energy in per hectare

The two groups compared quite differently in terms of the amount of energy they used per hectare. The Organic group used on average 727.4 GJ/ha/year while the Conventional group used 1126 GJ/ha/yr. The distribution of this variable required a log transformation to make it normal and to control for outliers. Once done this showed that the difference between the two groups was significant (Figure 18)

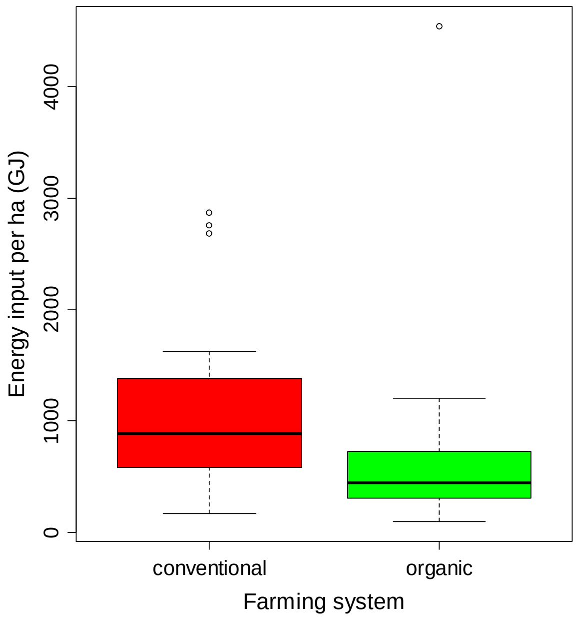

Figure 18 Annual input of energy per hectare in the form of fertiliser, electricity, and supplementary feeds for the Conventional (red) and Organic (green) groups of dairy farms.

Energy in per cow

Figure 19 shows the difference between the two groups was less pronounced when they were compared at the per cow level. In this case the average energy consumption per cow per year for the Organic group was 3.0 GJ and for the Conventional group 3.67 GJ, but the erratic nature of the distribution for this variable means averages should be interpreted with caution.

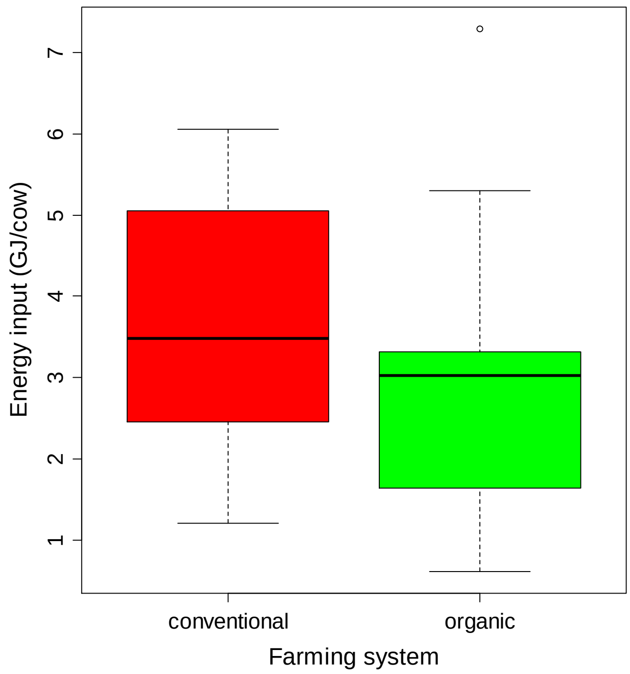

Figure 19 Energy input (GJ) in the form of fertiliser, electricity and supplementary feed per cow per year for the Organic (green) and Conventional (red) groups of dairy farms

Take home message

The take home message from this section is that the Organic group can be represented as significantly lower intensity, or somewhat lower, or virtually the same intensity depending on which scale (energy per hectare or per cow) we choose to present the comparison on.

2.2.12 Farm size versus output per hectare

There was a trend evident in both the Organic and Conventional groups for output, measured in milksolids per hectare, to decline with increasing farm size. The decline appeared sharper within the Organic group (see below) but this observation was not borne out by a significant interaction between farm size and management type. However there was, overall, a negative effect of farm size on production and after accounting for the difference between management types, production declined by about 200 kgMS/ha for every 100 ha increase in farm size.

