AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

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Kiwifruit causal mapping in 2008: Comparisons to 2005 and to other sectors

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Summary

The Agriculture Research Group On Sustainability (ARGOS) is investigating the social, environmental and economic consequences of different management systems in different farming sectors in New Zealand (for more information visit www.argos.org.nz). The sectors being studied include kiwifruit, sheep/beef and dairy, and the systems being studied include conventional, integrated and organic management. Twelve farms under each system are being studied. In addition, there are eight high country farms included in the study.

As part of the ARGOS social objective, causal mapping was used to document how the participating kiwifruit orchardists described and explained the factors involved in their orchard systems, broadly defined to include economic, social and environmental factors. Participants identified which factors among those provided were important to the management and performance of their orchards and were asked to link these on a map. This method was first used in 2005 and then repeated with some modifications in 2008 in order to examine possible changes in orchardist's mapping over time.

All orchardists first completed a Q sort of 41 factors to identify the more important ones, then used these to create a map showing the important factors and the causal links between them. The strength of these linkages was also recorded on a 1 – 10 scale with one being weak and ten being strong. Centrality scores, the sum of the weightings of all the arrows entering and leaving a factor, indicate the importance of each factor. An overall or group map was produced by taking an average across the individual maps and this map characterised the overall orchard system. A similar process was used for each of the three management systems being studied, as well as two other groups of orchardists identified from Q-sort analysis.

Group map
The group causal map shows the central role of the orchardist as decision maker, with an emphasis on productions factors such as fruit yield and quality, vine health, fertiliser and soil fertility, and ZESPRI, and the financial factors orchard gate return and cash orchard surplus.

Analysis of goals and change questions
While the majority of orchards were in a similar if not identical position in 2008 compared to 2005, a minority were in a different position. The 2008 causal mapping results cannot be expected to be identical to 2005 results.

Panel results
- There is a very close match between the Green panel and the overall average.
- Organic orchardists had the most distinctive group map, and emphasised cash orchard surplus, satisfaction, fertiliser and soil fertility, orchard environmental health, vine health and family needs.
- Distinctive Organic connections included stronger connections from fertiliser and soil fertility to vine health, fertiliser and soil fertility to fruit yield and quality, cash orchard surplus to satisfaction, and orchard environment as a place to live to family needs.
- Gold orchardists emphasised orchard gate return, packhouse, post harvest quality and family needs.
- Distinctive Gold connections included stronger connections from packhouse to post-harvest quality, packhouse to orchard gate returns, orchard gate returns to cash orchard surplus, and exchange rate/macro-economy to orchard gate return.

Comparisons of panel results over time

Compared to 2005, the panel differences did not correspond well. There were two similar results and five dissimilar results for 2008 not found in 2005. Further, three significant differences were found in 2005 that were not found in 2008.

In both 2005 and in 2008 the Green panel maps was similar to the overall group map. In 2005 for the organic map there was only one factor with a higher centrality score – farm/orchard environmental health and this also occurred in 2008. However, a number of additional connections were highlighted as stronger in 2005.

There were few similarities between the distinctive attributes of the Gold panel in 2005 and 2008.

Compared to 2005 there were many clear distinctions for the organic panel.

Q-sort groups

Two groups were found with one emphasising a more business-like orientation and one emphasising family, and attributes to do with the orchard's location.

- Q-sort type 1 (kiwifruit business, n=20) emphasised post harvest quality, and supermarket/customer satisfaction.
- Q-sort type 2 (kiwifruit lifestyle, n=9) emphasised water supply and quality, orchard environment as a place to live, orchard location, family needs, off-orchard activities and retirement.
- Distinctive Q-sort type 2 connections included stronger connections from decision maker to family needs, and from cash orchard surplus to off-orchard activities.

Interpretation

The results were used to characterise how the orchard system works, to better understand differences between the 2005 and 2008 results and the Q-sort distinctions, and to discuss the implications of the results from a resilience point of view.

Chapter 1
Introduction: Background and Research Objectives

1.1 Background

A study of kiwifruit management was completed in 2005 (Fairweather et al., 2006) using causal mapping to show factors important in kiwifruit orcharding and how orchardists think about and manage their orchards. The method was then applied to sheep/beef farmers (Fairweather et al., 2007), to dairy farmers (Fairweather et al. 2008a) and to high country farmers (Fairweather et al. 2008b). In the latter three studies the method was applied in a slightly different way compared to the first kiwifruit study. In this report the revised method was applied to kiwifruit orchardists in 2008 so that a set of results using the same method is available for all the sectors studied.

The 2006 kiwifruit report (Fairweather et al., 2006) set out in detail the method and results of the study. It gave a full account of the literature on cognitive mapping relevant to farming, introduced fuzzy cognitive mapping (Ozesmi and Ozesmi, 2004), provided an evaluation of it and described how the mapping method was tested and developed. The subsequent reports, particularly the sheep/beef report, describe in detail the revised method. Since those reports provide full information about the causal map method, it is not necessary to repeat the details again in this report. Here, only the basic elements of the method are described, and emphasis is given to presentation of the follow-up mapping results, their analysis and implications, and to making comparisons between 2005 and 2008, and between orchardists and farmers in other sectors.

The causal map method used for the 2005 kiwifruit research employed a generic map that had the factors in a fixed position but allowed orchardists to draw arrows showing causal connections. Causal mapping can be improved by allowing farmers to create their own map by selecting and moving factors around and then connecting them up. Accordingly, the main change in the method, starting with the sheep/beef farmers, was to allow farmers to construct their own causal map from factors written on small cards. This was done to strengthen our claim that the map is a construct of the farmers. However, there needs to be some initial sorting process to prioritise the factors so that farmers can focus on mapping the important factors in their orchard system. Q method was used as a precursor to the mapping since it allows for subjects to prioritise items. It also allows for exploration of the other groupings of farmers.

1.2 Research objectives

The primary research objective was to document how orchardists participating in our ARGOS research describe and explain the management of their orchard system broadly defined. The research aimed to develop a full account of such perceptions by identifying the factors that comprise their orchard system and by showing how the factors are linked. Accordingly, it allows us to examine the degree and depth of ‘systems thinking’ by orchardists when managing their orchards. It does this by employing a modified cognitive mapping method in which farmers portrayed their view of their orchard system in the form of a map. The main modifications in the method were to allow for creation of the causal map and to precede the mapping with Q-sorting of factors. A second research objective was to assess the results for any patterns in the way farm systems are seen and understood. Specifically, we shall test the ARGOS null hypothesis that there is no difference in the construction of their farm system using causal mapping across the three different management systems under study (Green, Organic, Gold). In addition, we shall examine any groupings of orchardists other than by

panel which are useful in explaining different approaches to orchard management. A third objective was to assess the degree of change in orchardist perception of their orchard system. This objective is necessarily limited by the fact that since the method was modified, we cannot be certain if any changes found are due to the change in method or due to changes in the orchardists. The fourth objective was to compare the 2008 results with the results from other sectors studied.

1.3 Outline of report

In Chapter 2, the causal mapping method is described and attention is given to the refinements in its application in this study. In Chapter 3, the results of the ARGOS study are presented followed by Chapter 4 which includes a summary of the results and provides discussion and interpretation.

Chapter 2
Method: Q-methodology and Causal Mapping

2.1 Introduction

This chapter describes the approach to the research including the modifications to the list of factors used in the interview, an outline of Q methodology, and the interview procedure. The method employed a two-stage approach which uses the Q-sort method as a precursor to the causal mapping. It also describes the different analyses deriving from each part of the methods used. By way of clarifying our terminology, we note that our use of causal mapping involves factors that farmers identify and link to show causal connection in the formation of their causal maps and that Q methodology also uses the same term, 'factor', but with a different meaning. The causal mapping factors are more correctly known as variables since they have varying levels of importance in a causal map. We continue to use the term 'factors' since this was how the components of the maps were thought of by participants and was the word used during the interview with the participants. The approach used here also includes Q-sort data and analysis. Q-sorting usually refers to items that are sorted and Q methodology focuses on factors that are created by the factor analysis, where a factor is a group of subjects who sort items in a similar way. Since our earlier study used the term 'factor' and this is what we talked to farmers about it seems reasonable to persist with this use of the term. To distinguish these factors from those usually referred to in the Q method, we will refer to the latter as Q-sort types.

2.2 Modifications to the list of factors

The 36 factors used in the 2005 kiwifruit study (see Table 1) were the starting point for the factors used in the 2008 study. These original factors were derived from 14 open-ended interviews with a variety of farmers near Lincoln University. The challenge of moving to a more participant-driven list involves the potentially large variety of terms individuals might employ to refer to very similar elements of management systems. There is a trade-off between number of factors and efficiency of research design: more factors would increase the chance that each farmer would have all the key factors they would need but additional factors would make the sorting task more difficult. Accordingly, some attention was given to the number of factors used but with a concern not to significantly increase the total number.

The 2008 study included several additional factors. From discussions with ZESPRI staff during presentation of the causal map results it was clear that customer satisfaction was an important factor and one that was not well represented by customer requirements, so the latter was added to the list of factors. Additional environmental factors were included in order to provide a more balanced representation of these in comparison to economic and social factors. To this end the following were added after suggestions from a key member of the ARGOS environment team: increasing plant and animal biodiversity, water supply and quality, and stream health. The contractors/packhouse factor used in 2005 was separated into its two constituent factors. Vine health was a completely new factor in 2008. These changes are indicated in the list of factors in Table 1 which shows the 2008 kiwifruit factors next to the 2005 kiwifruit factors. Bolding is used to highlight the changes.

Table 1: List of factors used in the 2005 and 2008 kiwifruit studies

2005, n=36	2008, n=41
Advisors, consultants etc.	Advisors, consultants etc.
Production expenditure	**Cash orchard expenditure**
Cash orchard surplus	Cash orchard surplus
Community	Community
Contractors and packhouse	**Contractors/labour**
Labour	
Customer requirements	**Supermarket/customer requirements**
Exchange rate, macro economy	Exchange rate, economy
Family history and background	Family history and background
Family needs	Family needs
Farmer or grower decision maker	**Decision maker - orchardist/manager**
Farm/orchard environment as place to live	**Orchard environment as place to live**
Farm/orchard environmental health	**Orchard environmental health**
Fertiliser and soil fertility	Fertiliser and soil fertility
Quality and quantity of plants and/or livestock	**Fruit yield and quality**
Future generations	**Future generations/succession**
Government policies	Government policies
Grower groups or orgs	Grower groups or organisations
Improve equity/land size	Improve equity/land size
Information	Information
Marketing organization (ZESPRI)	Marketing organization (ZESPRI)
Neighbours	Neighbours
Off-farm activities	Off-farm activities
Off-farm work	Off-orchard work
Orchard gate returns	Orchard gate returns
Plant and machinery	Plant and machinery
Post harvest quality	Post harvest quality
Regulation	Regulation
Retirement	Retirement
Satisfaction	Satisfaction
Smallholding/subdivision	Smallholding/subdivision
Soil type/topography	Soil type/topography
This location	**Orchard location**
Time in farm work	**Time working on orchard**
Weather/climate	Weather/climate
Weed and pest management	Weed and pest management
	Increasing plant and animal biodiversity
	Stream health
	Vine health
	Water supply and quality
	Supermarket/customer satisfaction
	Packhouse

2.3 Outline of Q methodology

Q-sort methodology, established by William Stephenson in the 1950s (Stephenson, 1953), is a well-established but not mainstream approach to documenting human subjectivity

(Stephenson, 1953; Brown, 1980; McKeown and Thomas,1988; Fairweather, and Swaffield, 2000). Generally, it involves sorting items into a Q-sort array which is factor analysed to identify groups of subjects who sort the items in similar ways. In effect, this approach develops a typology across cases. It is unusual in that the analysis focuses on the subjects, not the variables, in the data matrix. The method had been applied in a wide range of disciplines and appears to have increasing popularity in recent years.

Q-sort methodology is well documented by Brown (1980), McKeown and Thomas (1988), and Addams and Proops (2000). New Zealand research using and documenting this method includes Fairweather (2002) and Fairweather and Swaffield (2000, 2002). Generally, Q method provides a quantitative means of documenting or exploring subjective viewpoints about a wide range of phenomena.

There are three basic steps in Q method. First, items, usually statements but also photographs, are sorted into the Q-sort distribution in response to a 'condition of instruction' such as: which ones do you most like? Second, the Q-sort data are factor analysed to find groupings of subjects who sort the items in similar ways. This step includes rotation of factors or spreading the variance across factors in order to achieve 'simple structure'. Third, the resulting factor array that represents the group of subjects whose individual Q sorts define it is interpreted to explain why the items have that particular distribution.

