COMPARISON OF THE FINANCIAL PERFORMANCE OF ORGANIC AND CONVENTIONAL FARMS

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Abstract

The Agriculture Research Group on Sustainability (ARGOS) is comparing the sustainability of organic, integrated and conventional farms in New Zealand by monitoring environmental, social, economic and management parameters. The literature comparing the relative financial performance of organic and conventional agriculture is summarised, and the results of four years' ARGOS monitoring of farm financial performance in the sheep/beef and kiwifruit sectors are presented. Although the results show that there are some significant differences in farm costs and revenue across farming systems within a sector, there is greater variability in the "bottom-line" indicators of profitability within farming systems than across them.

Keywords: organic agriculture, integrated farming, sustainable land use, land-use systems, financial performance

Introduction

The financial viability of organic farming – whether farmers can make sufficient money from organic production to continue farming in this way – has been debated since its origins. Despite this uncertainty, there has been consistent expansion of organic industries world-wide in recent years. Annual growth in the USA has exceeded 20 per cent since 1992, and the European Union has seen a 25 per cent increase per year (Lotter 2003). If this expansion is to be encouraged as a means of achieving non-financial benefits, such as positive environmental outcomes and health benefits for consumers, the financial implications for farmers of adopting organic production methods must be clarified.

Most of the literature on this has compared financial performance of conventional and organic farming systems in relation to yield, product prices and production costs. Other factors affecting relative performance include product, region, farm size and the understanding and application of farming principles, whether organic or not. Detailed, farm-level comparisons can shed light on the causes of differential performance amongst farms using different production methods.

In New Zealand, panels of farms from the kiwifruit and sheep and beef sectors have participated in a multi-year research project, the Agriculture Research Group on Sustainability (ARGOS), since 2003. This project was established to examine the environmental, social and economic sustainability of selected New Zealand farming systems, and to develop a better understanding of the environmental, social and economic consequences of different farming systems. Economic, environmental, and social data about the farms and farmers will continue to be collected into 2009. For both sectors, one panel consisted of conventional farms and a second contained organic farms. In the kiwifruit sector, a third panel comprised orchards growing gold kiwifruit (*Actinidia chinensis* var. Hort16A), whereas the third panel in the sheep and beef sector was farms under integrated management. Clusters of three farms, one from each panel, were matched geographically. As part of this research, detailed annual monitoring of farm financial data and analysis is undertaken to establish the relationships between management systems and key measures of financial performance.

Here we review the literature on the comparative performance of organic and conventional farm management systems; and describe the design of the ARGOS project and the methods used for comparing farm financial performance. The results of the comparison are presented, followed by a summary of findings and a discussion of their implications.

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Summary of comparisons between organic and conventional production

Yield

On average, the yields of organic crops have been reported as lower than conventional yields, with some exceptions (Morris 2001). Results from a 21-year study of farming sectors in Central Europe found crop yields to be 20 per cent lower in organic systems (Mäder 2002). In a review of the relative yield performance of farming systems in 18 European countries, Offermann and Nieberg (2000) showed that, despite the overall lower yields of organic farms, some individual crops had yields as high as or higher than nearby conventional reference yields. In New Zealand, as elsewhere, weed infestation has been identified as a major threat to organic arable production as the impact of weeds can be immediate and devastating on crop yield, quality and value (MAF 2002). The level of success with weed control on organic farms has a large and direct impact on yields relative to conventional farms (Posner, Baldock, & Hedtcke 2008).

Organic livestock production levels per hectare are also generally lower than those of conventional farming systems although differences in per head production are minor. Offermann and Nieberg (2000) reported that per cow production in European organic systems is typically in the range of 80-105 per cent of conventional farms, and milk production per hectare was lower (70 and 80 per cent of conventional yields in the Netherlands and Switzerland respectively). In New Zealand, per hectare production for organic dairying has been estimated to be between five and ten per cent lower than conventional yields (MAF, 2002; Christensen & Saunders 2003). Morris et al (2001) attribute the differences in yield between organic and conventional dairying primarily to the lower stocking rates and lower feed crop yields on organic farms. They may also reflect differences in feed rations as a result of purchase restrictions on organic feed (fewer purchased concentrates, more forage) and its higher price (Nieberg & Offermann 2003).

Price

Product prices are a major determinant of financial performance. Adoption of organic farming methods often depends on favourable market prices (or price expectations) for organic products (Pacini et al 2002; Morris et al. 2001).

Offerman and Nieberg (2000), reviewing prices in 18 European countries, found substantial variation amongst countries. They concluded that it is difficult to calculate an average organic farmgate price, even within a country, because there are a large number of sales channels for organic products (amongst which prices vary considerably) to which producers have unequal access. Their conclusion was that the price premium received by an organic producer will depend on both the consumers' willingness to pay a premium for an organic product and the producer's ability to access marketing channels that capture that premium and to meet the quality requirements of that channel.