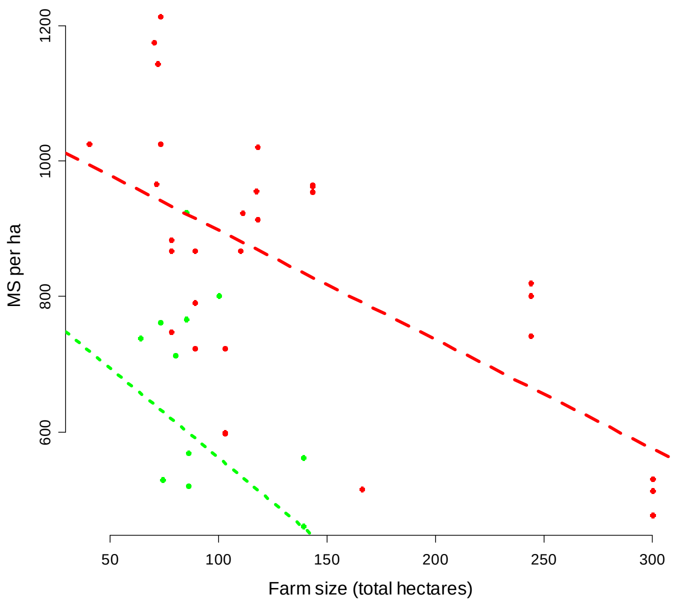

Figure 20 Relationship between output (MS/ha) and farm size for Organic (green) and Conventional (red) groups of dairy farms

2.2.13 Summary

There was a clear cut difference in output with the Organic group having significantly fewer cows per hectare and getting significantly less milk from these cows. The organic group produced about 30% less milksolids per hectare than the Conventional group. The cash farm surplus was significantly lower for the Organic group when measured at the per hectare level, but not different when measured at the per cow level. Expenditure on animal health per cow was significantly lower in the Organic group.

Energy embodied in fertiliser applied annually by the Organic group was about half that applied by the Conventional group, with this difference driven by the low levels of nitrogen applied and the less energy intensive form of Organic nitrogen. Energy embodied in fertiliser applied did not vary significantly between the groups when compared at the per cow level. The Organic group generally applied less of the common fertiliser types, with the exception of calcium.

Energy embodied in supplementary feed was significantly lower for the Organic group while electrical energy did not vary significantly at the per hectare level but was higher in the Organic group at the per cow level.

The ratios of energy output (MJ of milksolids) to energy input (fertiliser, supplementary feeds, and electricity) were very similar between the two groups, but varied significantly in regards to energy input. The variation depended whether per cow or per hectare inputs were used.

There was a negative relationship between farm size and output per hectare, with an increase of 100 ha in farm size being associated with a drop in production of 200 kgMS/ha for all farms.

Overall, for the Organic group the output per unit hectare and per cow was clearly lower than for the Conventional group which probably drove the lower cash farm surplus. Inputs for the Organic group were often lower also, but the difference was not as clear cut as for the outputs. So are they lower in intensity? On the basis of the ARGOS data thus far, yes they are, but not to the revolutionary degree that some would wish.

2.3 On-farm Greenhouse Gas Emissions from 23 Surveyed Organic and Conventional NZ Dairy Farms

Introduction – Note: this section of the report is not for public release.

The following section consists of a supplementary report by Andrew Barber of Agrilink, based on on-farm greenhouse gas emissions from 23 surveyed organic and conventional NZ dairy farms. Information in this report is derived from dairy farms involved in ARGOS.

The project surveyed and established the carbon footprint of 23 dairy farms from around the Waikato, Taranaki and the Manawatu. Thirteen farms used organic production practices. The average Green House Gas (GHG) emissions from these organic farms have been compared to the 10 conventional farms using the same methodology and emissions modeling based on Overseer and a Life Cycle Assessment resource use emissions database. The life cycle assessment is through to the farm gate.