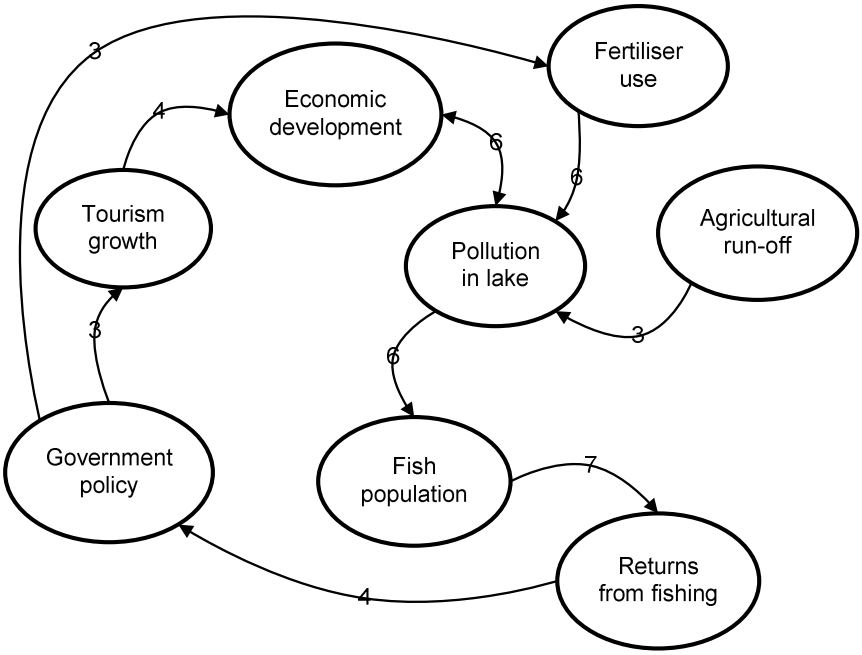
Q method took its name from the need to show that it was different from the usual approaches which typically used correlations and Pearson's R. In comparing Q and R techniques, Gorsuch (1983) explains that while the factors from Q and R analyses could be translated one to the other, this applied only to the unrotated factors. Because the configuration of individuals will usually be different from the configuration of variables, the rotated factors need not be the same. Each will rotate to its own simple structure and the factor scores will no longer equal the factor loadings of the other analysis (Gorsuch, 1983: 315). Further, R technique will include information on mean differences between individuals which are excluded from Q technique by virtue of its 'ipsatised' data[1]. Only the R technique has the possibility of finding a general factor. Therefore, if the research objective is to establish the extent of similarity among variables, then R technique is indicated; but if the research objective is to develop a typology across cases, then Q technique is indicated.

2.4 Interview procedure

Interviews were conducted from August to October 2008 mainly by the kiwifruit field officer. The 30 orchardists studied were those enrolled in the ARGOS research. The introduction to causal mapping started with an illustration of a simplified causal map of the factors involved in pollution in a lake (see Figure 1). The example was used to point out that the key features of any causal map included the identification of factors, linkages between factors, and the assigning of numbers to the linkages to indicate the strength of the causal connection. It was also pointed out that some linkages were bi-directional, that is, there were some lines with arrows on each end.

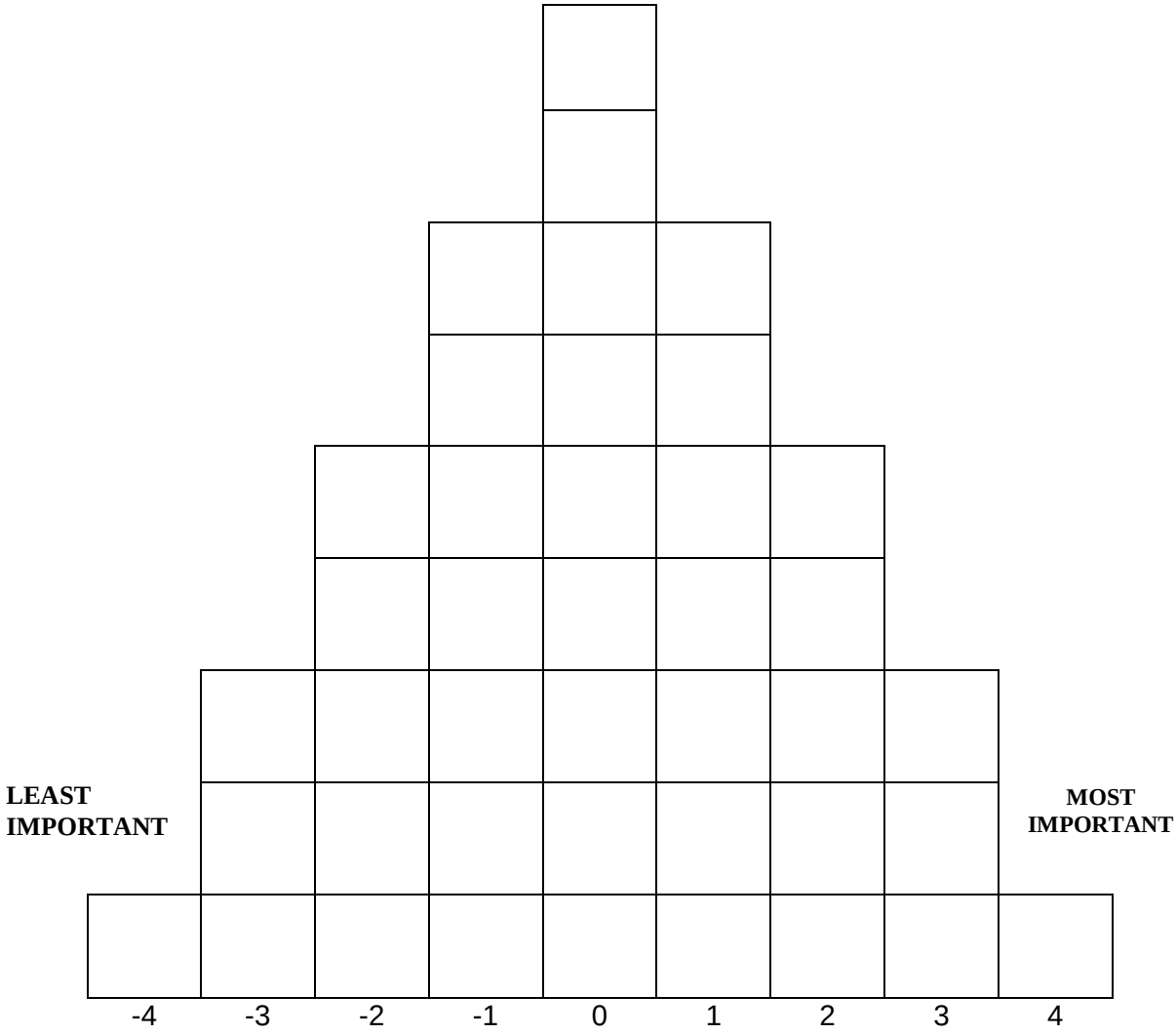
[1] Each case has the same mean, median and range.

Figure 1: An example of a simple causal map



It was explained that the objective of the interview was for the orchardist to prepare a causal map for the orchard system, broadly defined. Emphasis was given to thinking about the orchard in the broadest sense (i.e., not just in terms of production) so that all factors should be included, whether social, economic or environmental. The aim was for each orchardist to represent his/her orchard accurately. To achieve the causal map for their orchard, it was explained that there was a three-step process. The first step was to sort the set of 41 possible factors into three piles: one for the factors important in their orchard system, one for the factors unimportant in their orchard system and the remainder for the factors that were of some importance in their orchard system. The second step was to then identify from the first pile of important factors the one that was the most important, then the three that were next on order of importance and so on to form the distribution shown in Figure 2. On this basis the data were ipsatised. This part of the interview was in effect a Q-sort of the importance of factors in the orchardist's system. The third step was to take some of the important factors and put them on to a blank piece of A2 paper and move them around in preparation for showing how they were connected.

Figure 2: The Q-sort distribution



Note: This figure includes the column score which generated the numbers used in the analysis but the scores were not included on the recording sheets.

The first step went smoothly with orchardists either making three discrete piles of cards or by making an array of cards so that all were visible but in three groupings. Either way, they generally selected most factors as either very important or of some importance with a smaller number of factors as unimportant. The second step involved working with just the important factors and moving these cards around to put the ones that were more important on the right hand side and those that were less important on the left hand side. They then selected the one factor that was most important from those on the right hand side and continued with the remaining important factors, thereby building up their Q-sort distribution of cards. The selected factors were placed in front of the orchardist but above their working area. They were ordered in the same way as the distribution shown above. When the important factors were ordered the orchardists were asked to consider the unimportant factors. When these were sorted, the orchardists were asked to consider the remaining factors, the ones of some

importance. As the orchardists were Q-sorting the factors, the numbers were recorded on a copy of the distribution shown in Figure 3. They were invited to review their completed sort and make any adjustments that were necessary. With the sorted cards placed above the working area, there was space to introduce the sheet of A2 paper in preparation for the final step.

The third step was the core part of the interview and took most time. Orchardists chose cards from the important piles, not necessarily starting with the most important factor. Once the orchardist had about four factors on the paper they were given a pen and asked to show the causal connections between these factors. If there were two orchardists were present they were each given a pen. Most orchardists talked about their factors and this enabled us to understand what they meant when they made connections. Sometimes it was necessary to ask for more information about their lines to ensure that the line accurately represented what they were saying. For example, they might say that information leads to fertiliser and soil fertility. We asked if this was direct or through something else. Usually they would explain that they would respond to information and that it was them as decision makers that lay between these two factors. If the decision maker factor was not already on the paper the orchardist selected it from the piles and included it in their map.

As the orchardists talked about their factors the interviewer would reflect back what he was told and used the phrase “I hear you saying that A causes B, is that right? If so, put the line(s) in”. Careful observation of the emerging map was needed because orchardists might say that A causes B but put the line in with the arrowhead indicating that B causes A. When this happened, and for some orchardists it happened many times, we asked about the causal link by saying “So you are saying that B causes A?” In most cases they modified the line and reversed the direction, but in some cases they went on to explain further what they meant and this clarified the situation. In some of these cases, the orchardist realised that there were causes going both ways in which case a double arrowhead was used.

The orchardists continued to build up the causal map by adding in factors from the sorted piles. They were asked to continue as long as each factor was an important part of the emerging map of their orchard system. Each new factor was considered for what it caused and, in turn, what caused it. Comments or explanations made by the orchardists that illustrated something unusual about the linkages between factors were recorded on the data sheet.

The last part of the mapping was assigning numbers to each arrowhead. We explained that the main point with the numbering was to gain a general indication of the importance of the causal connection and to find out if the connection was of high, medium or low strength. This scale was written on the paper along with numbers to give some options within each of the broad categories. The scale was as follows:

Low: 1, 2 or 3
Medium: 4, 5 or 6
High: 7, 8, 9 or 10.

The orchardists had a tendency not to use the score of ten, which meant that typically three numbers were used in effect making the range similar to the other two.

When the map was finished to the satisfaction of the orchardist, the interview was completed with some final questions and directions which match those asked in the earlier studies. These are listed below:

1. Is either of quantity or quality more important to you?

2. What does farm environmental health mean? What does increasing biodiversity mean?
3. What are the important feedbacks to you as decision maker?
4. What are you trying to maximise? Minimise? What is at the heart of your system?
5. To what degree can the system change? How resistant to change is it? What is the main driver of change?
6. What makes for a resilient orchard (able to withstand shocks)? Which type of shock (environmental, economic or social) has most impact?
7. What are your main farming goals?
8. What is your level of inputs/ha compared to other orchards of a similar type to you (above average, average, below average)?
9. The interviewer observes key features of the completed map and discusses a summary statement with the orchardist, recording it using double quotation marks for the orchardist's key summary.
10. Has this process been of any benefit to you? In what way?

Question 3 was designed to check if the orchardists had considered the factors which needed to have arrows pointing back to decision maker. Most orchardists had overlooked some of these feedback connections and this question led to a few more being added in.

Question 9 was a good way of getting to the key aspects of the map as the orchardist saw it. The quote was written on the map using double quotation marks. If the orchardist was unable to state a summary view there was a joint discussion and in these few cases single quotation marks were used.

Finally, two questions distinct to this second study of the kiwifruit sector were asked at the end of the interview. The first asked if there had been any major changes to the orchardist's situation. This question addressed the third research objective of assessing the degree of change since 2005. The second question asked if the orchardist had developed any innovation or invention. This question addressed the needs of related research on user-derived innovation.

2.5 Analysis of Q-sort data

The ordering of items in a Q-sort array shows which items are important or salient in some way and provides the quantitative data used for factor analysis. The columns in the Q-sort are routinely assigned numbers with zero for the middle column and, in this case, ranging from -4 for the left hand or unimportant column, to 4 in the right hand or very important column. This numbering is somewhat arbitrary and is deployed merely to provide numbers for the subsequent correlation between all Q-sorts and to impose (somewhat artificially) an ordering of the data that has a mean of zero and is not skewed. In effect, the columns in the middle of the Q-sort, enumerated as zero or close to zero in the data analysis, can be taken to mean some importance since the orchardists put most factors into the important and some importance piles at the beginning of their Q sort.

Factor analysis is applied not to variables but to subjects in order to find factors or groups of subjects who sort the items in a similar way. Q method analysis focuses on the emergent factors or types represented by an array of items based on the individual Q sorts of those subjects who load significantly on that factor. The usual research task is to develop a

detailed interpretation of the Q-sort type by abductively developing an explanation that fits the order of items on the Q-sort type array. In this study, only a preliminary interpretation has been developed since the main goal was to develop the causal maps.