In most European countries the farmgate price for organically produced wheat has typically been 50 to 200 per cent higher than for conventionally produced crops (Offermann & Nieberg 2000), whereas premiums for organic livestock products are generally smaller. Premiums for organic milk in Europe ranged from eight to 36 per cent, and prices for organic beef were in most cases on average 20 to 30 per cent higher than the conventional prices (Offermann & Nieberg 2000). In New Zealand, Christensen and Saunders (2003) found that retail prices for organic milk were 51 per cent higher than conventional milk prices. In Great Britain and Germany 40 to 75 per cent of organic arable farm profits are attributed to price premiums for organic products, whereas 10 to 50 per cent of dairy farm profits are derived from these premiums (Offermann & Nieberg 2000).

Costs

Total costs for operating most organic farming systems are lower than those for comparable conventional farms, and there are differences in the relative importance of individual cost elements. The restrictions on the use of fertilisers, pesticides and feed concentrates on organic farms result in reductions in these costs of production (Morris 2001). Mader et al (2002) found that inputs of fertilizer and energy were 34 to 53 per cent lower and pesticide inputs 97 per cent lower on organic than conventional farms in 21 European countries. Shortly after the first oil shock in the 1970s, research in the USA found that organic farms used far less energy to produce maize, a finding that did not hold for soybeans (Klepper et al. 1977).

Reductions in machinery depreciation with reduced fertiliser and spray application on organic farms may be offset by the additional use of mechanical weed control and tillage (Morris 2001). On the other hand, organically produced inputs, such as feedstuffs and seeds, often incur higher prices, reducing these benefits and, as inputs such as herbicides are replaced by labour in organic systems, wages and salaries are often higher under organic systems (Offermann & Nieberg 2000). Registration and certification fees are an additional fixed cost in organic farming.

Although organic farming does provide opportunities for cost reduction, capitalising on them requires farmers to be well acquainted with organic farming both conceptually and practically (Tzouvelekas et al. 2001). Many organic farmers simply replace chemical inputs with purchased organic equivalents, thereby leaving their cultivation practices and cost structures, largely unaltered

Anecdotal evidence suggests that as the organic sector grows, production (as well as processing, delivery and retail) costs per tonne are decreasing over time (Moran 2001).

Profitability

The relative profitability of organic and comparable conventional farms in the EU has generally been found to be similar on average, although there has been considerable variability within samples and amongst countries and farm types. Nieberg and Offermann (2003) found arable farms in several EU countries to be more profitable than conventional farms because of the high price premiums realisable in the last few years and the Common Agricultural Policy (CAP). CAP measures such as compensatory payments, which are linked to production area rather than the amount of production, effectively reduce the difference between conventional and organic farm revenues (Offermann 2003). On dairy farms, however, profitability per hectare was generally lower on organic farms, although profits per family work unit were generally equal to or higher than those of comparable conventional farms.

Research in the USA has explored the comparative profitability of conventional and organic management systems. Early research compared the revenue, cost, and net return per cropping acre on mixed crop-livestock farms in the Corn Belt of the USA (Klepper et al. 1977). The comparison found that net return per acre was the same across conventional and organic systems, despite differences in gross returns and costs. A more recent review of research on the comparative profitability of organic and conventional farming found that the results have been mixed (Klonsky & Greene 2005). Some studies found that organic production relied on a price premium to be as profitable as conventional production, while other research found that organic production did not require the premiums. In addition, locality, crop, and weather all played roles in the comparative profitability of the two management systems.

Organic profitability often depends on the application of knowledge of organic farming principles and techniques that optimise input–output ratios in production (Tzouvelekas et al. 2001). Lansink, Pietola and Backman (2001) believe that organic farms are on average more efficient relative to their own technology, but use less productive technology than conventional farms. This was illustrated in an economic and technological comparison of organic dairy farming systems with conventional dairy farming systems (defined here as the prevailing high-technology, high-intensity) in the province of Ontario, Canada over a three-year period (Stonehouse, Clark, & Ogini 2001). The study revealed superior technical performance on conventional farms, as measured by milk yield per cow, milk shipments per hectare of land and per person equivalent. In contrast, economic performance was found to be superior on organic farms, by virtue of the much lower costs of production for almost all material inputs, including dairy herd replacements and livestock feeds. The lower costs were rooted in an apparent bid by organic dairy farmers to be as self-sufficient as possible in plant nutrients, animal nutrients and replacement livestock.