Previous studies that compared organic and conventional farms had mixed results with two studies showing GHG emissions per unit of production was between 8% and 11% higher in organic systems while another study showed organically produced milk with 14% lower emissions than conventional farming.

Findings

Variation between farms highlights the enormous potential from applying good GHG management practices where the lowest GHG emitting organic farm, per unit of production, was 24% lower than the highest GHG emitting farm and 12% lower than the average organic farm. The best performing conventional farm had 33% lower emissions than the highest farm per unit of production, and 21% lower than the average conventional farm. In all cases the highest and lowest emitting production systems were in the respective bottom or top quarter of production per cow.

Organic farms, which were less intensive in terms of resource inputs and stock density, had significantly lower greenhouse gas emissions per hectare (Figure 21). However organic and conventional farming systems had almost identical GHG emissions per unit of milk production (Figure 22 following page).

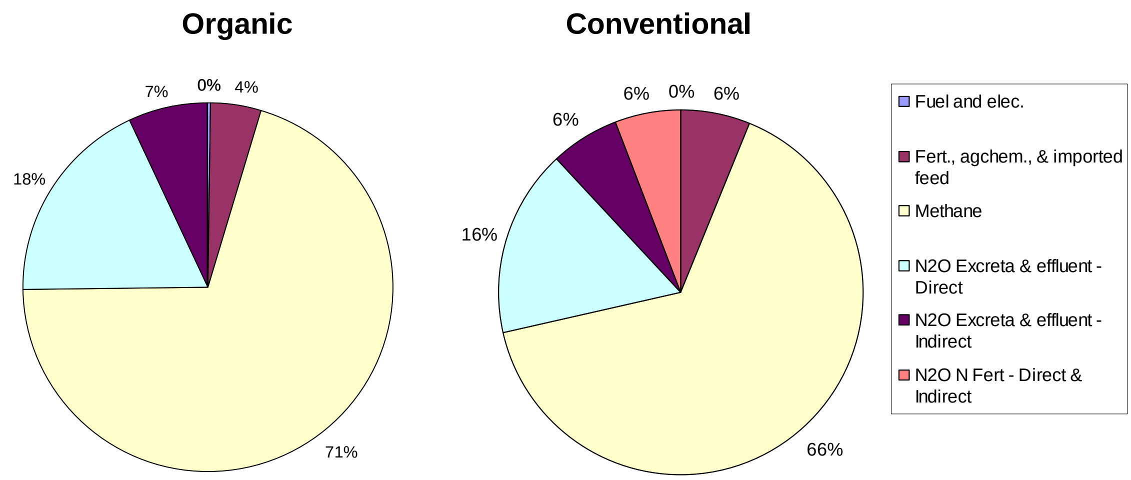

Figure 21 GHG Emission Profile per hectare

GHG mitigation strategies were investigated including animal productivity, the use of feed pads to restrict winter grazing, nitrification inhibitors, better utilisation of farm dairy effluent, dung beetles, the use of the antibiotic monensin, and supplementary feeding with oil and cereal grain. On their own none of these strategies is going to result in dramatically lower on-farm GHG emissions. However where appropriately used many will not only lower GHG emissions but will also improve farm profitability.

