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**COMPARISON OF THE PRODUCTIVITY AND PROFITABILITY OF ORGANIC AND
CONVENTIONAL FARMS IN THE NEW ZEALAND SHEEP/BEEF AND KIWIFRUIT SECTORS
2002/03 TO 2007/08**

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Abstract

Organic industries world-wide have been expanding rapidly over the past decade but there has been comparatively little recent discussion of the relative financial performance of organic and conventional farming systems. If organic agriculture is to contribute to improved environmental and economic outcomes in New Zealand in future, this is an issue of considerable importance to farmers considering organic conversion. The Agriculture Research Group on Sustainability (ARGOS) has been examining the sustainability of organic and conventional land-use systems in New Zealand, by monitoring the comparative performance of these production systems with respect to a wide range of environmental, social, economic and management parameters over the last seven years. Financial data from matched clusters of sheep/beef farms from the east coast of the South Island and clusters of kiwifruit orchards, mainly located in the Bay of Plenty, have been analysed on their own and in conjunction with social data to identify differences in farm financial performance. In this paper a brief summary of international conclusions on relative organic profitability precedes the description of the results of the first six years' ARGOS monitoring of farm financial performance in the sheep/beef and kiwifruit sectors. The results show that, while there are some significant differences in farm costs and revenues between farming systems within a sector, there is greater variability in the "bottom-line" indicators of profitability within farming systems than between them and few conclusions can be drawn about relative profitability. Analysis of the data suggests that the characteristics of individual farmers may have more influence on farm financial outcomes than the management systems they adopt.

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

Introduction

Despite the consistent expansion of organic industries world-wide in recent years, there has been little recent discussion of the relative financial viability of organic and conventional (not organic) farming in the literature (Greer et al, 2008). However, if organic production is to be encouraged as one of the future pathways to agricultural sustainability, through the delivery of positive environmental outcomes and health benefits for consumers, prospective producers will need to consider the financial implications of organic conversion.

This paper discusses the results of the analysis of six years of financial data on organic and conventional sheep/beef and kiwifruit farms that has been collected as part of the ARGOS (The Agriculture Research Group on Sustainability) programme. ARGOS is a collaborative research programme that involves intensive long-term monitoring of panels of farms to examine the sustainability of selected New Zealand farming systems, and to develop a better understanding of the consequences of differing production systems. The ARGOS null hypothesis, that environmental, economic and social and management characteristics do not differ significantly between different management systems on the participating farms and orchards has been evaluated by teams of researchers from each of the disciplines involved, and the current thrust of the research is the synthesis of the results from each of the objectives. The financial analysis has examined firstly the differences in financial performance that are attributable to management system and, secondly, the

possibility that factors other than management system may be more important determinants of financial outcomes.

International comparisons

A literature review by Greer et al (2008) found comparatively few published comparisons between organic and conventional production from the last five years but a number of earlier comparisons of yields, prices, costs, and profitability.

In general these studies have found:

- The yields of organic crops and per hectare organic livestock production to be lower than under conventional management systems (Morris et al, 2001).
- Product prices, which are a major determinant of financial performance, are highly variable between countries (Offerman and Nieberg, 2000), but a high proportion of organic arable farm profits is usually attributable to organic price premia while premia for organic livestock products are generally rather lower. The impacts of increasing supply on organic premia will be an important influence on long term industry viability.
- Total costs are generally lower on organic farms than on comparable conventional farms and there are significant differences in the patterns of costs that relate to the restrictions imposed by organic certification. In some organic systems inputs such as herbicides are replaced by labour (Morris et al, 2001) and labour costs are, therefore, higher (Offerman & Nieberg, 2000).
- Profitability is similar on conventional and organic farms in the EU, although there is considerable variability within samples, between sectors and between countries.

Analytical Approach

At the outset the ARGOS programme monitored twelve clusters (36 farms) of sheep/ beef farms and twelve of kiwifruit orchards. Each cluster comprised three farms, conventional, organic and “integrated”, matched on geographic location and farm size.

The management system definitions employed were:

- Sheep/Beef sector: Organic - certified organic; Integrated -involvement in a quality-assurance audited supply chain; Conventional, minimally audited.
- Kiwifruit sector: Organic - Certified Green organic (Hayward); Integrated - GlobalGAP certified Gold (Hort 16A); Conventional - Global GAP certified Green (Hayward).