By its very nature factor analysis is indeterminate in that there are a number of factor solutions which can emerge from the data. As a guide to the optimal total number of Q-sort types, Brown (1980) recommends that the unrotated factor matrix is inspected in order to count the number of factors which have at least two statistically significant loadings. Factors over 0.40 are statistically significant as calculated in the following equation: $1/\sqrt{n} * 2.58$, where n is 42 in the present case. This assessment indicates the upper limit to the number of factors.

The Q data were analysed using the downloadable freeware PQMethod version 2.11. Principle Components factor analysis was used to identify groups of orchardists who sorted the items, in this case orchard-related factors as listed in Table 1, in a similar way. Varimax rotation was used to enhance the structure of each type.

2.6 Analysis of Map Data

Each map drawn by an individual was reproduced as a digital map using the Microsoft Visio drawing programme, and a copy of this map was returned to the orchardist. The map data were entered into an Excel spreadsheet. The spreadsheet consisted of a matrix of 41 by 41 factors whereby the row factor was taken to cause the column factor. All the cells, except the diagonal, were available to be used. This means that in the case of a bidirectional arrow, one number was entered on one side of the diagonal (X caused Y) and another number entered on the other side of the diagonal (Y caused X). For some bidirectional arrows the weightings were different for each direction.

Characteristics of the matrix were identified by summing column totals (indegree – measuring the combined weight of arrows leading to that factor), and row totals (outdegree – measuring the combined weight of arrows leading away from that factor). These two numbers were added together to provide a measure of the overall importance of that factor in the map or, as it is known in causal mapping, the centrality of the factor[2]. In addition, there were other maps characteristics such as the number of factors used (N), the number of connections (C), the number of connections per factor (C/N), and the number of double arrows. Density (C/N^2), an index of connectivity, or the number of causal relationships between the factors compared with the maximum possible, provides a measure of the options available for change (Ozesmi and Ozesmi, 2004: 50).[3] The number of receiver factors (see Figure 3), factors that only have other factors impacting on them, are regarded as a measure of complexity. “Many receiver variables indicate that the cognitive map considers many outcomes and implications that are a result of the system (Ozesmi and Ozesmi, 2004: 51). The number of transmitter factors, factors that only impact on other factors, indicate top-down thinking. Hence the ratio of receiver to transmitter factors is considered a measure of a map’s complexity. The hierarchy index, which is calculated by considering the variance of all the total scores leaving each factor, adjusted by $12/(100N*(N+1))$ to give it a value between zero and one, means that one indicates a fully hierarchical system (see Figure 4), and zero indicates a democratic system. According to Ozesmi and Ozesmi (2004: 51), “Stakeholders with more democratic maps are more likely to perceive that the system can be changed …”.

[2] While centrality gives a good overall measure, in some cases attention can equally be given to comparing indegree and outdegree.

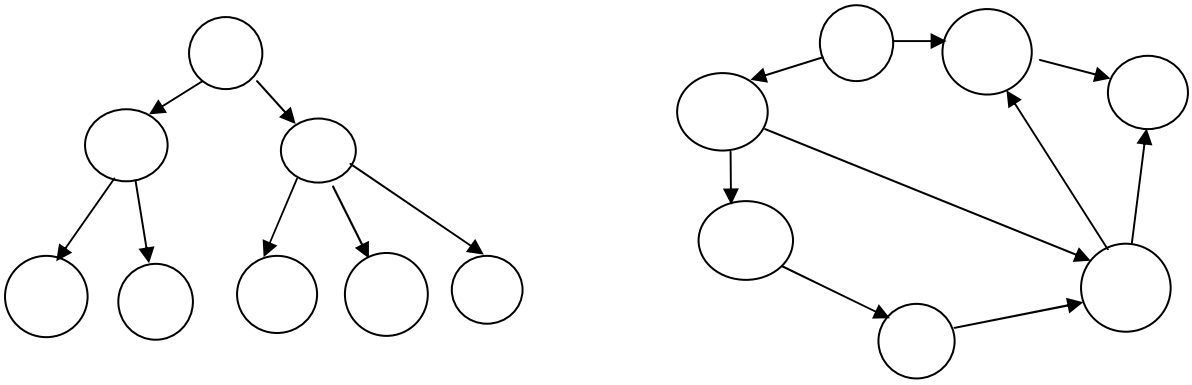
[3] For our maps (and Ozesmi and Ozesmi’s comparisons (2004: 60-61)) these calculations were made using the number of factors each participant used rather than the maximum number available. This imposes some limits on comparison to other density measures.

Centrality is the main measure that this report deals with and indicates what orchardists consider to be important or not important in their orchard system. A factor with a high centrality indicates that it plays a bigger role in the system by virtue of the number and weighting of causal connections between it and other factors in their orchard system. In some cases, where a factor has a low centrality score, the factor may still be important for individual orchardists. It is possible that in any system some connections with low centrality might play an important role under some particular circumstances.

Figure 3: Receiver and transmitter factors

Receiver Transmitter

Figure 4: Hierarchy in map systems



A hierarchical system A democratic system

The map data for each individual map were averaged across the 30 maps to obtain the group map data. The main focus was on the mean scores given to the arrows connecting one factor to another analysis of which provided a means to characterise the group map and the relationship between the factors that the group considered important in managing an orchard. Then group map data were analysed by panel, each panel consisting of nine Green, 12 organic and nine Gold orchardists respectively[4], and by Q-sort type.

2.7 Conclusion

The two-stage method applied to the kiwifruit orchardists, having been well tested on other farmers, worked well in its application to the kiwifruit sector in the sense that it was unproblematic to undertake. Having obtained the data in an unproblematic way it is possible,

[4] While the kiwifruit panels each have 12 orchardists, at the time the interviews were conducted some were not available and some were new to ARGOS and it was not considered appropriate to begin interviews with the causal mapping exercise.

but not yet demonstrated, that the results are valid and useful. However, the use of the modified method means that all ARGOS farmers and orchardists have been interviewed using the same causal mapping approach and this allows for analysis by both panel and Q-sort type and for comparisons between sectors.

Chapter 3
Kiwifruit Results and Sector Comparisons

3.1 Introduction

In this chapter, data are presented for the group map for all 30 orchardists, followed by the group map for each panel, then the group map for each Q-sort type. The main task here is to understand group maps, those that are formed from the data from all orchardists or from particular groupings of the orchardists. At this aggregate level we can develop an understanding of the general properties of orchard systems, as seen by orchardists. One of the main ways we assess maps is by measuring the centrality of factors. Centrality measures a factor's importance as it is the sum of the weightings of arrows going into and out from the factor. Centrality is influenced by both the number of arrows and the weightings of the arrows. This chapter also includes comparisons of the causal mapping results for all the sectors studied. The focus is on learning in what ways the sectors and the panels are either similar or different. Readers less interested in the details of the results may directly go to Chapter 4 for a detailed summary of the results and a discussion about them.

3.2 Group map data for all 30 orchardists

When the data for each of the 30 cases had been entered into individual Excel spreadsheets as a data matrix it was possible to create an equivalent data matrix for the group map by calculating the average score for each cell in the group matrix. These average scores then formed the basis of further calculations. The complete matrix for the group map data showed that for the average group map there were a total of 195 separate connections between factors, considerably short of the theoretical maximum of 41 times 40 or 1,640 connections, (or double that if consideration is taken that connections can go both ways). This is still rather too many to represent easily on a single map (see later).

In this section of the report the data are presented by first focusing on the group map data and then focusing on the group map generated by these data.

Map data

Table 2 shows the core descriptive data derived from the average centrality scores in the kiwifruit group map. These data include the overall average, then the averages for the three panels. (In order to minimise the number of tables, this table also includes the results for other groupings of orchardists based on analysis of the Q-sort data – see later). For all 30 orchardists, the table shows that the two highest rated factors are decision maker (79) and fruit yield and quality (68). These are followed by orchard gate returns with a moderately high score (55), then a group of four factors (vine health, cash orchard surplus, marketing organisation and satisfaction) with scores in the thirties. Following these are factors steadily decreasing in centrality.

Table 2: Average centrality for all 30 cases, all panels and all Q-sort types

Factor	All 30	Panels			Q-sort types	
		Green (9)	Organic (12)	Gold (9)	1 (20)	2 (9)
Decision maker	79	97	75	68	73	95
Fruit yield and quality	68	68	74	59	70	59
Orchard gate returns	55	43	58	64	54	59
Vine health	39	36	48	30	42	36
Cash orchard surplus	38	23	46	41	36	40
Marketing organisation (ZESPRI)	36	45	35	29	37	33
Satisfaction	33	16	45	33	26	47
Cash orchard expenditure	28	32	26	25	29	21
Fertiliser and soil fertility	26	23	34	19	26	28
Orchard environmental health	25	21	34	17	23	27
Family needs	25	6	33	33	13	47
Packhouse	22	24	15	28	20	24
Weather/climate	20	15	22	24	17	27
Weed and pest management	19	23	19	14	19	19
Post harvest quality	17	13	16	23	20	11
Contractors/labour	17	18	20	11	18	13
Orchard environment as a place to live	15	18	20	7	7	31
Water supply & quality	15	18	14	15	11	24
Advisors, consultants etc.	15	20	11	16	16	14
Information	13	17	11	10	13	12
Exchange rate, economy	12	17	9	13	14	10
Supermarket/customer requirements	12	13	11	11	12	8
Supermarket/customer satisfaction	12	7	13	14	15	4
Orchard location	9	5	10	13	6	18
Regulation	9	9	10	8	11	5
Government policies	9	12	8	7	11	4
Time working on orchard	9	7	13	4	6	14
Off-farm activities	8	3	12	6	3	17
Increasing biodiversity	8	9	12	1	6	10
Soil type/topography	7	9	7	6	9	5
Future generations/succession	5	0	9	5	2	11
Plant and machinery	4	6	5	3	3	6
Improving equity/land size	4	9	2	3	2	9
Retirement	4	4	8	0	0	11
Stream health	4	1	7	4	2	9
Grower groups or organisations	3	3	5	1	3	3
Off-orchard work	3	5	3	1	2	6
Community	3	0	4	5	2	1
Neighbours	2	3	1	4	2	3
Smallholding/subdivision	2	2	2	3	1	4
Family history and background	1	0	1	2	0	2

Comparisons of kiwifruit results for 2008 and 2005. Table 3 lists all the factors and their respective centrality scores in 2005 and 2008. Most of the factors have a similar score but there are ten factors with statistically significantly different scores, indicated by bolding. Decision maker was higher by 89 in 2005. In addition, in 2008, orchard gate return was higher, cash orchard expenditure was lower and family needs was higher. The remaining significant differences all relate to factors of low importance and in 2008 they all received even lower centrality scores. The difference in score appears to relate to whether or not factors were linked to decision maker in 2005 and not in 2008, for example, orchard gate return, family needs, regulation and time working on orchard.

Table 3: Comparison of centrality scores in 2008 and 2005

Factor	2008	2005	P-value
Decision maker	**79**	**168**	**0.000**
Fruit yield and quality	67	61	0.313
Orchard gate returns	**55**	**42**	**0.005**
Vine health	39		
Cash orchard surplus	38	31	0.138
Marketing organisation (ZESPRI)	36	41	0.339
Satisfaction	33	30	0.624
Cash orchard expenditure (production expenditure)	**28**	**38**	**0.027**
Fertiliser and soil fertility health	26	25	0.523
Orchard environmental health	25	20	0.254
Family needs	**25**	**11**	**0.014**
Packhouse	22		
Weather/climate	20	17	0.217
Weed and pest management	19	23	0.429
Post harvest quality	17	20	0.306
Contractors/labour	17		
Orchard environment as a place to live	15	15	0.944
Water supply and quality	15		
Advisors, consultants etc.	15	13	0.692
Information	13	10	0.399
Exchange rate, macro-economy	12	11	0.681
Supermarket/customer requirements	12	12	0.950
Supermarket/customer satisfaction	12		
Orchard location	9	13	0.330
Regulation	**9**	**19**	**0.001**
Government policies	9	10	0.516
Time working on orchard	**9**	**19**	**0.003**
Off-farm activities	8	10	0.374
Increasing biodiversity	8		
Soil type/topography	**7**	**12**	**0.049**
Future generations/succession	5	5	0.800
Plant and machinery	**4**	**14**	**0.000**
Improve equity/land size	**4**	**12**	**0.008**
Retirement	4	6	0.382
Stream health	4		
Grower groups or organisations	3	6	0.055
Off-orchard work	3	6	0.058
Community	3	4	0.603
Neighbours	**2**	**7**	**0.002**
Smallholding/subdivision	2	4	0.414
Family history and background	1	3	0.082

Table 4 compares the order of the top factors for 2005 and 2008 and shows the top three factors are in identical order and for many of the others the order is broadly similar. The main differences are that family needs was given more emphasis in 2008 while contractors and packhouse were given less emphasis. (Note that this factor was combined in 2005 as contractors/packhouse.) The high ranking of vine health indicates the value of introducing it to the factor list in 2008.