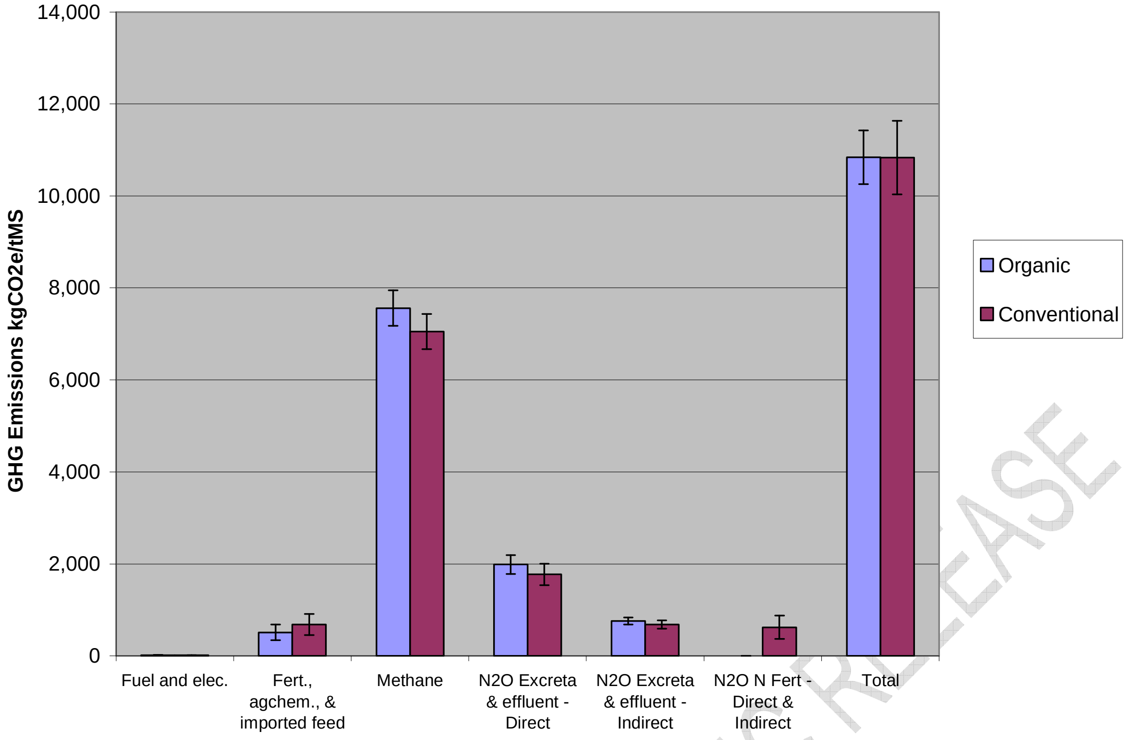

Figure 22 GHG Emissions per Tonne of Milk Solids

Production of milk solids per hectare was much lower on organic farms at 585 kgMS/ha compared to 982 kgMS/ha on conventional farms. GHG emissions per unit of production were almost identical (0.3% difference) at 10,865 kgCO_2e/tMS and 10,835 kgCO_2e/tMS for organic and conventional systems respectively. Organic farms had statistically significantly lower GHG emissions per hectare than conventional farms, driven predominantly by their lower stocking rate of 1.6 cows/ha compared to 2.6 cows/ha on the conventional farms.

Lower resource use GHG emissions on the organic farms were offset by lower production per cow resulting in almost identical emissions per unit of production. Not surprisingly there is a strong relationship between production per cow and GHG emissions per unit of production (Figure 23), clearly increased production comes at the price of only a small marginal increase in GHG emissions. Analysing the production systems separately (not shown) shows an even stronger relationship.