The sheep/beef farms included in the study were located along the east coast of the South Island from Marlborough to Southland, although all three of the Marlborough properties have dropped out following landuse change. All but two kiwifruit clusters were located in the Bay of Plenty with one cluster each at the northern (Kerikeri) and southern (Motueka) ends of the growing region.

There has been some attrition amongst study participants, particularly during the last two seasons, as a result of farm sales and dairy farm conversions, and the complexity of some vertically integrated kiwifruit operations meant that orchard-level financial data were never available. In total 23 sheep/beef farms remained in the study by 2007/08 and financial data were still available from 19 kiwifruit orchards by that time.

Earlier analysis (Greer et al, 2008; Greer et al 2009) found that there were no systematic differences in financial performance between the conventional and integrated sheep/beef farmers. Evaluation of their farm management practices has suggested that there is little consistent difference overall in

the management systems employed by farmers in the two panels during the period, particularly in comparison to the differences between individual farmers within panels. In addition, there was greater attrition in the integrated panel than others and very large changes had occurred in the structure of some integrated farms before, for example, conversion to dairy production. These had a major impact on panel means. The very large yield differences between integrated and other kiwifruit management systems - a reflection of differences in varietal characteristics - dominated the kiwifruit analysis. Consequently it was decided to re-analyse the data to determine whether there were differences in financial parameters between organic and conventional farms only. To do so, the conventional and integrated results were aggregated for the sheep/beef sector while the gold results were removed from the kiwifruit analysis.

Farm accounts data have formed the basis of the financial analysis, but these data have been supplemented by additional information from farmers and their accountants in order to reallocate costs to categories that are more meaningful, while preserving the integrity of the “bottom-line” in all cases. Accounts data have also been adjusted to ensure that all cash and non-cash resources used in production, as well as all production, whether or not it has been sold at balance date, are accounted for in a consistent manner.

Major adjustments have included:

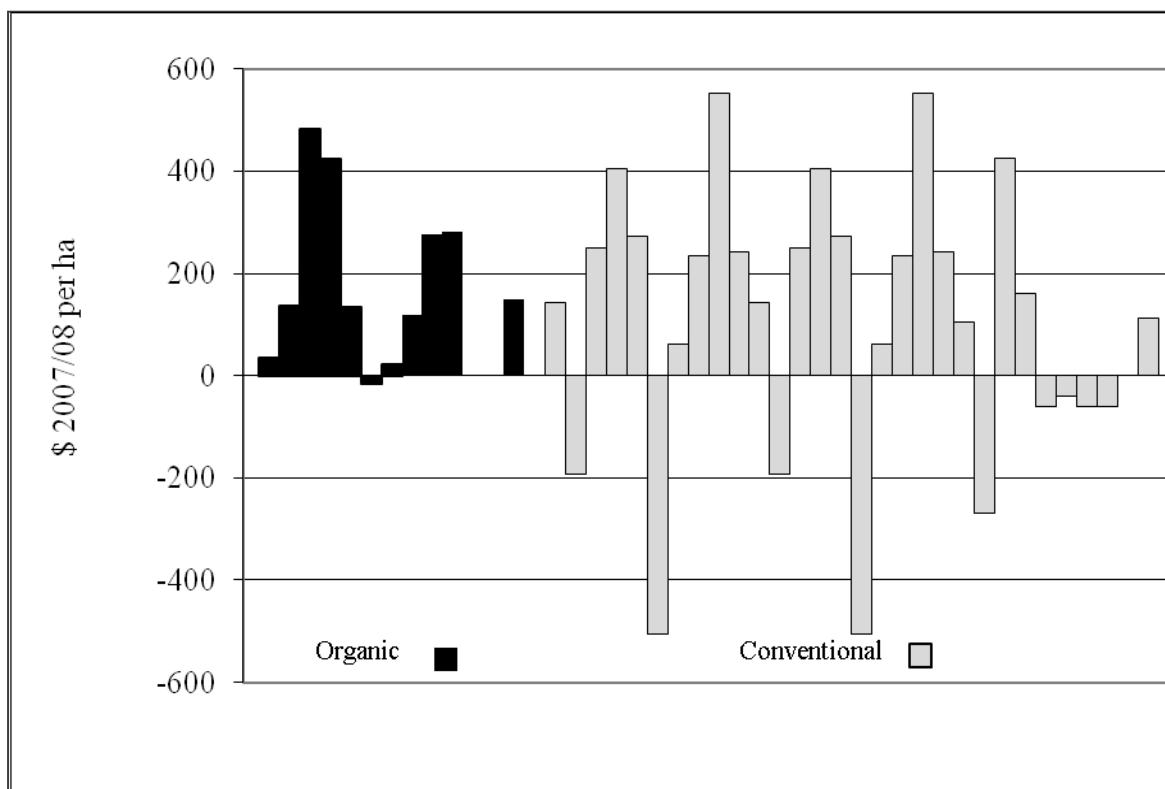
- The exclusion of all internal transfers and aggregation of the income, cost and capital streams of all asset-owning and operating entities involved in the farm;
- Revaluation of assets on the basis of the most recent Government valuations and the local knowledge of district valuers;
- Valuation of unpaid labour using farmer estimates of unpaid labour hours and the current hourly rates for farm labour;
- Valuation of Wages of Management using the MAF Farm Monitoring approach (MAF Farm Monitoring reports, various years);
- Valuation of changes in feed inventory at estimated market price for pasture equivalent dry matter;
- Revaluation of livestock at National Average Market Values (Inland Revenue, various years);
- Conversion of all accounts data to 2008/09 values has been undertaken using the Consumer Price Index (Statistics New Zealand, 2010).