In some countries, subsidies increase the profitability of organic farms relative to conventional farms. The EU provides support payments to organic farming, but the eligibility for, and level of, these vary significantly amongst countries. Many countries support both conversion to and continuation of organic farming (Nieberg & Offerman 2003), but in France and the United Kingdom only conversion is supported. For the few EU countries for which data were available, payments ranged from 15 per cent of total profits in Denmark to 26 per cent in Germany.

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Tzouvelekas, Pantzios, and Fotopoulos (2001) provide a good example of how the factors discussed in the previous sections contribute to farm profitability in their analysis of Greek olive growing farms. Despite an average price premium for organic olive oil of 20 per cent, and an additional subsidy of 15 per cent, the average revenue was 3 per cent lower on organic farms as a result of the considerably lower (approximately 29 per cent) yields achieved by organic producers. However, as total costs on organic olive farms were approximately 11 per cent lower than on conventional farms, reflecting lower labour, rent, fertiliser and pesticide costs, the average gross profit of the organic farms was 1,020 drachmas/0.1 hectare ($NZ 62/hectare) compared with a loss of -8,940 drachmas/0.1 hectare (-$NZ 540/hectare) on conventional farms.

In conclusion, many studies have shown that organic farming can be a financially viable alternative to conventional farming practices in a range of circumstances and farming sectors. Although in most cases conventional farming systems are higher yielding, lower inputs, particularly of fertiliser and pesticides, under organic farming systems often compensate for the yield impacts on revenue. Price premiums for organic produce also make a major contribution to the financial viability of organic farming systems, and in some countries, subsidisation contributes to the economic viability of organic agriculture.

Methods

The ARGOS (Agriculture Research Group on Sustainability) research group is an unincorporated joint venture of the AgriBusiness Group, Lincoln University and the University of Otago. It was formed in 2003 to undertake a six-year research programme to examine the environmental, social and economic sustainability of contrasting faming systems in several of New Zealand's agricultural sectors. Research in the sheep/beef and kiwifruit sectors, which is the subject of this paper, involves comparison of three farming systems. The research programme commenced in October 2003.

In 2003, twelve clusters of three farms were selected in both the kiwifruit and sheep/beef sectors. They were selected on the basis of geographic proximity; farm size; willingness of farmers to participate in an intensive long-term study; and growers' involvement with market audit and certification schemes. The audit and certification schemes impose and/or prohibit particular farm management practices and, as such, may be expected to change the relative magnitudes of costs incurred. The organic farms were selected on the basis of their participation in a third-party certification scheme, such as BioGro or Agriqual Organic. In the design of the project, there was no attempt to categorise the organic farmers as taking either a 'shallow' or a 'deep' approach (Hill 2000). However, sociological interviews and qualitative assessment during the project will allow the financial results reported in this paper to be integrated into a transdisciplinary analysis to examine relationships between farmer attitudes and financial variables.

An objective of the financial analysis is the estimation of the extent to which farm management system influences financial sustainability. The management panels, comprising one farm from each cluster, are defined as:

- Sheep/Beef sector: (1) certified organic; (2) integrated - involvement in a quality-assurance audited supply chain; and (3) conventional - minimally audited.
- Kiwifruit sector: (1) certified green organic (Hayward); (2) GlobalGAP certified gold (var. Hort 16A); and (3) conventional - GlobalGAP certified green (Hayward).

The financial data for four farming seasons, 2002/03 to 2005/06, have been analysed to test the null hypothesis of ARGOS that there are no significant differences in the economic outcomes of the management systems on the participating farms and orchards.

Annual farm accounts tend to be the main source of financial data from farmers. In ARGOS, farm accounts have been collected for each of the four farming seasons. However, as these are prepared primarily for taxation purposes, they usually fail to provide a clear and current picture of the operation and some changes to accounts data have been required. In most cases the data obtained from farm accounts have been supplemented with information obtained from farmers and accountants in order, for example, to reallocate costs to categories that are more meaningful in a management sense than the accounting categories commonly used. The integrity of the "bottom-line" reported in the accounts has, however, been preserved in all cases. In order to take a "whole-farm-entity" approach that evaluates all farms

on the same basis, irrespective of the ownership and operating structures involved, all internal transfers have been excluded, and the income, costs and capital streams of all entities involved have been aggregated.

Most schedules of farming assets are prepared on a “depreciated historical cost” basis, which, although not likely to lead to major value distortions when applied to plant, machinery and other fixed assets on sheep/beef and kiwifruit orchards, is not appropriate for ascertaining current capital values. Instead Quotable Values New Zealand Ltd has supplied annual updates of capital values for each ARGOS property, based on the most recent Government valuations and the local knowledge of district valuers. On many of the kiwifruit farms it has not been possible to obtain capital data since the ARGOS orchard is only a small part of a much larger fruit-growing or packing enterprise and no separate data are available.