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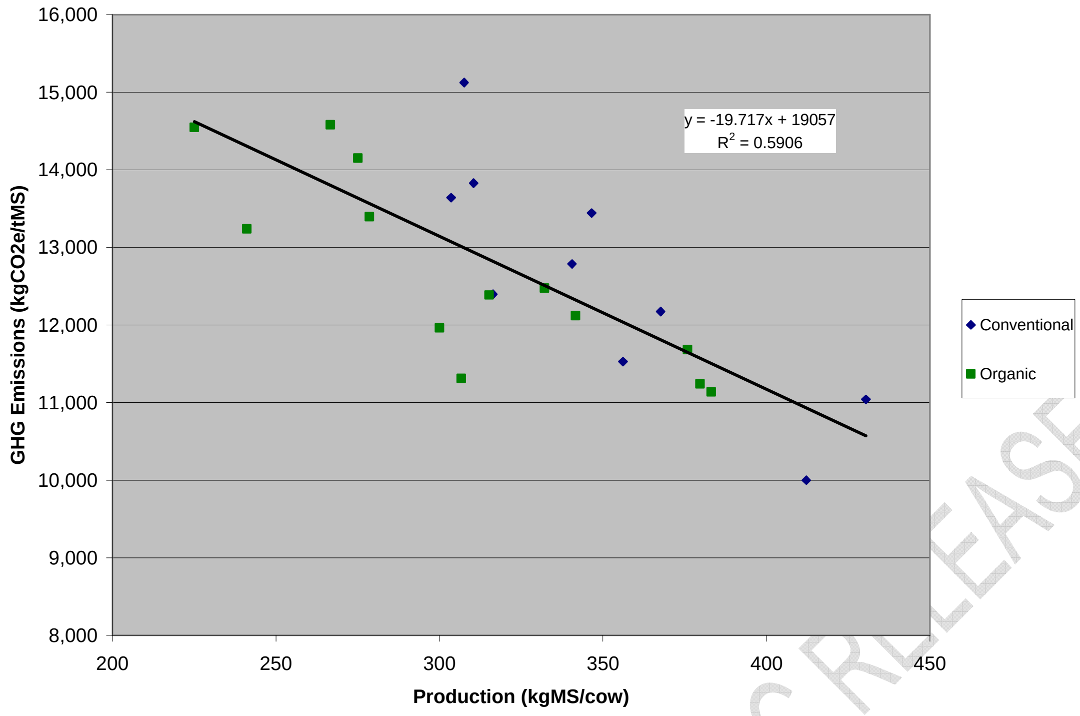


Figure 23 GHG Emissions per Tonne of Milk Solids vs. Cow Productivity

Discussion

More important than the absolute GHG emissions is how the emissions can be reduced in the future. While a range of strategies were investigated there is no “golden bullet” that will dramatically lower on-farm GHG emissions. Modeling showed that a combination of improved productivity and the use of a nitrification inhibitor lowered emissions by approximately 12%. Both these strategies, where appropriately used, not only lower GHG emissions but also improve farm profitability.

Improved productivity and farm management skill are possibly the two biggest opportunities. There is a clear linear relationship between higher productivity per cow and lower GHG emissions per unit of production (Figure 23).

While this project did not look beyond the farm gate other studies have shown that farmers’ own and control most of the life cycle GHG emissions (around 85%). This empowers farmers to make changes that will be reflected in a noticeably lower carbon footprint of the final consumer product.

3 Environment

Introduction

Worldwide, agricultural intensification has caused biodiversity loss and New Zealand is not an exception. The New Zealand dairy industry relies on its ‘clean & green’ image for market access. However, given the recent increase in consumer demands for environmentally-sustainable food production systems, the dairy industry may need to work on promoting native biodiversity on dairy farms, to secure market access in the future.

Yuki Fukuda has been researching biodiversity attributes of shelterbelts on dairy farms over the last 2 years. This is potentially important work as this knowledge will improve the ability of enhancing bio-diverse landscapes and may lead to a decrease in artificial inputs saving time and money. This work has led to a new role for Yuki as regional manager of Conservation Volunteers New Zealand, which is implementing the “Catchment Care” program in partnership with Fonterra. This is a free program that centres primarily on riparian zones, wetlands and waterways, that would benefit from restoration activities and which have been impacted upon by dairying.

The next section of the report contains the main findings of Yuki’s post doc research on shelterbelts and insect life on Dairy farms in the Waikato, and starts with a survey based on farmers’ attitudes to tree planting and bird conservation on their properties.

3.1 The New Zealand Dairy Farmers’ Attitudes towards Tree Planting and Bird Conservation on Their Properties

Introduction

Worldwide, removal of woody vegetation through agricultural intensification has caused a major decline in bird diversity. To determine the New Zealand dairy farmers’ attitudes towards tree planting and shelterbelts on their properties in relation to bird conservation a survey was completed from 457 farmers with the following results.

Results

Native birds were favoured over exotic ones: shelterbelts’ role in offering food and habitats for *native* birds were rated a lot more important (0.9) than for *exotic* birds (0.2).

71% of farmers have included native trees for planting. 26% of these selected them because native trees would offer important food for birds. In contrast, only 5% of the farmers who planted exotic trees planted them for birds.