Since the dataset does not include all farms in all years, the analytical approach selected was Analysis of Variance (unbalanced treatment structure). Analysis was conducted to determine whether there were significant differences in yields, prices, costs and profitability between management systems. In both the sheep/beef and kiwifruit analysis farm cluster was included as a blocking variable to account for differences in location, altitude, etc. Season was also used as a blocking variable since all years' data were analysed as a single dataset to increase the power of the analysis.

On the kiwifruit orchards kiwifruit revenue has accounted for 92 percent of total orchard revenue over the analysis period in both panels. On the sheep/beef farms there are multiple sources of income and a high proportion of the variability in financial parameters was accounted for by the proportion of revenue and costs generated by cash cropping, which varied markedly between farms. Cropping proportion was, therefore, included as a covariate in the sheep/beef analysis.

Throughout the analysis of the ARGOS financial data the high level of within-panel variability in the relatively small panels with respect to some variables, particularly measures of profitability, has been a barrier to determining whether a statistically insignificant between-panel difference supports the null hypothesis or is simply the result of low analytical power. This variability is well illustrated in Figure 1, which shows the variability in Net Farm Profit before Tax (NFPBT) on sheep/beef farms in a

single year, 2007/08. The difference between the estimated panel means is considerably less than the differences between highest and lowest values within either panel. In the absence of very large numbers of observations, this level of variability will result in low analytical power. The power of the analysis is its ability to reject a false null hypothesis, or, how likely it is that a response of a specified size would be detected. In designing experiments, sample sizes are usually set at levels that will result in analytical power of 80 percent. While the ARGOS financial analysis has identified a number of significant differences between panels, in general where no difference has been identified analytical power has been too low to accept the null hypothesis.



Prices

Work on relative prices received by organic and conventional sheep/beef farmers has been delayed by the difficulty of obtaining data required. The difference in the value of livestock output (including inventory change) per stock unit per between the ARGOS organic (\$61.33) and conventional farms (\$64.78) was not shown to be significant.

The average difference in the orchard-gate price received by organic and conventional kiwifruit growers in the ARGOS programme from 2002/03 to 2007/08 has been 46 percent and was statistically highly significant. This difference incorporates both the price premium paid by Zespri for organic fruit and quality differences in fruit grown under different management systems. Fruit quality losses have ranged from 1.7 percent to 11.6 percent in conventional fruit, and from 1.5 percent to 4.3 percent in organic fruit during the analysis period (ZESPRI™, various years).

Incomes

Although it is not yet possible to separate the influences of yield and price on the incomes of ARGOS sheep/beef farms, both CFR (Cash Farm Revenue) and GFR (Gross Farm Revenue – CFR plus value of inventory changes) are significantly ($F<.001$) lower on organic farms as Figure 3 shows. Estimated mean GFR per hectare on organic farms during the period has been \$954 per hectare, only 80 percent of GFR on conventional farms (\$1179 per hectare).