Table 4: Comparison of the order of the top 16 factors, 2008 and 2005

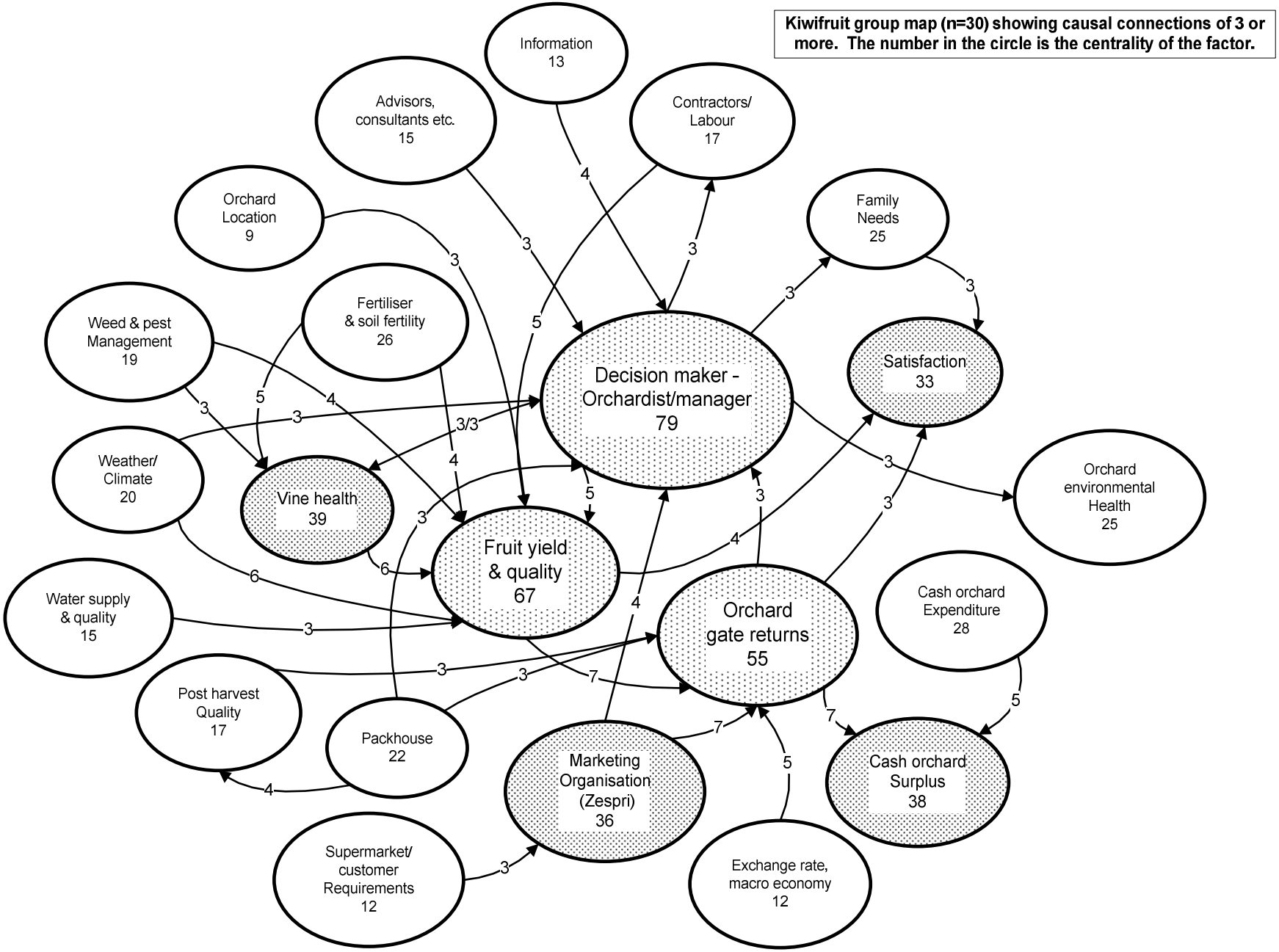
Factor	2008	2005
Decision maker	1	1
Fruit yield and quality	2	2
Orchard gate returns	3	3
Vine health	4	-
Cash orchard surplus	5	7
Marketing organisation (ZESPRI)	6	4
Satisfaction	7	8
Cash orchard expenditure	8	5
Fertiliser and soil fertility	9	9
Orchard environmental health	10	12
Family needs	**11**	**25**
Packhouse	12	6
Weather/climate	13	16
Weed and pest management	14	10
Post harvest quality	15	13
Contractors/labour	**16**	**6**

Group map

The centrality scores show which factors are important but they do not show, in detail, how all the factors are linked. To show linkages, we need to use the average data to generate a causal map based on strength of causal connections. However, the full group map has linkages between many factors and is difficult both to present and to interpret. To simplify the group map it is useful to include only those factors with centrality scores of 3 or more.

The derived group map is shown in Figure 5. The map was created by taking the three top factors and placing them in triangular fashion in the centre of the map. The top three factors are shown in the largest font and with a lightly shaded background. Then the next four factors were placed around these so as to minimise the overlapping of arrows. These four factors are shaded slightly darker. Finally, the remaining factors were positioned in close proximity to the factors with which they connected while keeping the lower rated factors on the perimeter. The figure shows only one arrow with double arrowheads and two numbers on the line. The number nearest to the arrowhead applies to that arrowhead.

Figure 5: Kiwifruit group map, causal arrows with scores of three or more



At the core of the map are orchardist decision maker, fruit yield and quality and orchard gate returns. The other links among these highly rated factors show that fruit yield and quality is influenced by vine health, weather and climate, water supply and quality, decision maker, contractors/labour, fertiliser and soil fertility health, and weed and pest management. In turn, fruit yield and quality affects orchard gate returns, as does post-harvest quality, packhouse and ZESPRI. Satisfaction is derived from fruit yield, quality and orchard gate returns and family needs (presumably satisfying family needs).

Overall then the group causal map is showing the central role of decision maker (orchardist), fruit yield and orchard gate returns. Two production factors, vine health and fertiliser and soil fertility, plus ZESPRI, cash orchard surplus and satisfaction, also play an important role. The group map shows a production emphasis with little integration of social or environmental factors.

Comparison to 2005 results. The 2008 kiwifruit group map is broadly similar to the 2005 group map. In total, the 2008 group map has 30 connections of which 19 relate to those in 2005. There are 11 connections which are new; but, of these, four relate to vine health and one to water supply and quality—both new factors in 2008. Thus, the adjusted number of distinctive connections is four. These are listed as follows:

- Orchard location to fruit yield and quality.
- Orchard gate returns to satisfaction.
- Decision maker to family needs.
- Family needs to satisfaction.

Distinctive connections related to the new factors are:

- Contractors/labour (contractors/packhouse in 2005) to fruit yield and quality (only for Green in 2005).
- Packhouse (contractors/packhouse in 2005) to orchard gate returns.

Referring back to the 2005 group map, there are 15 connections which occur there but do not occur in 2008.

- Family needs to decision maker.
- Decision maker to fertiliser and soil fertility, and reverse direction.
- Decision maker to weed and pest management, and reverse direction.
- Regulations to decision maker.
- Soil type and topography to quality and quantity of production.
- Weed and pest management to production expenditure.
- Contractors/packhouse to production expenditure.
- Labour to production expenditure.
- Cash orchard surplus to decision maker.
- Cash orchard surplus to satisfaction.
- Decision maker to plant and machinery.
- Decision maker to time in farm work.
- Decision maker to contractors/packhouse.

Clearly, there are some features of the group maps which are quite different in each year. Many of the connections that appear only in the 2005 map derive from the higher centrality score for decision maker which shows up seven times in the above list[5].

[5] This could relate to the change in interviewer and whether or not importance was placed on factors which could have operated through the decision maker.

There were four double arrows in 2005 group map and one double arrow in the 2008 group map. The scores presented in the group maps were four and above and ranged to eight in 2005, but three and above and ranged to seven in 2008[6]. This criterion was chosen in each case because it resulted in a group map with a similar and acceptable number of connections, where acceptability was judged in terms of ease of comprehension without being overwhelmed by connections.

Data from questions asked after the mapping

The main purpose of the analysis of orchardists' response to the questions asked after the mapping was to assess if there was any obvious change in their situation. To that end, two questions were given attention: that asking about their goals and that inquiring about significant changes having occurred since 2005. These data are collated in Appendix 1 and show that for most of the orchardists their reported goals were unchanged between 2005 and 2008. There were ten (36 per cent) for which we assessed there was no change in their goals and there were 13 (46 per cent) for which we assessed there was little change in their goals. However, one orchardist had moderate change (goals in 2005 related to production only, in 2008 related to family and the threat of rezoning), and four orchardists had significant change (now land banking rather than maximising production, moving off orchard, subdivision pressures, drop in orchard gate returns - selling property). These data show that while the majority of orchards are in a similar if not identical position, a minority were in a different situation in 2008. This observation means that the 2008 causal mapping results cannot be expected to be identical to the 2005 results.

3.3 Group map data for each panel

The assessment of differences between the group maps created for each of the ARGOS management panels involved the identification of significant differences for centrality scores and map characteristics among the panels. These data were examined using unbalanced one-way ANOVA analyses and the significant results are shown in Table 5. Superscript letters are used to denote a statistically significant difference between scores, and bolding is used to show the highest centrality for each factor. At first glance, seven of the eight significant differences are at the five per cent level for a two tailed test. However, for the factor, vine health, our earlier research (Fairweather et al., 2006; Hunt et al., 2005) suggests a hypothesis that Organic orchards would have a higher score a hypothesis that Organic orchards would have a higher score for several reasons. It may reflect production issues as there is a smaller margin for error in organic production because fewer fruit are available to thin, vines are less vigorous and thus pruning is more exact, etc. Also the emphasis placed on environmental health by organic orchardists is likely to apply to vine health. Therefore a one-tailed test of the alternative hypothesis that this is so is appropriate. This consideration means that all the differences reported in the table are, in effect, significant at the five per cent level.

The total centralities are included to show that at the aggregate level there are no statistically significant differences across the panel maps. Six of the differences across the 41 factors occur in the comparison with the Organic panel. For six of these the Organic orchardists had the higher centrality score emphasising orchard gate returns, satisfaction, fertiliser and soil fertility, orchard environmental health, vine health and, along with Gold orchardists, family needs. They placed less importance on packhouse. Gold orchardists also emphasised packhouse and post harvest quality.

[6] This could just demonstrate a difference in scale between the two interview times. However, on investigation, the lower average in 2008 is not reflected across all scores with some scores in 2008 being higher than those in 2005.

Table 5: Statistically significant centrality means for each panel

Factor	All 30 (mean)	Panels		
		Green	Organic	Gold
Orchard gate returns	38	23 [b]	**46** [a]	41
Satisfaction	33	16 [b]	**45** [a]	33
Fertiliser and soil fertility	26	23 [b]	**34** [a]	19 [b]
Packhouse	22	24	15 [b]	**28** [a]
Orchard environmental health	25	21	**34** [a]	17 [b]
Vine health	39	36	**48** [*a*]	30 [*b*]
Post harvest quality	17	13 [b]	16	**23** [a]
Family needs	25	6 [b]	**32** [a]	**33** [a]
Total centrality	735	701	805	678

Notes:
1. Superscripts in normal font indicate difference at a 5% level of significance.
2. Superscripts in italic font (underlined) indicate significance at the 5% level for a one-tailed test.

The above statistically significant differences in centrality scores give us good reason to conclude that the group maps for each panel have some distinctive characteristics. These panel differences were explored by examining all the connections going into or out of the factors with statistically significant different centrality scores. Where there were differences in the weighting of these connections, these are shown in the following figures in parentheses. The significantly different centrality scores are also shown within the relevant circle in the following figures. On some maps, there are additional circles and arrows because for that panel there is a connection of three or more, unlike for the overall group map. The circles and arrows that are unique to the panel maps are indicated with hatched lines. Bolding is used to highlight differences in the strength of connections to draw attention to the distinctive features of the panel maps. In all cases, when three numbers are presented the order is as follows: Green, Organic, Gold.

Green panel

The Green panel map is the same as the group map for all orchardists (see Figure 3).

Organic panel

Figure 6 shows the Organic panel map and it has many differences when compared to the overall map. In the following description, attention is given to each factor with a significantly higher centrality and the connections that drive this result. Here, most of the comparisons relate to the overall average centrality score from the group map. Then attention is given to the connections with which there are particularly large differences when Organic is compared to either Green or Gold. Bolding is used to highlight the factors with statistically significant differences across the panels, and asterisks are used to show, more precisely, where the differences lie.

Many of the distinctive connections on the Organic map relate to satisfaction, including both stronger connections from decision maker, orchard gate returns, cash orchard surplus and family needs as well as additional connections with scores of three from orchard environment as a place to live and orchard environmental health. Orchard environmental health is important to organic orchardists and they indicate this with stronger connections from weather and climate, and fertiliser and soil fertility. Note however, that the link from decision maker to environmental health is modest compared to that of Green orchardists. In addition, there is a stronger connection from orchard environmental health to satisfaction, as noted above, and to vine health. Family needs has a stronger connection from decision maker and from cash orchard surplus, and a stronger connection (compared to Green only) to satisfaction. Family needs is also more strongly connected to orchard environment as a

place to live. Fertiliser and soil fertility has a stronger connection from decision maker and stronger connections to vine health and fruit yield and quality. As noted above, there are stronger connections to orchard environmental health and cash orchard expenditure. Orchard gate returns is more important to organic than to green orchardists. As noted above, it is more strongly connected to family needs and to satisfaction. In addition, there is a stronger link from decision maker. The one additional factor on this map, orchard environment as a place to live, strongly connects to family needs (4) and satisfaction (3) and is in turn influenced by family needs. In summary, organic orchardists emphasise the environment in a number of ways, and also value living in the environment in ways that meet family needs and provide satisfaction.