In comparing the sustainability of business growth and operation across farms it was necessary to assess the extent to which the final cash result was achieved at the expense of non-cash items. These included unpaid family labour and other non-cash items such as feed reserves and soil fertility. Adjustments to farm accounts were made where it was possible to value those resources. To date “Wages of Management” have been calculated using the approach advocated by the Ministry of Agriculture and Forestry for each of the industries. Unpaid labour over and above the management role that has been reported by farmers has been charged at the prevailing average wage for each industry. Data on feed inventories has been incorporated since 2004/05. Finally, changes in soil phosphate levels have been valued in dollar terms for kiwifruit farms, but insufficient data are available to date to do so for sheep/beef farms.

On several properties a major enterprise other than those normally associated with that farm type is carried out (e.g. contracting) and the resources it uses could not be separated from those devoted to farming. The resource costs and returns from these ventures could not be excluded from the analysis.

One data limitation has been that of the 12 integrated orchards, 6 produce only gold kiwifruit, while six grow both green and gold kiwifruit. As the latter are not able to provide separate data on their gold and green enterprises, they have been excluded from the financial analysis. Of the six gold-only orchards, only four have provided financial data. Although this limitation affected the comparison between integrated (gold) orchards and the other systems, it did not affect the comparison between organic and conventional production of Hayward kiwifruit.

Analysis of Variance (unbalanced treatment structure) was conducted to determine whether there were significant differences across panels with respect to financial variables. The analysis was conducted firstly for each individual year, then using the entire dataset converted to real 2005/06 values using the Consumer Price Index (all groups). The treatment was the management system. The farm cluster was treated as a blocking variable to account for differences in location, and, in the case of the sheep/beef panels, the emphasis on cash cropping as a source of farm revenue. In the real value analysis the season was included as a blocking variable.

In addition, power analysis (Bausell & Li 2002) was conducted to assess the power of the data to evaluate the null hypothesis. Power analysis considers the variability of the data and the sample size to investigate the ability of the data to detect differences between means. It also provides an indication of the sample size that would be necessary to detect a statistically significant difference.

Results

For any individual year, relatively few significant differences were detected across the three panels (organic, conventional, and other) in either sector with respect to a range of income and cost aggregates and individual cost variables. The results presented in this section are the results of “real value” analysis of all four years’ data, in which all costs and returns were converted to 2005/06 values using the Consumer Price Index for New Zealand so that the complete dataset could be analysed. In this analysis a number of significant differences were detected amongst panels, particularly with respect to individual cost elements in the sheep/beef analysis and yield, price, income and cost aggregates in the kiwifruit analysis.

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Yields, Prices and Revenues

The variability of the production systems on the sheep/beef farms included in ARGOS has made comparison of prices received and yields achieved extremely complex and work in this area is continuing to further clarify this. A wide range of products is produced by these farms including beef and sheep meats of differing grades, livestock sold prime or store, and wool of differing micron counts. Inventory changes from year to year are often large. Analysis of real cash returns to livestock production per livestock unit wintered and the real returns including inventory change per livestock wintered was undertaken, but no significant differences were found amongst management systems. There was large variation within all panels with respect to these variables. No significant differences in real cash revenue (CFR) per hectare or real gross farm revenue (GFR) were found. Income, cost and profitability aggregates for the sheep/beef panels over the four years from 2002/03 to 2005/06 are shown in Figure 1.