The higher average prices received for organic kiwifruit appear have offset the lower yields of organic orchards and resulted in similar total income levels (see Figure 3) but analytical power was too low to establish a true lack of difference in income measures between panels.

Costs

In both sectors there have been marked differences in the patterns of costs incurred on organic and conventional farms. Organic sheep/beef farms have significantly ($F<.001$) lower animal health, pasture, cash feed, total feed (including the value of feed inventory change) and fertiliser expenses than conventional farms. These reflect restrictions on the use of agrochemicals and availability of purchased feed in organic systems, and the fact that the organic farms have been stocked at considerably lower rates. Although the cash costs of farm labour on ARGOS farms are no higher on organic farms, when the value of unpaid labour is also included in the analysis the difference in total labour cost approaches significance ($F=.191$). This is consistent with the international experience (Morris et al, 2001). However, there are some concerns over the accuracy of some of the estimates of unpaid labour provided by farmers. Vehicle costs have been lower on organic farms ($F=.056$), probably reflecting lower use of vehicles for cultivation, feed conservation and feeding out.

On conventional kiwifruit orchards the significantly higher costs included spray/chemicals ($F=.004$), pollination ($F=.051$), and repairs and maintenance ($F=.042$). No explanation for the latter has been identified. Fertiliser costs are significantly higher ($F<.001$) on organic orchards because of the sector's dependence on costly compost and organic fertilisers. Overhead costs are also higher on organic orchards ($F=.001$) reflecting both the high costs of organic certification and the higher costs associated with information and education, etc. incurred.

Organic sheep/beef farms have lower total costs as well as lower outputs which is consistent with international findings. On organic farms both Farm Working Expenses (FWE) and Cash Farm Expenses (CFE) are approximately 75 percent of the mean levels on conventional farms (FWE=\$570 per hectare compared with \$741) and these differences are highly significant ($F<.001$) statistically. Figure 3 presents these values in relation to other financial aggregates.

However, this is not the case in the kiwifruit sector where comparatively small cost differences exist as Figure 3 shows, but low analytical power means that it is not possible to conclude that there are no between-panel differences in total costs. Estimated mean conventional Orchard Working Expenses (OWE) were \$20,325 per hectare compared with \$19,993 on organic orchards.

On sheep/beef farms the mean ratio of FWE to GFR was approximately 65 percent in both panels, but although the relatively large difference in the CFE to GFR ratio is not significant (88 percent on conventional farms compared with 80 percent on organic farms) this may be a reflection of low analytical power. These ratios are higher than farm management guidelines for financial sustainability (50 percent and 75 percent respectively). MAF Farm Monitoring reports show that this has been the case for New Zealand sheep/beef farms for some years. A significant difference in debt servicing ratios was identified between panels. Lower geared organic farms had an average debt servicing ratio of 15.6 percent compared with 19.5 percent on conventional farms.

It was not possible to detect significant differences in cost: income ratios between kiwifruit panels.

Profitability

While it was possible to determine that there is no significant difference between the Cash Farm Surpluses of organic and conventional sheep/beef farmers, there was insufficient analytical power to determine whether there were significant differences in Net Farm Profit before Tax (NFPBT). The difference in Economic Farm Surplus (EFS) was found to be significant over the six year period ($F=.043$). This finding is extremely important, since EFS is the return after all cash and non-cash resources used in production have been accounted for and is the most important indicator of relative profitability among those estimated. However, it should be noted that calculation of the EFS relies on valuing farmer estimates of unpaid labour employed on farms. In some cases these appeared to be higher than might be expected given farm size, topography, and stocking rates.

The between-panel differences in indicators of kiwifruit profitability (see Figure 3) were not shown to be significant, but low analytical power means that it is not possible to accept the null hypothesis on the basis of this result. Figure 2 shows the profitability measures and total income and cost aggregates on the sheep/beef farms while Figure 3 presents these measures for the kiwifruit orchards.