Distinctive Organic connections. There are four connections in which the organic panel average is higher by at least four points.

Fertiliser and soil fertility to vine health: 5 (average) (**6** (Green), **6** (Organic), 2 (Gold)). Compared to Gold orchardists, Organic orchardists emphasise this link probably because it is more of a challenge to them to keep vines healthy, productive, and pest free. It also may be a characteristic of growing green kiwifruit compared with gold kiwifruit, the latter being more vigorous and therefore needing less emphasis placed on soil fertility, hence the weak link on Gold orchardists' maps as well.

Fertiliser and soil fertility to fruit yield and quality: 4 (3, **7**, 2). Organic orchardists place more importance on fertiliser and soil fertility as a factor impacting on fruit yield and quality and for them fertiliser use, and hence maintaining or increasing soil fertility is also more of a challenge.

Cash orchard surplus to satisfaction: 2 (0, **4**, 2). Unlike Green orchardists, Organic orchardists emphasise this connection as well as the connection from orchard gate returns to satisfaction, thereby emphasising both net returns and gross returns. This suggest that organic growers may be more aware or conscious of costs e.g., higher administration (certification) costs, or that they derive satisfaction from making a good go with management which is sometimes portrayed as unviable. This viewpoint is distinctive since orchard gate returns (gross income) is the indicator commonly used in the industry.

Orchard environment as a place to live to family needs: 2 (0, **4**, 2). Clearly, organic orchardists attach importance to living in the orchard environment and see this as meeting family needs. These two factors are connected together in a feedback loop. This finding is consistent with our previous work that shows organic orchardists to express greater levels of concern and awareness in regard to environmental factors.

Gold panel

Figure 7 shows the Gold panel map. The Gold orchardists gave more emphasis to the packhouse with stronger connections from packhouse to post-harvest quality and to orchard gate returns. In addition, there is a connection of three from decision maker to packhouse. Gold orchardists also emphasise post-harvest quality by a stronger link from packhouse, and a stronger link to orchard gate returns. The greater importance of family needs is shown by a connection to off-farm activities, and stronger connections to and from satisfaction. (This is in contrast to Organic orchardists who had a stronger connection between family needs and orchard environment as a place to live.)

Some of the distinctive qualities of the gold map relate to the nature of gold kiwifruit which are more perishable compared to green kiwifruit and reflects their learning from the past season in which a higher than usual percentage of damaged and rotten gold kiwifruit was delivered to the export markets. This makes the packhouse critically important in Gold kiwifruit management. The following distinctive Gold connections illustrate this point.

Figure 6: Organic panel group map

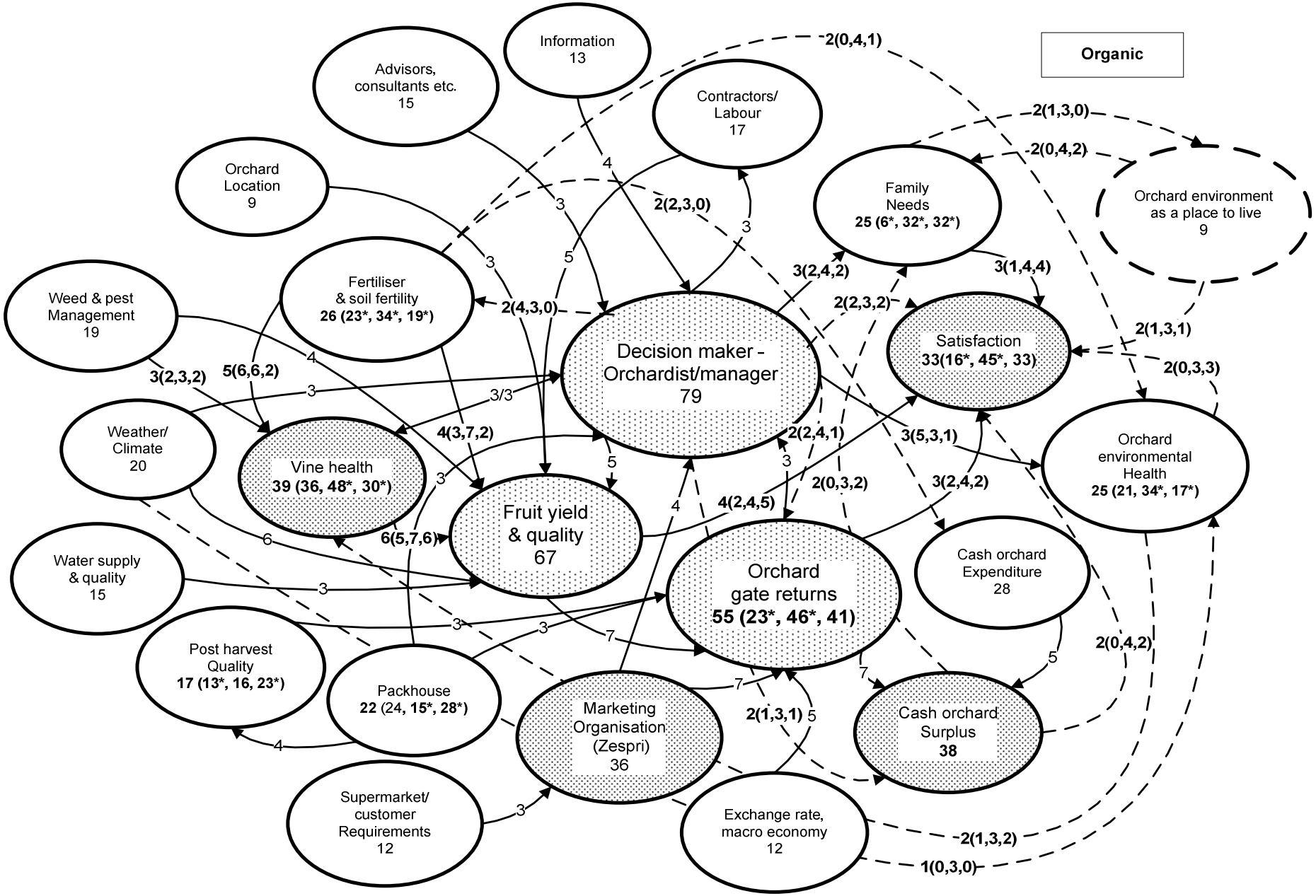
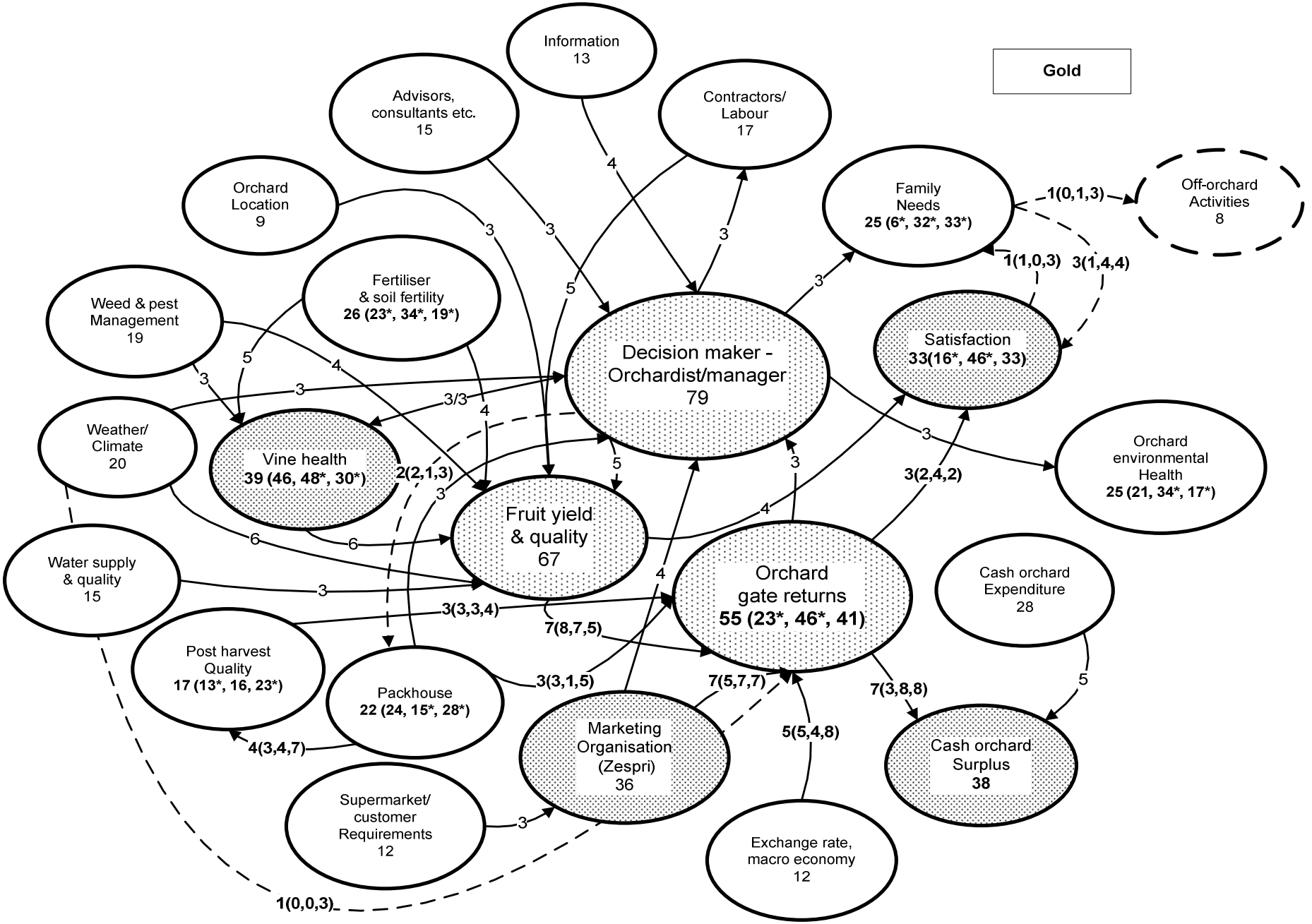


Figure 7: Gold panel group map



Distinctive Gold connections. There are four connections in which the Gold panel average is higher by at least four points compared to at least one other system.

Packhouse to post-harvest quality: 4 (3, 4, **7**). Gold orchardists compared to Green give much more emphasis to this connection.

Packhouse to orchard gate returns: 3 (3, 1, **5**). Gold orchardists compared to Organic orchardists see that the packhouse strongly affects gross returns.

Orchard gate returns to cash orchard surplus: 7 (3, **8**, **8**). Like Organic orchardists, but unlike Green orchardists, Gold orchardists place very high value on the influence of orchard gate returns on cash orchard surplus.

Exchange rate/macro-economy to orchard gate returns: 5 (5, 4, **8**). Gold orchardists assign greater importance to the effect of the exchange rate on returns.

Comparisons to 2005 results

The centrality scores for the three panels when compared to the results in 2005 do not show much similarity. Table 6 shows the significantly different centrality scores by panels for 2005 and 2008 with bolding used to highlight the highest of the significantly different (at the 5% level) scores. Note that there were some changes in the list of factors used: contractors and packhouse were combined in one factor in 2005 but separated in 2008. This may account for different result found, although in very general terms there is similarity in that in both years Organic orchardists gave it a lower score. Orchard environmental health was given more emphasis by Organic orchardists in both years. There are five significant differences for 2008 not found in 2005 and two of these could be related to Gold orchardists' experiences with postharvest quality in the previous season. Further, there were three significant differences found in 2005 that were not found in 2008. For example, in 2005 quality and quantity of production (renamed fruit yield and quality in 2008) had highest centrality for Green orchardists while both production expenditure and information were high for Gold orchardists.

Table 6: Comparison of significant differences in centrality scores, 2005 and 2008

Factor	2005			2008		
	Green	Organic	Gold	Green	Organic	Gold
Contractors & Packhouse	**49** [a]	27 [b]	33			
Packhouse				24	15 [b]	**28** [a]
Farm/orchard environment health	17	**27**[a]	16 [b]	21	**34** [a]	17 [b]
Orchard gate returns	38	42	42	23 [b]	**46** [a]	41
Satisfaction	28	31	30	16 [b]	**45** [a]	33
Fertiliser and soil fertility	23	26	24	23 [b]	**34** [a]	19 [b]
Post harvest quality	18	23	20	13 [b]	16	**24** [a]
Family needs	8	12	14	6 [b]	**32** [a]	**33** [a]
Quality and quantity of production	**71** [a]	53 [b]	58			
Fruit yield and quality				68	74	59
Production expenditure	30 [b]	40	**42** [a]	32	26	25
Information	7 [b]	10	**13** [a]	17	11	10

In 2005 for the organic map there was only one factor with a statistically higher centrality score – farm/orchard environmental health and this also occurred in 2008. However, a number of connections were highlighted as stronger in 2005: decision maker to fertiliser and soil fertility, fertiliser and soil fertility to production expenditure, orchard gate returns to decision maker, orchard environmental health to satisfaction, decision maker to plant and machinery and decision maker to time in farm work. Most of these connections did not occur

in 2008 except for those connections to satisfaction and point to the emphasis placed on decision maker in the 2005 maps reported on earlier.