The major barriers against planting trees (in order of magnitude) were:

- a lack of space,
- fencing costs,
- maintenance costs,
- do not see any benefits,
- labour costs
- cost of purchasing trees.

Of the farmers who had not planted trees, 40% said that they would consider planting if incentives would cover up to 50% of the planting costs. Nevertheless, only 13% of them were willing to pay higher rates to support such an incentive.

The majority of respondents (457 out of 2000) were farmers who were interested in conservation and had actively planted trees on their properties in the past five years. The rest of them may not have been interested?

There was a stronger preference for providing food and habitats for *native* birds than to exotic ones. But the majority of existing shelterbelts comprised of exotic species. Research on habitat usage by native and exotic birds to identify whether native birds prefer native trees need to be conducted.

Increasing woody vegetation is crucial for native bird conservation.

Incentives and the use of volunteers may promote further tree planting and bird conservation on dairy farms.

3.2 The effects of farming practice, shelterbelts on insect biodiversity on dairy farms

Introduction

In this study 6 pairs of conventional and organic farms plus another two conventional farms were monitored and then 2 to 6 shelterbelts were randomly selected from each farm. The shelterbelt attributes (the origin of shelterbelt trees, conifers vs. broadleaves, fenced or unfenced) were recorded and spiders and beetles collected from both above and underneath shelterbelts litter and pastures

Main findings

• Organic farming practice increased density of spiders (both exotic and native spiders). Organic farming also increased the density of native spiders compared with conventional farms.

• The density of beetles, the density and species richness of native beetles and the species richness of spiders were higher under shelterbelts relative to pastures.

• Herbivorous beetle densities were significantly higher in conventional pastures compared with shelterbelt habitats, and organic farms.

• Weed biomass did not change between underneath shelterbelts and pastures, between unfenced and fenced shelterbelts, and between conventional and organic farms.

• Shelterbelts with broadleaves enhance densities of spiders that live on the ground.

• The density of pasture pest beetles (Argentine stem weevils and Clover root weevils) did not differ between under fenced or unfenced shelterbelts

• During drought, fenced shelterbelts act as drought refuges for ground-dwelling beetles; beetle densities (overall beetles, native and exotic beetles) were higher under fenced shelterbelts than unfenced shelterbelts in 2008.

• Both density and species richness of native beetles and the species richness of native spiders that live on shelterbelt foliage increased when shelterbelts comprised of native tree species than those comprised of exotic tree species. The origin of shelterbelt trees (native vs exotic) had no measurable influence on ground-dwelling spider and beetle species density and diversity.

Management implications

• Organic farming practice may play a key role in biodiversity conservation of spiders.

• Shelterbelts provide crucial habitats for spider and beetle (especially native beetle) diversity conservation.

• The use of native shelterbelts should be encouraged on farms as they promote conservation of native spiders and beetles that live on shelterbelt foliage.

• If fenced off, the extent to which shelterbelts play a role in biodiversity conservation of ground-dwelling beetles and spiders could be greatly improved, <u>without increasing pasture pests</u> (The exception appears to be oaks: when they are fenced off, weeds appeared to increase – in this case, it may be better off that they are left unfenced)

• More work needs is required to more fully understand the role that spiders and beetles may have in regards to biological control in regards to other pasture pests.

3.3 Would native-tree corridors promote insect dispersal from native bush to farms?

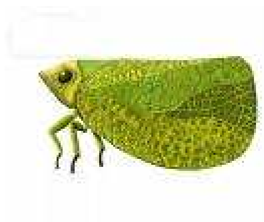
The reasons for having carried out the study:

Some farmers in New Zealand have native bush patches and are keen to plant more native trees on their properties. However, time and money that can be spent on tree planting are often limited. To make the most out of available trees, optimum planting intervals that would maximise conservation benefits needs to be identified. To date, such an interval is not known because no one has studied it, not only in New Zealand, but also globally.