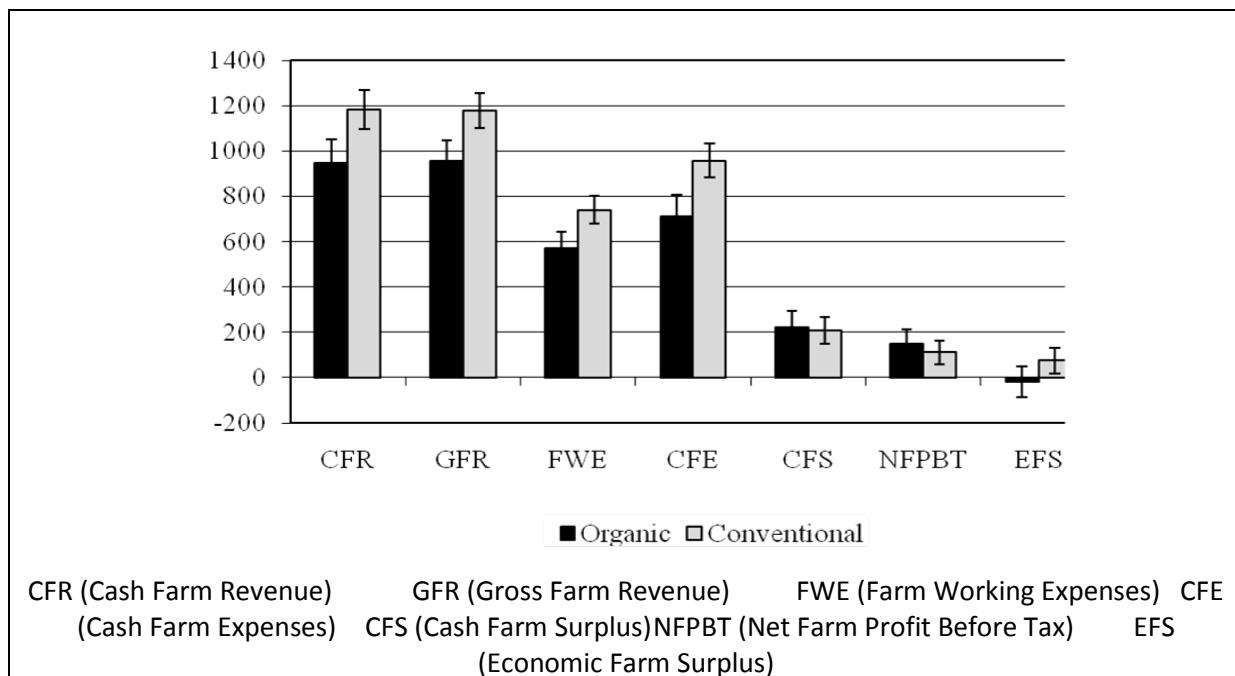
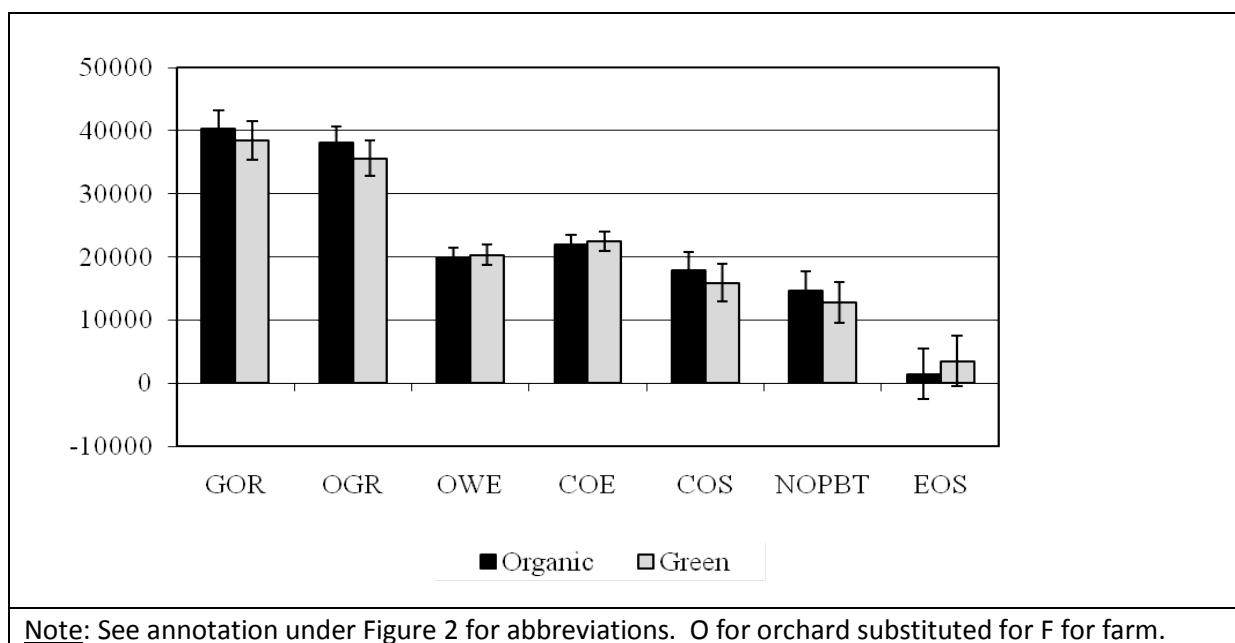