There were few similarities in the distinctive qualities of the Gold panel between 2005 and 2008.

3.4 Group data for each Q-sort type

The Q-sort data provided the basis for an examination of groups of orchardists based on how they rated the importance of the factors. The factor analysis result that gave two Q-sort types was the best solution in terms of readily interpretable types with reasonable numbers of orchardists being associated with each type. The standard criterion of at least two significant loadings on a factor in the unrotated factor matrix indicated that up to four Q-sort types could have been extracted. However, factor 3 had only two orchardists loading on it and one of these was negatively loaded, indicating that its individual array was in the opposite order. This Q-sort type, derived from only two people, did not allow for easy interpretation. Q-sort type 4 seemed to reflect elements of Q-sort types 1 and 2. These considerations suggested two Q-sort types would be a better resolution. Inspecting the preliminary findings for two Q-sort types showed that most of the cases on Q-sort types 3 and 4 migrated to Q-sort type 1, and that the general characteristics of Q-sort types 1 and 2 remained unchanged. It also resulted in all orchardists loading on Q-sort types whereas the four Q-sort types solution had four cases with multiple loadings.

This section of the report examines the data for the two Q-sort types and develops a preliminary interpretation of each type. It then presents the group map for each type, that is, the map generated by selecting those orchardists who comprise each Q-sort type. Note that while 30 orchardists were interviewed only 29 completed the Q-sort.

Table 7 shows the number of orchardists who loaded significantly on each Q-sort type. The table shows that each Q-sort type was well represented by the different panels and therefore there is no association between panel and Q-sort type.

Table 7: **Numbers of significant loaders on each Q-sort type**

Panel	Q-sort type 1	Q-sort type 2	Total
Green	6	3	9
Organic	7	4	11
Gold	7	2	9
Total	20	9	29

It is usual in Q-sort analysis to examine the type arrays, which include those factors that make up the underlying or prototypical characteristics of each Q-sort type. However, before presenting these data, it is necessary to examine the centrality scores and map characteristics to see if in fact there are differences in the maps for each type.

Table 8 shows the statistically significant centrality scores for the two Q-sort types, each score being an average for the Q-sort type. All reported factors have a significant difference at the 0.05 level. Bolding is used to show the highest scores. Looking at each type shows that Q-sort type 1 gives more importance to post harvest quality and supermarket customer satisfaction. Q-sort type 2 gives more importance to water supply and quality, orchard environment as a place to live, orchard location, family needs, off-orchard activities and retirement. Note that some of the centrality scores are low so some caution is needed in interpreting that the factors for which there are significant differences as being definitively

important for those Q-sort types[7]. Just because they are significantly different does not mean that the difference is critically important. Note also that while the total centrality for Q-sort type 2 is higher the difference is not statistically significant. As before, these differences between Q-sort types give a preliminary indication of possible map differences and so they prepare the way to show more subtle differences at the level of individual connections between factors on the respective maps.

Table 8: Statistically significant differences in centrality scores

	Q-sort Type		
Factor	**Q-sort 1 (N=20)**	**Q-sort 2 (N=9)**	**P-value**
Post-harvest quality	**20**	11	0.034
Water supply and quality	11	**24**	0.032
Orchard environment as a place to live	7	**31**	0.023 *
Orchard location	6	**18**	0.045
Supermarket/customer satisfaction	**15**	4	0.013 *
Family needs	13	**47**	0.017 *
Off-orchard activities	3	**17**	0.032 *
Retirement	0	**11**	0.027 **
Total centrality score	685	825	0.073

Notes:

1. * indicates variances were unequal so the t-test was adapted to compensate for this.

2. ** indicates that one group had no variability at all, so it was tested to see if the mean of the other group was different from zero.

Q-sort type 1 – kiwifruit business

Before presenting the maps for each Q-sort type it is useful to first characterise each type by referring to Q-sort data. The main Q-sort result is the array of items, in this case factors, that make up the prototype for that Q-sort type. This array is central to characterising the type. In addition, type arrays can be compared by examining the distinguishing items, the factors which received a significantly different score compared to the other type. We start with these distinguishing items to identify the factors with widely different scores and therefore different importance to the orchardists who make up each type. Table 9 shows the distinguishing items, those factors which received different scores for each Q-sort type. Q-sort type 1 gives more emphasis to supermarkets, customer satisfaction and requirements, advisors/consultants, and post-harvest quality. This type gives less emphasis to family needs, off-orchard activities, orchard environment as a place to live, time spent working in the orchard and retirement.

[7] Analysis was carried out using SPSS and this makes observation of outliers and normality of data more difficult to determine. The lower the frequency of orchardists placing a value on a factor linkage the less the likelihood that the data follows a normal distribution because of the large number of zeros in the data.

Table 9: Distinguishing items

Factor	Q type1	Q type 2
Family needs	-1	4
Off-orchard activities	-2	2
Orchard environment as a place to live	-1	1
Supermarket customer satisfaction	1	-2
Government policies	0	-3
Supermarket customer requirements	1	-1
Advisors, consultants etc.	1	-1
Satisfaction	0	2
Post-harvest quality	2	0
Time spent working on the orchard	-1	1
Retirement	-2	0

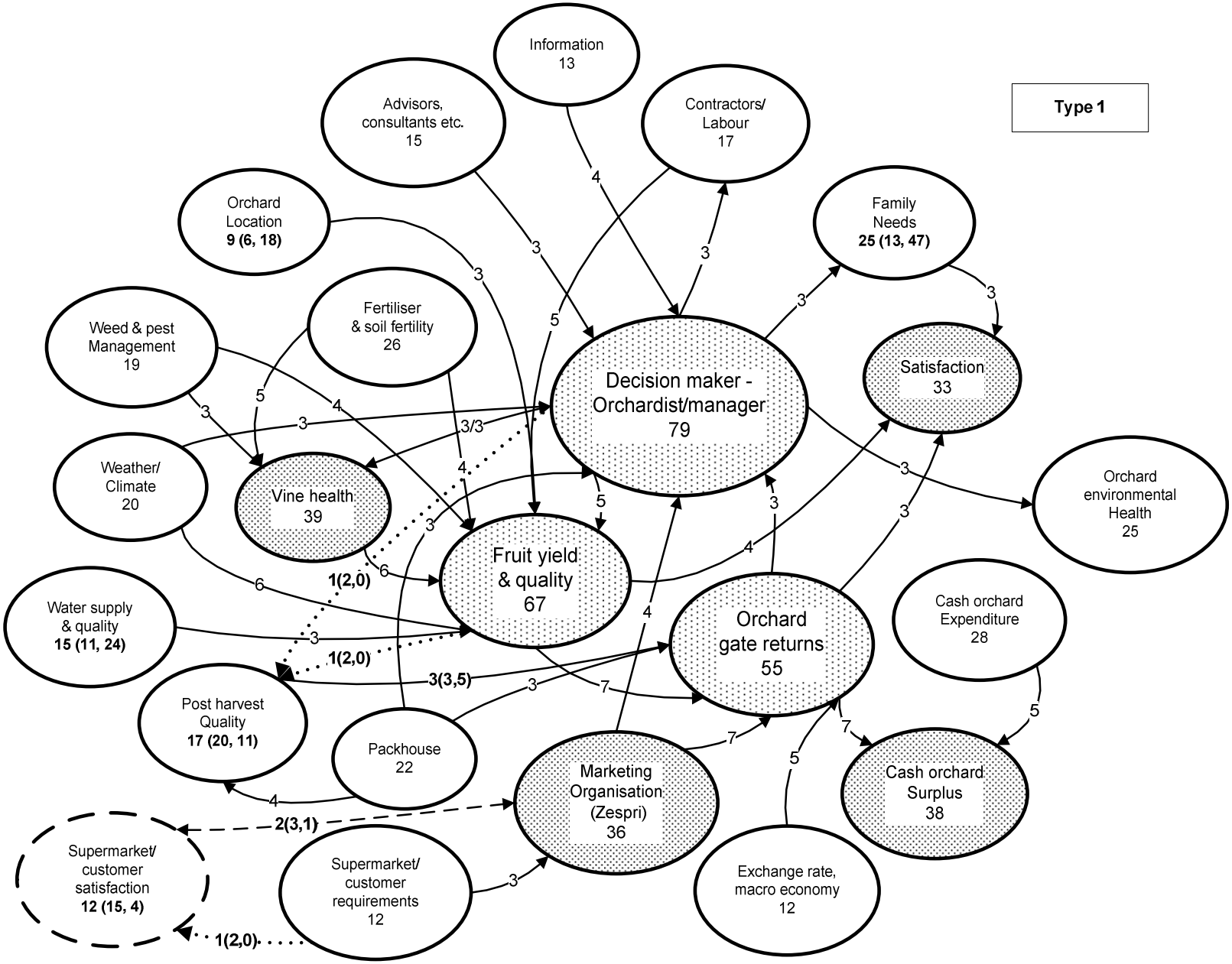
The type array for Q-sort type 1 shown in Table 10 reinforces these characteristics. The table shows the top eight factors and their corresponding Z scores derived from the Q-sort raw scores ranging from -4 to 4. High among these highly rated factors are financial and production factors along with decision maker. Q-sort type 1 clearly emphasises the business of kiwifruit production.

Table 10: Highly rated factors for Q-sort type 1

Factor	Z score
Orchard gate returns	1.8
Fruit yield and quality	1.6
Cash orchard surplus	1.4
Decision maker	1.2
Marketing organisation (ZESPRI)	1.2
Vine health	1.2
Fertiliser and soil fertility	1.1
Post-harvest quality	1.0
Weather/climate	0.9

Figure 8 shows the group map for Q-sort type 1 based on average data for the 20 cases. The map shows the additional factor of supermarket/customer satisfaction. Generally, there are few differences in Q-sort type 1 compared to the overall group map for all 30 orchardists. Q-sort type 1 has a higher but still modest centrality score for post harvest quality. This higher score is derived from the connections from decision maker and from fruit yield and quality which are themselves very modest with a score of two, as indicated by lighter hatching on the line, but not zero as was the case for Q-sort type 2. However, they do see that postharvest quality is influenced by more than one factor. This is in contrast to Q-sort type 2 who see this factor as a given and only influenced by the packhouse. Supermarket/customer satisfaction also has a modest centrality score. Q-sort type 1 connects it to ZESPRI with a score of three in both directions while Q-sort type 2 connects it with a score of one.

Figure 8: Group map for Q-sort type 1



Q-sort type 2 – kiwifruit lifestyle

Q-sort type 2 complements all the qualities of Q-sort type 1 indicated in the earlier table showing the distinguishing items (see Table 9). This type give more emphasis to family needs, off-orchard activities, orchard environment as a place to live, time spent working in the orchard, and retirement. The type array for Q-sort type 2 reinforces these characteristics as Table 11 shows with the highest rated factors for this type. Family needs is rated highest then there are two production factors and decision maker. However, orchard environment as a place to live is also important, along with satisfaction among the remaining production-related factors. This shows that Q-sort 2 types are also interested in production like Q-sort 1 but also have other interests.

Table 11: Highly rated factors for Q-sort type 2

Factor	Z score
Family needs	2.6
Orchard gate returns	1.7
Cash orchard surplus	1.6
Decision maker	1.3
Orchard environment as a place to live	1.3
Fruit yield and quality	1.3
Satisfaction	1.3
Off-orchard activities	1.0
Cash orchard expenditure	1.0

Figure 9 shows the group map for Q-sort type 2 based on average data for the nine cases. The map shows many differences compared to the group map for all orchardists. The map includes five additional factors: stream health, retirement, orchard environment as a place to live, off-orchard activities and future generations/succession. Let us consider each of these in turn. The higher centrality score for stream health is derived from its connection to water supply and quality. Retirement has a stronger connection to satisfaction. Orchard environment as a place to live has stronger connections to and from family needs, from decision maker and to satisfaction. Off-orchard activities has a stronger connection from cash orchard surplus. Finally, there is a stronger connection from family needs to future generations and succession.

There are three original factors on the map which have a higher centrality for Q-sort type 2. Family needs is important and this is derived from connections from decision maker and from orchard gate returns, plus connections to decision maker, satisfaction and future generations/succession. Water supply has a higher centrality because of its connection to stream health and to orchard environment as a place to live. Orchard location is a factor with low centrality but there are two additional weak connections that make for the higher centrality for Q-sort type 2 – to weather and climate and to satisfaction.