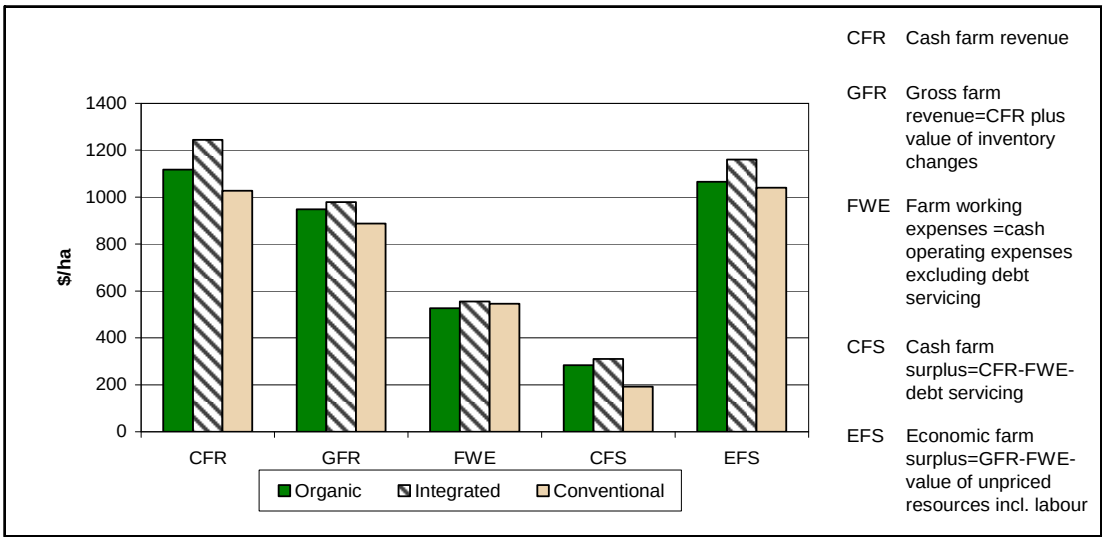

Figure 1. - Sheep/Beef panels mean values over four years – major financial aggregates (Real NZ$ 2005/06 values)

The yields of gold kiwifruit, particularly in the later seasons as orchards reached maturity, were found to be significantly higher than those of conventional or organic orchards. Although organic orchards consistently produced lower yields than those under conventional management, these differences were not statistically significant. Significant differences were found in the prices paid for kiwifruit under the three management systems with organic fruit returning more than gold kiwifruit, which in turn returned more than conventional fruit. The mean prices received ($ per tray) and yields produced (trays per hectare) under each management system are shown in Figure 2 (the gold kiwifruit orchards are labelled as 'integrated' or 'int.' in these figures). The low mean yield in 2003/04 for gold orchards was the result of very low yields on two large orchards.

The significantly higher yields of gold kiwifruit and its price premiums over conventional fruit (although not organic fruit) resulted in significantly higher Gross Orchard Revenue (GOR) (which on kiwifruit orchards is the same as Cash Orchard Revenue [COR], since no inventory is held between financial years). Orchard-gate return for kiwifruit (OGR) per hectare on gold orchards was higher than on green kiwifruit under conventional or organic management. Although the price premiums for organic fruit were significantly higher than for fruit produced under the other systems, significantly lower yields may explain the lack of significant difference in revenues between organic and conventional kiwifruit orchards. The GOR and OGR, as well as cost and profitability aggregates for the kiwifruit panels over the four years are shown in Figure 3.

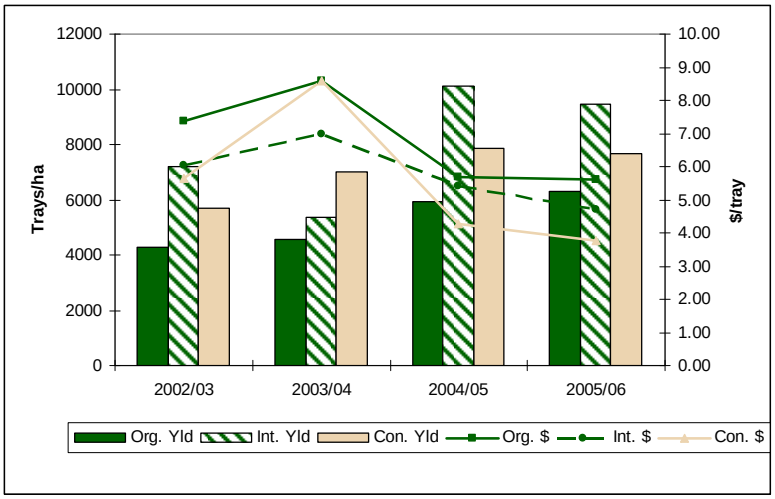

Figure 2. Kiwifruit yields and prices under differing management systems 2002/03 to 2005/06