Figure 2: Sheep/beef Mean Financial Parameters (\$/ha) by Management System 2002/03 – 2007/08



Note: See annotation under Figure 2 for abbreviations. O for orchard substituted for F for farm.

Figure 3: Kiwifruit Mean Financial Parameters (\$/ha) by Management System 2002/03 – 2007/08 Farmer Typologies

Since the analysis was unable to identify differences in profitability between groups of farms within a sector that have been defined on the basis of management system employed, it was decided to see whether a different approach classification of farms could provide more explanation for differences in farm financial performance. During the farmer interviews the Q-sort methodology was used to get farmers to select the most important factors influencing their farming systems from a broad range of possible factors. A cognitive map, known as a “causal map” (Fairweather et al 2007) was prepared by each farmer to show how the economic, social and environmental factors, important to their farming systems, were integrated. From all the individual maps group maps were constructed for each management system using averaged data. Four separate cross-system groups were

identified amongst sheep/beef farmers. These were later simplified to two farmer typologies, Type A and Type B.

The maps of Type A farmers had fewer connections and less emphasis on environmental factors than those of Type B farmers, which, had more connections and particular emphasis on personal satisfaction, external factors, the environment and family. Fairweather et al (2009) described Type B farmers as having “a more profound view of their systems and this manifests wherever they focus their attention, whether it be family, environment or production”. The Q-sort analysis of kiwifruit orchardists identified two farmer typologies. These were Type 1 farmers (described as the “business” group) who gave more emphasis to post farmgate aspects such as customer satisfaction and requirements and post-harvest quality, and Type 2 farmers (described as the “lifestyle” group) who emphasised family needs, off-orchard activities and the orchard environment as a place to live (Fairweather et al, 2009).

Unfortunately it was not possible to identify directly comparable groups within the sheep/beef and kiwifruit panels because the factors that were most important to participants differed between sectors. However, members of both the Type A and Type 1 groups were more closely focused on business performance than those in the second group for each sector. Members of the Type B and Type 2 groups were influenced by a wider range of non-business factors. Table 1 shows the group compositions in both sectors. Unclassified farmers were either unavailable for the interview or unable to be fitted into either of the main groups defined for their sector.

While the majority of organic sheep/beef farmers were classified as having a broader social and environment focus, as might be expected, a greater proportion of organic kiwifruit growers were classified as Type 1 or business-oriented. The stringent organic audit system, and the close relationship between Zespri and these growers, ensures all aspects of post-harvest and market conditions are particularly important to them. As the larger group of conventional sheep/beef farmers were also classified as belonging to Type B the broadly-focussed Type B group comprised 60 percent of sheep/beef study participants while only 30 percent of kiwifruit participants were classified as Type 2.

Table 1: Q-sort farmer typologies by management system – sheep /beef and kiwifruit sectors.

Sheep/beef	Type A	Type B	Unclassified
Organic	2 (17%)	10 (83%)	0 (0%)
Conventional	7 (35%)	9 (45%)	4(20%)
Total	9	19	4
Kiwifruit	Type 1	Type 2	Unclassified
Organic	6 (55%)	4 (36%)	1 (9%)
Conventional	5 (50%)	2(20%)	3 (30%)
Total	11	6	4

Financial Results in Relation to Farmer Typologies

Re-analysis of the financial data on the basis of Q-sort score rather than management system produced markedly different results. In both sectors, profitability (as measured by all three indicators) was significantly higher on properties farmed by Type A/Type 1 farmers. Amongst sheep/beef farmers this was achieved by lower costs but not higher revenues, while the reverse was true of kiwifruit orchards on which revenues were higher on farms operated by Type 1 farmers but costs were not significantly lower. In both sectors estimated EFS was positive for Type A/Type 1

farmers but negative for Type B/Type 2 farmers. Figures 3 and 4 show the main financial aggregates for each sector.