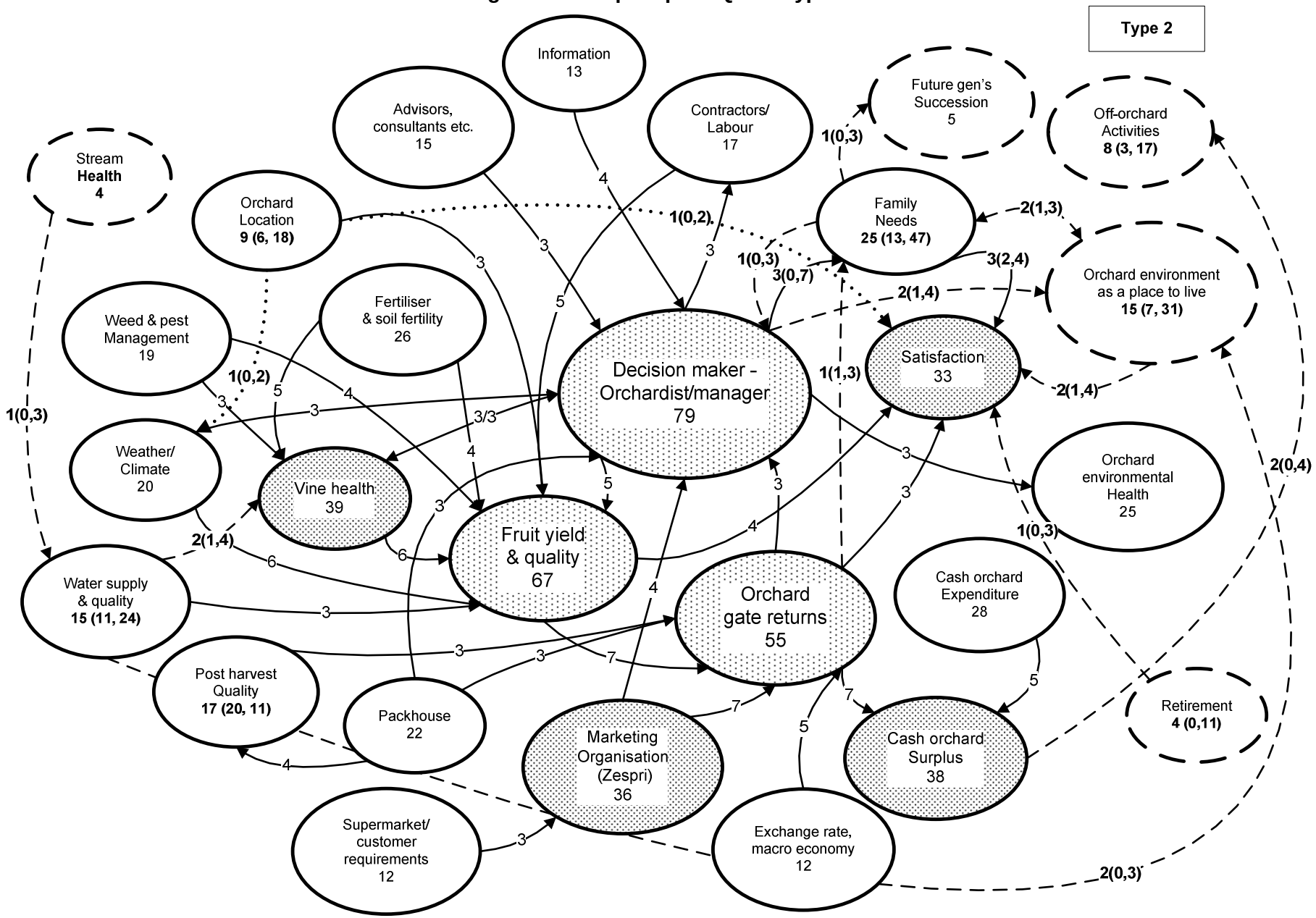
Distinctive connections. There are two connections in which the Q-sort type 2 average is higher by at least four points.

Decision maker to family needs: 3 (0, **7**). There is a sharp contrast in the scores for this connection. Q-sort type 1 orchardists have no connection from decision maker to family needs while Q-sort type 2 rate it a very strong connection. Clearly, for Q-sort type 2 the family is an integral part of the orchard system.

Cash orchard surplus to off-orchard activities: 2 (0, **4**). Again there is a contrast here with Q-sort type 2 seeing that their cash orchard surplus supporting off-orchard activities.

These results are in line with the distinguishing items presented earlier which showed Q-sort type 2 to have a distinctively high score for family needs and off-orchard activities.

Figure 9: Group map for Q-sort type 2



3.5 Comparisons between sectors for conventional and organic panels

Having presented results for the second causal mapping of the kiwifruit sector we are now in a position to consider whether the causal maps produced by ARGOS participants show the same characteristics across the sectors (sheep/beef, dairy, kiwifruit) and whether these characteristics are common to both the organic and conventional management systems within each sector[8]. Such an analysis can address questions about similarities and difference between sectors and management systems. It might be expected that farmers in the two pastoral systems would see their farming systems in similar ways and this similarity would reflect in their causal maps, and that these would be different from those of horticulturalists. Alternatively, it may be dairy farmers' causal maps would be similar to horticulturalists since their systems are more intensive. Further, it might be expected that organic farmers would have causal maps with similar characteristics regardless of sector. Alternatively, it may be that sectoral differences modify this pattern.

In order for this analysis just to be a comparison between organic and conventional management systems the kiwifruit sector data has been reduced to the Green panel representing conventional management in comparison to Organic green, i.e., the Gold panel has been omitted. In the sheep/beef sector the Integrated panel has been omitted from the analysis.

The analysis for these comparisons and those in the following sections has been carried out using a two-way analysis of variance with the two factors[9] as sector and management system (or Q-sort type) with an interaction component which implies that we were expecting there to be a possible interaction between these two factors. Conventionally, in such statistical analysis, the focus is on the main effects of the factors (in this case the overall means for each sector (three means) and each management system (two means)) and the 'simple' effects (the means for each sector within each management system - six means altogether) are ignored unless there is a significant interaction. However, in a strict statistical design for which this analysis was intended, the levels of the factors would be consistent across the whole 'experiment'. In this case the levels of the factor 'sector' are sheep/beef, dairy and kiwifruit, while the levels of the management system are 'conventional' and 'organic'. The question is whether we can make the assumption that an organic sheep/beef or dairy farm or kiwifruit orchard can be considered the same organic management system, and a conventional sheep/beef or dairy farm or green kiwifruit orchard be considered the same conventional system. The latter is probably more subject to challenge. For example, (1) all kiwifruit is grown under an audited system and must comply with GlobalGAP requirements which have incorporated KiwiGreen, an integrated management system, along with compliance with many other requirements for standards for input supply sources, and environmental and social practices; and (2), can a system which produces meat and wool be compared with one that produces milk be compared with one that produces fruit? As a result we have also reported in the following tables the 'simple' effects, as often these show a different pattern from the main effects, even though there is no significant interaction present. These simple effects often can be seen to demonstrate some differences that could be interpreted as exemplifying the difference between these management systems across the sectors.

Similarly, in the Q-sort analysis across sectors, we already know that the Q-sort groups were decided by a Q-sort analysis carried out for each of the sector results and therefore the factors taken into account and the resulting two groups produced could actually be quite

[8] This part of the research broadens the focus from the kiwifruit sector and may not be of interest to all readers of this report. Readers less interested in sector comparisons may turn to the conclusion for a discussion of the kiwifruit sector results. In this and the subsequent sections of the results we present various comparisons and provide an interpretation of the results.

[9] Here we are referring to ANOVA factors as distinct from the causal mapping factors.

different across the sectors. Hence, by reporting the simple effects we are able to discern whether these separate analyses produced Q-sort groups with similar qualities in each sector.

In proceeding with the analysis, the first question to ask is whether there are any differences between the sectors (sheep/beef, dairy, kiwifruit) that are common to both the organic and conventional management systems. If so then this indicates that regardless of management system there is an effect due to the sector. The second question is whether there are instances in which the difference between sectors is not repeated in both management systems. Table 12 lists the results of these queries and shows where there is a sector difference the source of that difference. Hence the table includes results (1) for which the overall mean for the sectors may differ and does not show up for the panels (e.g., for advisors, consultants etc.), (2) for which the overall mean for the sectors may differ and does show up in some or all of the panels (e.g., contractors), and (3) where there is a difference for a panel only (e.g., net profit before tax). The interaction column indicates if the pattern of results is different across the sectors within each management system, that is, if there is a combined effect of the two independent variables (sector and management system) on the dependent variable (factor centrality score or map characteristics score).

Table 12: Comparisons of centrality scores and map characteristics for conventional and organic panels across sectors

Factor	Management	Sector			
		Sheep/beef	Dairy	Kiwifruit	Interaction
Advisors, consultants etc.	Conventional	5.2	0.6	20.0	
	Organic	1.8	0.7	10.8	n.s.
	Mean	3.4[b]	0.6[b]	15.0[a]	
Net profit before tax/Cash orchard surplus	Conventional	23.9	38.0	22.8	
	Organic	23.5[b]	16.4[b]	46.3[a]	p=0.014
	Mean	23.7	26.3	35.5	
Contractors/contractors and labour	Conventional	6.1[b]	3.7[b]	18.4[a]	
	Organic	4.4[b]	4.7[b]	19.9[a]	n.s.
	Mean	5.2[b]	4.2[b]	19.2[a]	
Customer/Supermarket satisfaction	Conventional	18.5	7.3	7.3	
	Organic	17.6[a]	2.8[b]	13.1	n.s.
	Mean	18.0[a]	4.9[b]	10.4	
Family history and background	Conventional	12.9[a]	3.2[b]	0.0[b]	
	Organic	3.4	3.9	0.8	n.s
	Mean	7.8[a]	3.6	0.5[b]	
Family needs	Conventional	41.2[a]	38.3[a]	6.4[b]	
	Organic	35.8	33.0	32.5	n.s.
	Mean	38.3[a]	35.5	20.5[b]	
Farmer/grower decision maker	Conventional	153.3[a]	126.8	96.6[b]	
	Organic	140.1[a]	127.9[a]	75.2[b]	n.s.
	Mean	146.2[a]	127.4[a]	85.0[b]	
Farm/orchard environmental health	Conventional	30.1	24.7	21.2	
	Organic	60.6[a]	48.0	34.0[b]	n.s.
	Mean	46.6[a]	37.3	28.1[b]	
Fertiliser and soil fertility/health	Conventional	40.5[a]	45.1[a]	23.4[b]	
	Organic	57.8[a]	44.0	33.8[b]	n.s.
	Mean	49.8[a]	44.5[a]	29.0[b]	
Government policies	Conventional	4.6	5.6	12.2	
	Organic	5.0	0.3	8.0	n.s.
	Mean	4.8	2.7[a]	9.9[b]	
Farmer/Grower groups or organisations	Conventional	1.4	0.0	3.4	

Factor	Management	Sector			
		Sheep/beef	Dairy	Kiwifruit	Interaction
	Organic	0.5	2.1	4.5	n.s.
	Mean	0.9[b]	1.1[b]	4.0[a]	
Information	Conventional	4.6[b]	3.2[b]	17.2[a]	
	Organic	10.7	8.1	11.1	n.s.
	Mean	7.9	5.9	13.9	
Marketing/processing organisation /ZESPRI	Conventional	24.9[b](p<0.1)	23.4[b]	44.7[a]	
	Organic	20.5	18.1	34.8	n.s.
	Mean	22.5[b]	20.6[b]	39.3[a]	
Off-farm/orchard work	Conventional	18.2[a]	3.0[b]	4.8[b]	
	Organic	3.9	3.0	3.4	n.s.
	Mean	10.5	3.0	4.0	
Cash farm income/Orchard gate returns	Conventional	34.3	42.3	42.8	
	Organic	38.1	30.9[b]	57.7[a]	n.s.
	Mean	36.3	36.2	50.8	
Off-farm product/Post harvest quality	Conventional	11.1	3.0	13.1	
	Organic	28.4[a]	12.1[b]	15.8	n.s.
	Mean	20.4[a]	7.9[b]	14.6	
Regulation	Conventional	2.1	6.0	9.1	
	Organic	0.0[b]	6.1	10.4[a]	n.s.
	Mean	1.0[b]	6.1[b] (p<0.1)	9.8[a]	
Satisfaction	Conventional	42.9	46.3[a]	16.2[b]	
	Organic	60.1	53.9	45.3	n.s.
	Mean	52.2	50.4	31.9	
Weather/climate	Conventional	33.3[a]	20.8	14.9[b]	
	Organic	38.3[a]	22.3[b]	21.8[b]	n.s.
	Mean	36.0[a]	21.6[b]	18.6[b]	
Stream health	Conventional	8.3	10.1	1.1	
	Organic	17.8	9.0	6.5	n.s.
	Mean	13.4[a]	9.5	4.0[b]	
Water supply and quality	Conventional	21.3	18.9	17.7	
	Organic	15.9	30.0[a]	13.8[b]	n.s.
	Mean	18.4	24.9	15.6	
Map characteristic					
Connections/factor	Conventional	2.7	2.3	1.8	
	Organic	3.0	2.8	2.1	n.s.
	Mean	2.9[a]	2.6[a]	1.9[b]	
Connections	Conventional	58.7[a]	51.3	40.8[b]	
	Organic	61.2	56.0	49.5	n.s.
	Mean	60.0[a]	53.8	45.4[b]	
Density	Conventional	0.13[a]	0.11	0.08[b]	
	Organic	0.15[a]	0.15[a]	0.09[b]	n.s.
	Mean	0.14[a]	0.13[a]	0.08[b]	
Doubles	Conventional	11.8[a]	5.6[b]	3.9[b]	
	Organic	11.5[a]	9.1	6.2[b]	n.s.
	Mean	11.6[a]	7.5[b]	5.1[b]	
Hierarchy Index	Conventional	0.14[a]	0.05[b]	0.07[b]	
	Organic	0.17[a]	0.08[b]	0.07[b]	n.s.
	Mean	0.15[a]	0.07[b]	0.07[b]	
Receiver factors	Conventional	1.8	1.7[b]	3.2[a]	
	Organic	2.2	1.0[b]	3.0[a]	n.s.
	Mean	2.0[b]	1.3[b]	3.1[a]	
Total number factors	Conventional	21.6	22.7	23.6	
	Organic	20.0[b]	20.2[b]	25.3[a]	n.s.
	Mean	20.8[b]	21.3	24.5[a]	
Transmitter factors	Conventional	3.6[b]	7.4[a]	7.0[a]	
	Organic	3.8[b]	3.8[b]	8.4[a]	P=0.03
	Mean	3.7[b]	5.5[b]	7.8[a]	