My aim was to compare three planting intervals (20, 60 and 180 m from native forests) and see which one was best in terms of helping native insects to move away from the forests and use those plants. One of the aims of conservation is to recover a whole suite of native insects and birds that would use those trees. I planted native tree species, mahoe (or whiteywood) and monitored insect movement on four Waikato farms.

Main findings:

The main insect group that moved to the plants established in the pastures were plant hoppers (pictured to the right). The shorter planting interval (20 m) was the better one to use for restoration than the longer (60 and 180 m) intervals. However, many native insects have a very limited ability to move away from the forests, so they stayed within forests. This means that the shorter interval might also have been too large for them. Another possibility for the lack of movement is that it may take more than 10 years for a whole suite of insects to be found on restoration sites.



Where to plant native trees on farms:

It would be best to use the same species of native plants that is already found in your existing bush blocks.

◆If you have one native forest on your property:

it is best to plant native trees immediately close to the forest. Many native bushes on farms are small size and have high edge areas. The edge habitat of forests gets higher wind speed and more sun, so it is drier and creates better habitats for exotic insects. So planting more native trees around the forests will, in time when the trees grow larger, increase the core, interior area of the forests, which is a more suitable habitat for native birds and insects.

- If you have two or more patches of native bushes within landscape,

it is best to plant native trees to create movement corridors (to connect the two or more patches of bushes). In this case, planting trees with shorter intervals than 20 m is recommended, because this should help native insects to move between the forests. The smaller the intervals, the quicker you will recover the whole suite of insects (that are important food for native birds, too). Connecting existing bush patches is very important because helping insects to move between habitats will prevent them from local extinction. Having said this, the tree corridors could also help exotic insect species disperse across the landscape. For example, passionvine hoppers (a major pest for kiwifruits, pictured right) actively used my corridors to disperse. A careful selection of native tree species, along with an assessment of the on farm/surrounding land use, may be required before planting takes place.

For more information regarding assistance with tree planting/bird conservation, see www.conservationvolunteers.co.nz

4 Social

4.1 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.)

4.2 Examining historical management changes – retrospective survey

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.

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.

5 Appendix

5.1 Acknowledgments and References

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.

Thank you for your support and input.

PUBLIC REPORTS

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

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

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

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

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

07/09 Management and Production Features of ARGOS farms and Differences between Production systems, by Jayson Benge, Dave Lucock, Martin Emanuelsson, Jon Manhire

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

07/06 There are Audits, and There are Audits: Response of New Zealand Kiwifruit Orchardists to the Implementation of Supermarket Initiated Audit Schemes, by Chris Rosin, Lesley Hunt, Hugh Campbell and John Fairweather

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

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

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

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

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

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

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

05/06 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

05/05 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

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

Conference Papers

Carey, P., Jayson Benge, Henrik Moller, Dave Lucock and Amanda Phillips. What effect does farming Organic vs. Conventional have on soil properties across increasingly intensive (sheep & beef, dairy and kiwifruit) production sectors? Organic Aotearoa New Zealand Conference, Lincoln University, 17 August 2007.

Fukuda, Y., Burns, B. and Moller, H. (2008). The effects of farming practices and shelterbelt types on invertebrate biodiversity in dairy farms. The 47th New Zealand Entomological Society Conference, University of Canterbury, Christchurch, 4-8 April 2008.

Hunt, L.M. (2008). Watching cows: associating farmer wellbeing and cows. Reflecting on our Relationships: Animals and Agriculture. Workshop, University of Auckland, 18 July 2008.

Mondot, M., Blackwell, G. and Maegli, T. (In Press). Does organic conversion promote bird community diversity and abundance by habitat modifications on New Zealand dairy farms? Proceedings of the 69th New Zealand Grasslands Association Conference, November 2007, Taupo, New Zealand.

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
15. Soil nematodes in kiwifruit orchards
16. Understanding kiwifruit management using causal maps
17. Bird Sampling Methods
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
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
36. Earthworms in kiwifruit orchards
39. Quality Assurance Programmes in Kiwifruit Production
41. The Relevance of Performance Indicators Used for Non-Agribusinesses to Kiwifruit Orchards
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