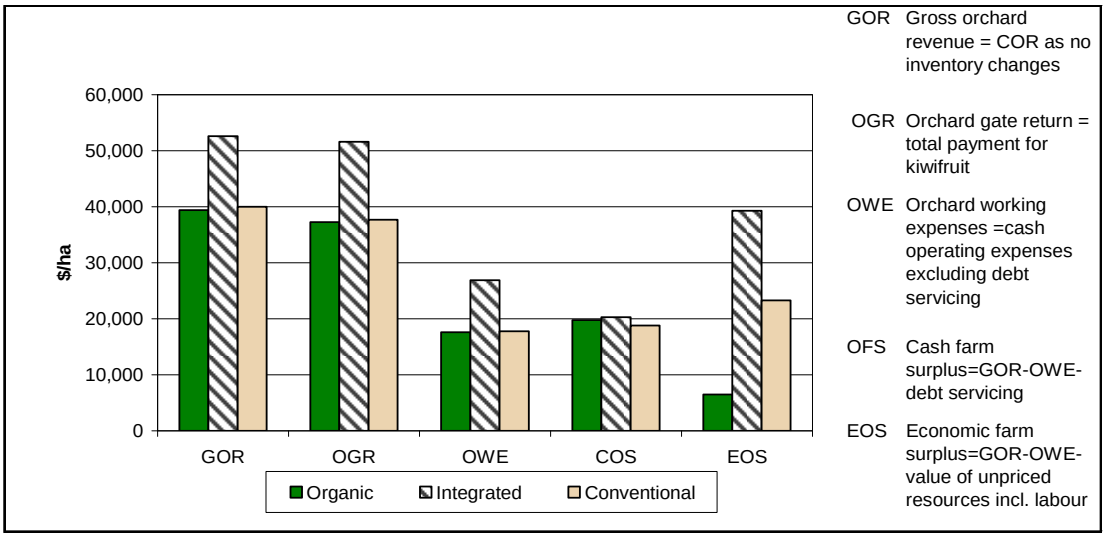

Figure 3. - Kiwifruit panels mean values over four years – major financial aggregates (Real NZ$2005/06 values)

Cost measures

Amongst the sheep/beef panels there were no significant differences in total farm working expenses (FWE). A number of significant differences were detected, however, in individual cost elements. Lower inputs of animal health products and fertiliser on organic farms have led to their significantly lower stock and fertiliser costs. Feed costs were higher on conventional than organic farms, probably reflecting the difficulty of purchasing organic hay and silage in many areas. That they were not also higher on integrated farms may well be because of their greater use of fodder crops. It was difficult to separate the costs of fodder crops from the costs of pasture renewal and maintenance, which were significantly higher on integrated farms than in the other panels. Total labour costs (paid and un-paid, including farm family labour) were found to be significantly lower on conventional farms. It should be noted, however, that there are reservations about the accuracy of the data on un-paid labour hours.

Other differences have yet to be explained. Overhead costs were higher on conventional than organic farms, despite the inclusion of organic certification costs under this heading for organic properties. The higher level of “other” working expenses on conventional farms did not appear to reflect a consistently higher level of any one of the costs included in this total. The significance of the differences found is shown in Table 1.

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Cost element	Significance of difference	Difference
Stock expenses	1%	(C,I)>O
Cash feed expenses	5%	C>O, C=I, I=O
Total labour expenses	1%	(I,O)>C
Pasture expenses	1%	I>(C,O)
Fertiliser expenses	1%	(C,I)>O
Overhead expenses	5%	C>O,C=I,I=O
Other working expenses	1%	C>O, C=I, I=O

Table 1. Sheep/Beef panel significance of differences in individual working costs

The relative magnitude of each of the elements of cash FWE for the sheep/beef panels is shown in Figure 4.

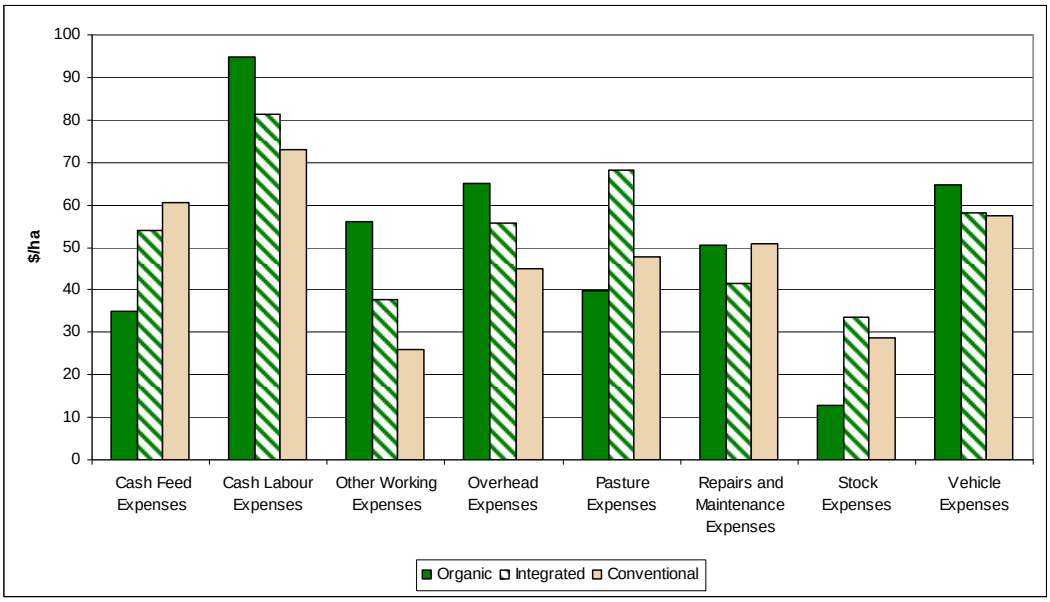

Figure 4. Cash Farm Working Expenses sheep/beef panels (Real NZ$ 2005/06 values)

The cash costs of labour comprised the largest element of total cash costs for each panel. On the conventional farms in the study, the next largest element of cost was feed (purchased and conserved), whereas pasture maintenance costs were much lower. The reverse was true on the integrated farms, although in both panels the total of pasture and feed costs was approximately 20 per cent, whereas on organic farms these two elements of stock feeding were significantly lower (approximately 14 per cent).