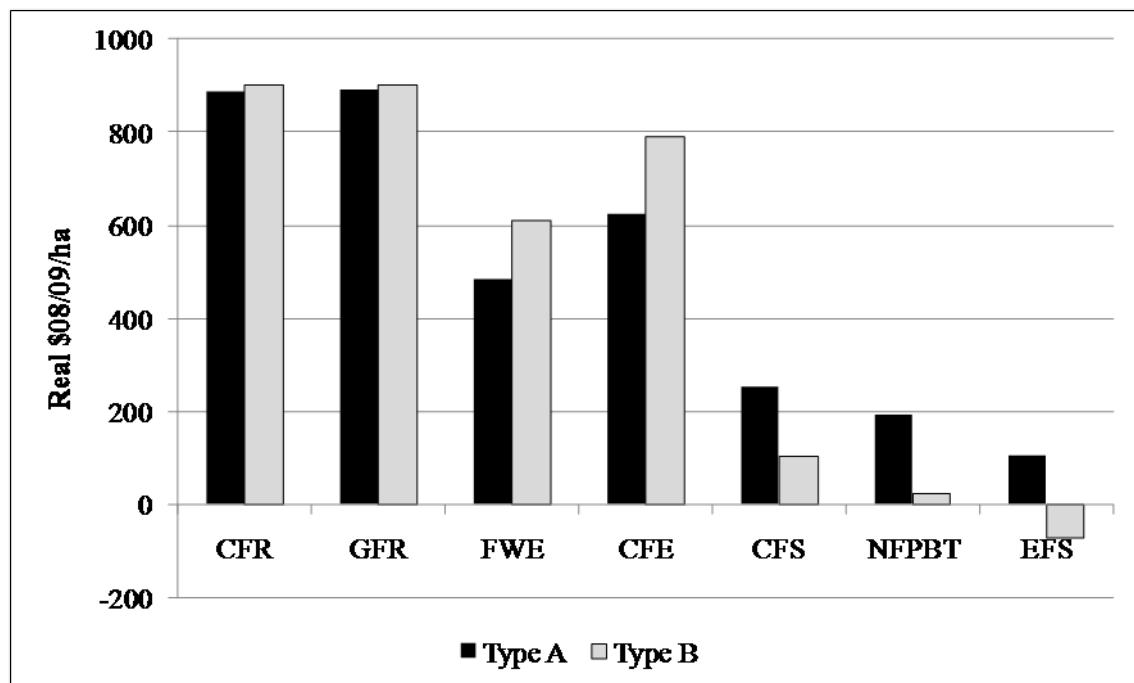


Figure 3: Sheep/beef Mean Financial Parameters (\$/ha) by Farmer Type 2002/03 – 2007/08