The differences found for the main categories of orchard expenses are summarised in Table 2. On gold kiwifruit orchards, the higher costs of picking and managing the higher-yielding fruit resulted in significantly higher total orchard working expenses (OWE) than those of the other panels; but fewer significant differences were detected in the levels of individual orchard costs amongst the kiwifruit panels. Labour costs were significantly higher on gold orchards than on other orchards, reflecting the costs of picking the high yielding gold kiwifruit crop. Fertiliser expenses were significantly lower on conventional orchards than on higher yielding gold orchards or on organic orchards, where composting costs were often high. Overhead expenses were higher on organic than conventional and gold orchards. This may have reflected the costs associated with organic certification. The only other difference detected at this level of analysis was that vehicle costs were significantly higher on organic orchards,

perhaps reflecting, in part, the extra numbers of operations required to apply compost and fish oils on these orchards.

	Significance of difference	Difference
Cash labour expenses	1%	Go>Gr>O
Total labour expenses	1%	Go>(Gr,O)
Fertiliser expenses	1%	(Go,O)>Gr
Overhead expenses	1%	O>(Gr,Go)
Vehicle expenses	1%	Gr>O,Gr=Go,Go=O

Table 2. Kiwifruit panel – significance of differences in individual working costs

The components of OWE for each of the kiwifruit panels is shown in Figure 5. Labour costs were the dominant element of OWE in all panels, but particularly in the integrated (gold) panel.

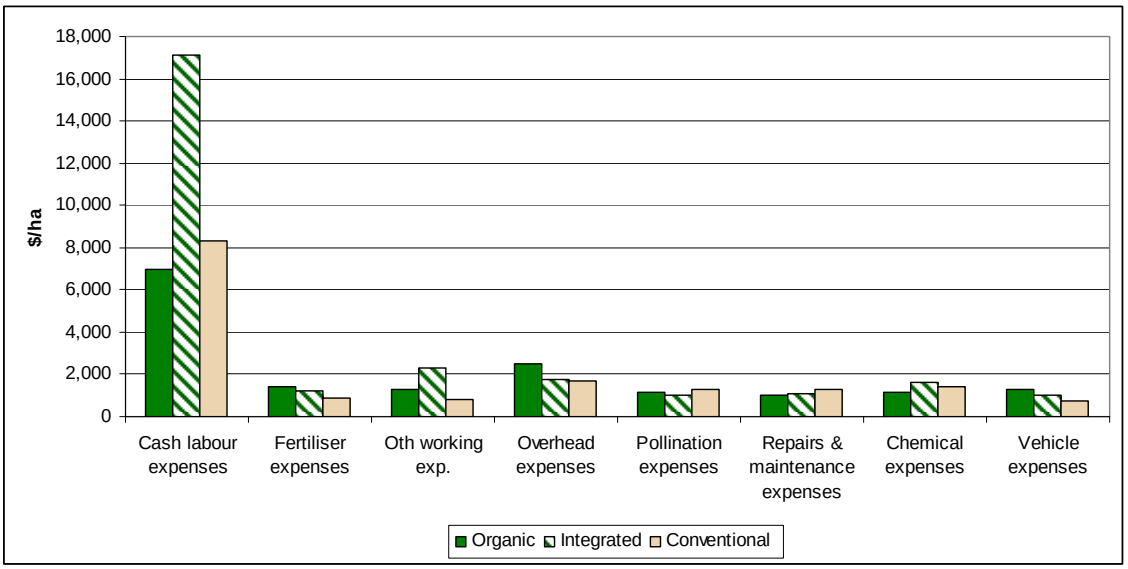

Figure 5. Cash Farm Working Expenses kiwifruit panels (Real NZ$ 2005-06 values)

Profitability measures

For all farms, the Cash Farm/Orchard Surplus (CFS/COS) and Economic Farm/Orchards Surplus or Operating Profit (EFS/EOS) have been calculated. These are shown in Figures 1 and 3. Despite the differences in costs and returns found, no significant differences could be detected, however, amongst sheep/beef or kiwifruit panels with respect to the "bottom-line" profitability variables CFS/COS and EFS/EOS.