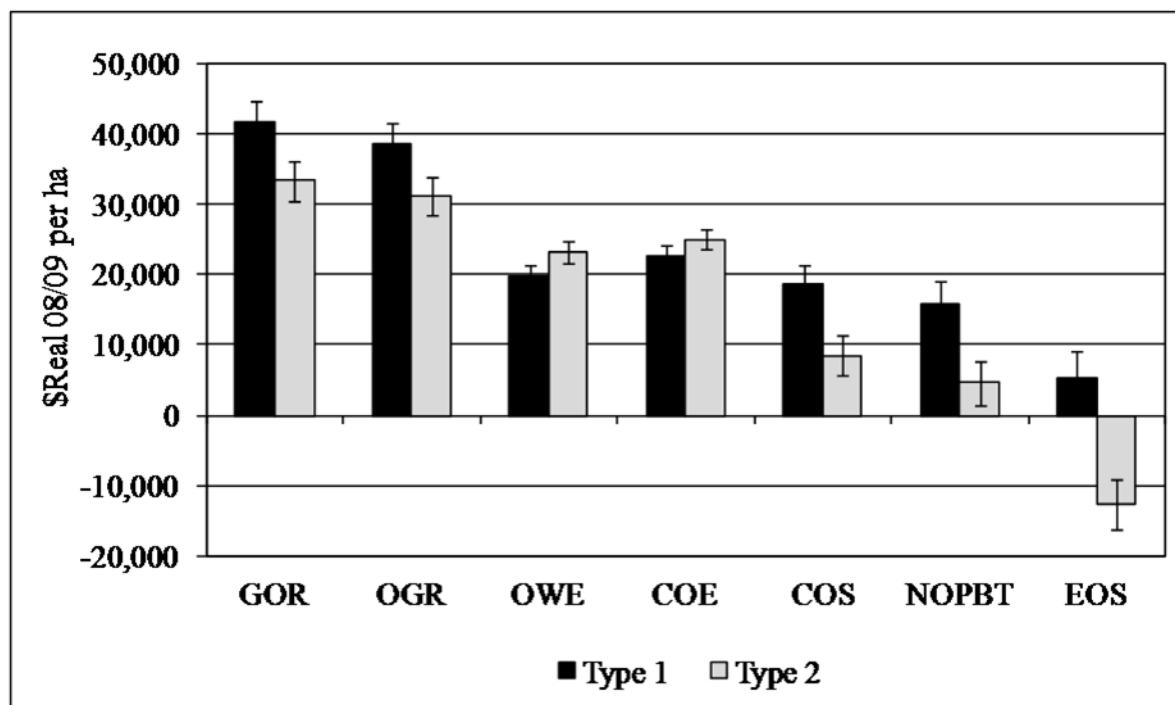


Figure 4: Kiwifruit Mean Financial Parameters (\$/ha) by Farmer Type 2002/03 – 2007/08

Conclusions

As international experience has shown, the high level of between-farm and between-sector variability in farm financial performance constrains our ability to make definitive statements about the relative performance of organic and conventional farm and orchard management systems.

The analysis of the ARGOS sheep/beef data shows clearly that organic farms are smaller and more lightly stocked than conventional farms and generate lower incomes per hectare and per farm. Not only are total costs lower on organic farms but the patterns of expenditure differ significantly between the farming systems, reflecting the limitations imposed by organic certification systems. The ARGOS organic sheep/beef farms conform to the international norm of lower input/lower output production but it is not yet possible to determine the extent to which price premia maintain total revenues. However, it is not possible to draw definitive conclusions about the relative profitability of the two systems. While the ARGOS data on the financial performance of sheep/beef farms does suggest that conventional farms have a higher return to all the cash and non-cash resources used in farm operation (EFS), doubts about the validity of labour data make drawing conclusions from this dangerous. No differences could be detected in estimates of mean NFPBT between organic and conventional farms but low analytical power means that it is not possible to say that no differences exist. We do know, however, that in most years the range of values of profitability parameters on organic farms lies within the range of conventional farms and that there is less variability between organic farms than between conventional farms.

On kiwifruit orchards lower outputs are not matched by lower inputs overall, although the pattern of inputs varies between management systems. Revenues are supported by price premia that reflect not only the level of demand for organic kiwifruit but also lower fruit quality losses. Because of the low analytical power the absence of differences in total costs, incomes or orchard profitability between kiwifruit panels cannot be assumed to support the null hypothesis that no differences in economic performance exist between panels.

However, despite the high level of between-farm variability in profitability, which has made detection of between-panel variation in profitability impossible, it has proved possible to differentiate the financial performance of farms on the basis of characteristics other than management system. Separation of farms by Q-sort scores has created groups that are significantly different with respect to farm profitability in both sectors. Farmers who have a narrower, more farm/business-oriented focus (Type A/Type1) achieve greater profitability through tight cost control rather than by generating significantly higher revenues in the sheep/beef sector, but in the kiwifruit sector it appears that higher incomes are responsible for the higher levels of profitability.

These findings are consistent with both New Zealand farm management understanding, and the findings in the international literature (Greer et al, 2008), that “the range of management skills, adaptive behaviour and learning patterns, which are key determinants of farm financial sustainability amongst farmers in any sector, is very wide and a skilled farmer is likely to achieve good financial results under any management or production system”.

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