Power analysis was conducted to assess the ability of the data to evaluate the null hypothesis. Very low power values indicated that the variability within panels is, in general, very much greater than the variability across panels in both sectors. For example, in the sheep/beef sector analysis the difference between minimum and maximum CFS for each panel is approximately $1,000 per hectare (ranging from $11,428 to $36,719 in the kiwifruit panels), whereas the largest difference between panel means (organic and gold) was only $213 ($5,803 for Kiwifruit) in 2005/06. If between-panel differences do exist, their detection would probably require the analysis of very large samples. The variability between and within panels with respect to real CFS/COS is shown in Figure 6. A similar pattern is shown with respect to both CFS/COS and EFS/EOS in all years.

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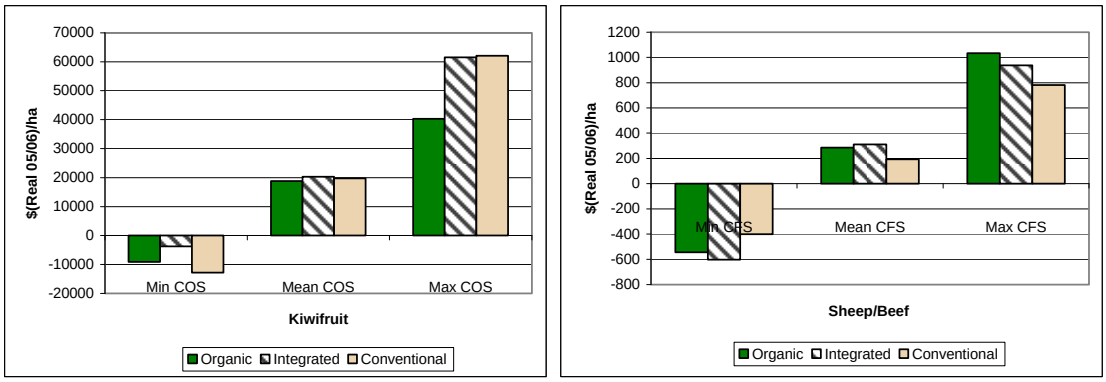

Figure 6 – Variability in Cash Orchard/Farm Surplus between and within kiwifruit and sheep/beef panels 2005/06

A range of ratios traditionally used as key performance indicators of profitability, efficiency, solvency and liquidity were calculated and tested for between-panel differences in both sectors. Only the debt servicing ratio, (interest and rent divided by gross farm income) differed significantly across the sheep and beef panels. The higher debt servicing ratio on conventional farms suggested that this panel has a higher level of vulnerability than organic and gold farms. On organic kiwifruit farms, the ratio of OWE to GOR was significantly higher, indicating a higher level of cost to produce at a similar level of income.

Discussion

The results of the analysis of four years of financial data from the sheep/beef and kiwifruit ARGOS panels showed that there were a number of significant differences in individual costs and returns. However, significant differences in profitability across panels in either sector were not found. Power analysis showed that, because of the large variation within panels with respect to these variables, the panel sizes required to demonstrate statistically significant differences would be beyond the scope of an intense monitoring project of this type.

Agriculture in New Zealand is extensive and low-input by international standards; financial differences across management systems may be different for intensive monocultural systems. In addition, New Zealand's larger horticultural industries have incorporated a range of integrated pest management practices into what are considered "conventional" production systems in order to meet market requirements. In the arable and pastoral sectors, particularly in least-cost industries such as the dairy sector, if an organic practice is shown to be effective and lower-cost than conventional practice, it will be adapted for inclusion into conventional systems. These changes blur the distinctions between organic and conventional systems and therefore potentially reduce the differences in financial performance.

The financial results presented here are now being incorporated into an analysis of the relationships amongst economic indicators and environmental and social indicators. The research is examining differences both within and across panels to investigate concepts of sustainability and resilience. The financial monitoring also continues in the background. It is hoped that greater understanding of these relationships will shed light on the factors that contribute to the resilience of New Zealand farming systems.

This research has been unable to reject its null hypothesis, which can be an unsatisfying result. The absence of between-panel differences and the high level of within-panel variation is, however, consistent with both the international literature and New Zealand farm management knowledge. This result leads to more questions. If farm profitability is not significantly affected by the choice of management system, then the sources of differences must be located elsewhere. Across all farmers, the range of management skills, adaptive behaviour, and learning patterns – key determinants of farm financial sustainability – is very wide in any sector. These are some of the aspects of the ARGOS farms that sociologists in the project are now exploring.

Acknowledgments

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