The maps from the kiwifruit sector had several factors with a greater impact in their map system than the sheep/beef and dairy maps and this was true across both conventional and

organic management systems. The factors were advisors and consultants, farmer/grower groups, and government policies (dairy only). This attention to 'outsiders' to the on-orchard system could indicate the mechanisms by which the kiwifruit sector is able to respond quickly to change. In addition, it could also reflect that these 'outsiders' are physically close to orchardists because of the concentration of production in one main region, that is, the overall industry structure has an effect on these relationships. This sector indicates a greater dependence on contractors and labour which we know already from our other work (e.g., Hunt et al., 2005; Hunt et al, 2006) and it is good to have this reaffirmed. But contractors and labour are also 'outsiders' and could be another mechanism for change though we know from our interviews that there is also concern from orchardists about how difficult it is to change pruning practices. This sector also placed less importance on stream health (than sheep/beef) but this could be simply because only a few of the kiwifruit orchards have streams passing through as the orchards are considerably smaller than the dairy or sheep/beef properties.[10]

The sheep/beef sector place more importance on the impact of the weather and climate on their farm system and this probably indicates their susceptibility to climatic extremes and the lower level of control they have of the impacts of this factor.[11] Both the pastoral sectors placed more importance on the impact of fertiliser and soil health on their systems.

The sheep/beef and dairy sectors have given more weight to the farmer as decision maker but this could be an artefact of the role of the different interviewer in the kiwifruit sector (as has already been described in comparing the 2005 kiwifruit maps with those made in 2008). It may also reflect that the pastoral farmers are more likely to be owner operators rather than managers or contractors.

There are some differences in the map characteristics across each sector. The sheep/beef and dairy sectors have more connections per factor than those in the kiwifruit sector, and fewer receiver only factors which indicates that they had fewer factors which they saw as being caused by other factors but not having an impact on other factors (see Figure 3). (These two characteristics contribute to the greater density of these two sector maps compared to kiwifruit.) This indicates that, dependent on what the receiver variables were, the kiwifruit sector maps could demonstrate a greater awareness of "outcomes and implications that are the results of the system" (Ozesmi and Ozesmi, 2004: 51). The sheep/beef sector had more double arrows in their maps than those in both the dairy and kiwifruit sectors, indicating an understanding that factors often mutually interact with each other. This sector also produced slightly less 'democratic' maps as measured by the hierarchy index (see Figure 4).[12] This indicates that those in this sector saw the factors in their system in a relationship in which one factor was more likely to lead to several others, which means in contrast, that the kiwifruit sector produced maps in which the power or impact of the factors was shared around, giving an indication of a more open system with possibilities, for example in kiwifruit, for a greater influence of 'outsiders' such as advisors, farm groups, policies, packhouses and labour.

The differences between the centrality scores across the sectors was sometimes just a reflection of the difference for a particular management system. Within conventional management this was true for sheep/beef and dairy sectors which placed a greater emphasis on family needs than their kiwifruit counterparts, indicative perhaps of the pastoral farmers being at a different life stage than those in kiwifruit or having a difference in ownership. Those in the sheep/beef sector also made more connections between factors than those in the kiwifruit sector. The sheep/beef maps showed a more 'traditional' orientation with a

[10] Note, we are taking a difference (that only shows up in the overall means) as indicating a common difference across all sectors, but which only has enough power to show up in the combined analysis.
[11] This may have changed after the drought experienced by dairy farmers in the Waikato in the 2007-8 season.
[12] This could be seen to contradict the previous statement. Perhaps though hierarchical some of the arrows in the hierarchy went both ways.

greater emphasis also placed on family history as well as family needs. The greater emphasis placed on off-farm work by these farmers may go against the grain but it may be required if the family farm is to survive. The conventional dairy sector had more links to and from satisfaction than their kiwifruit counterparts. The conventional kiwifruit Green orchardists showed a greater influence of information and ZESPRI (marketing organisation) on their maps which could be another indication of their being from an older age group and newer into kiwifruit growing. It could indicate the extent and relevance of the information that ZESPRI and others provide to those growing kiwifruit.

Some of the differences across the sectors related to organic management only and nearly all possible comparisons between sectors are present. The organic kiwifruit sector placed greater importance than the sheep/beef and dairy organic sectors on net profit and had the highest number of factors and transmitter factors, and the lowest density. Compared to the organic dairy sector, the organic sheep/beef sector paid greater attention to customer/supermarket satisfaction and off farm-product quality, indicating a greater market orientation of organic sheep/beef farmers who are more involved in the direct marketing of their product through selling their animals to companies such as the Southern Organics for processing. When compared to organic kiwifruit, the sheep/beef sector placed a greater importance on the links to and from farm environmental health and placed lesser importance on regulations. The organic kiwifruit orchardists, compared with organic dairy farmers, placed a greater importance on the economic factors (net profit before tax and cash income), whereas the organic dairy farmers placed a greater emphasis on water supply and quality compared to organic kiwifruit orchardists.

Another interesting map measurement was related to transmitter factors. Green kiwifruit orchardists (conventional) and conventional dairy farmers had more transmitter only factors than conventional sheep/beef farmers, but organic kiwifruit orchardists had more transmitter factors than organic dairy and sheep/beef farmers, indicating that the organic dairy farmers were more like the sheep/beef farmers and the conventional dairy farmers were more like their kiwifruit counterparts in seeing more factors as only impacting on other factors, not as also being impacted upon. This higher number of transmitter factors for kiwifruit may be related to the number of off-farm factors that orchardists see as impacting on their system over which they may have little influence. In an investigation to see which factors were more likely to be classified as transmitter only, the conventional farmers and Green orchardists had very few in common. Thirty-six percent of conventional sheep/beef farmers chose advisors and consultants, exchange rate and the economy, and this location as transmitter factors whereas conventional dairy farmers had four different factors and one the same as their sheep/beef counterparts, chosen by more than 30 per cent of their farmers as transmitters (exchange rate and the economy, regulations, information, weather and climate, water supply and quality) and Green kiwifruit orchardists had ten chosen by over 30%, six of which were different again. Those that were the same as their conventional sheep/beef counterparts were advisors and consultants and this location. Those that were the same as their conventional dairy farmer counterparts were weather/climate and water supply and quality. The other factors unique to them were contractors and labour, government policies, grower groups, post harvest quality, soil type and time working on the orchard. In contrast the organic farmers and orchardists showed a little more commonality with the only two factors chosen as transmitters by the sheep/beef farmers - soil type/topography and weather/climate being also chosen by organic dairy and organic kiwifruit. These latter maps had other transmitter factors in common – exchange rate and economy, government policies, plant and machinery, this location and supermarket and customer satisfaction. On top of this organic kiwifruit maps had many more and a greater diversity of transmitter factors, perhaps making this variable a suitable breadth of view indicator (see Rosin et al., 2007).

3.6 Comparisons between management systems in the different sectors

The second set of questions it is relevant to ask is whether there are any differences between organic and conventional management that are common across all sectors. If so then this indicates that there is a management system effect independent of sector. Table 13 lists the results and identifies if there is a management system difference and, if there is, the source of that difference. The main effect column indicates if there is a panel effect independent of the sectors. The interaction column indicates if the pattern of results is different across the sectors within each management system. As indicated earlier, we do not report main effects that are not consistently supported by the results in the sectors.

There were no differences between conventional and organic management common across all sectors except organic practitioners had more connections per factor on their maps. This lack of commonality of differences implies that the importance placed on factors in the causal maps and certain map characteristics are unique to the management systems in a particular sector, which makes us unable to generalise the differences between organic and conventional management systems as represented in the causal maps.

Organic farmers in both the sheep/beef and dairy sectors placed a greater importance on environmental health than their conventional counterparts but this difference was not replicated in the kiwifruit sector and possibly reflects the impact of KiwiGreen practices in the latter sector which has produced a greater awareness of environmental health for all orchardists. Conventional farmers in the sheep/beef sector placed more importance on family history and background, and off-farm work, but it was organic sheep/beef farmers who placed a greater importance on fertiliser and soil health and off-farm product quality. In the dairy sector organic farmers emphasised increasing plant and animal biodiversity, reflecting the change in pasture composition sought by many organic dairy farmers. These farmers also had a greater map density. Conventional dairy farmers were counter to those in other sectors by having more transmitter only factors in their maps, demonstrating an awareness of how factors impact on others but less awareness of how these factors might also be impacted upon. In the kiwifruit sector the difference between organic and Green orchardists farmers on the importance placed on family needs and satisfaction (higher for organic) was not reflected in the other sectors. In both the dairy and the kiwifruit sectors there was a difference between organic and conventional practitioners for net profit before tax/cash orchard surplus, but this difference went in opposite directions with conventional dairy farmers and organic orchardists placing a greater emphasis on this. This probably fits the common understanding that conventional dairy farmers have concerns to also be successful business people while organic kiwifruit orchardists also pay greater attention to their costs and returns than their more conventional counterparts.

Table 13: Comparison of centrality scores and map characteristics for conventional and organic panels across sectors

Factor	Management	Sector				Interaction
		Sheep/beef	Dairy	Kiwifruit	Main effect Mgt	
Net profit before tax/Cash orchard surplus	Conventional	23.9	38.0[a]	22.8[b]	27.8	p=0.014
	Organic	23.5	16.4[b]	46.3[a]	28.9	
Family history and background	Conventional	12.9[a]	3.2	0.0	5.7	n.s
	Organic	3.4[b]	3.9	0.8	2.7	
Family needs	Conventional	41.2	38.3	6.4[b]	28.7	n.s.
	Organic	35.8	33.0	32.5[a]	33.8	
Farm/orchard environmental health	Conventional	30.1[b]	24.7[b]	21.2	25.5[b]	n.s.
	Organic	60.6[a]	48.0[a]	34.0	47.9[a]	
Fertiliser and soil fertility/health	Conventional	40.5[b]	45.1	23.4	36.2[b]	n.s.
	Organic	57.8[a]	44.0	33.8	45.6[a] (p<0.1)	
Off-farm/orchard work	Conventional	18.2[a]	3.0	4.8	9.1	n.s.
	Organic	3.9[b]	3.0	3.4	3.5	
Off-farm product/Post harvest quality	Conventional	11.1[b]	3.0	13.1	9.3[b]	n.s.
	Organic	28.4[a]	12.1	15.8	19.3[a]	
Satisfaction	Conventional	42.9	46.3	16.2[b]	35.1[b]	n.s.
	Organic	60.1	53.9	45.3[a]	53.3[a]	
Increasing plant and animal biodiversity	Conventional	15.3	6.9[b]	8.7	10.5	n.s.
	Organic	10.2	33.9[a]	11.8	17.9	
Map characteristic						
Connections/factor	Conventional	2.7	2.3	1.8	2.3[b]	n.s.
	Organic	3.0	2.8	2.1	2.6[a]	
Density	Conventional	0.13	0.11[b]	0.08	0.11[b]	n.s.
	Organic	0.15	0.15[a]	0.09	0.13[a]	
Transmitter factors	Conventional	3.6	7.4[a]	7.0	5.9	p=0.030
	Organic	3.8	3.8[b]	8.4	5.3	

3.7 Comparisons between sectors for Q-sort types

This section, comparing the sectors for the Q-sort types, should produce very similar results to the section comparing the sectors for organic and conventional management systems but the Q-sort types were derived from all the data including Integrated management in sheep/beef and Gold kiwifruit management.

Using the Q-sort results we can now ask if there are any differences across the sectors (sheep/beef, dairy, kiwifruit) that are common to both Q-sort types. If so then this indicates that regardless of Q-sort types there is an effect due to the sector. (In the next section we will compare whether the differences between the Q-sort types are common across all sectors.) Table 14 lists the results and identifies if there is a sector difference in the mean score and, if there is, whether it is the sector that is the source of that difference or whether it is just occurring in the Q-sort type. This table shows different differences between sector results than Table 12 because the Q-sort types were calculated from all the data including the integrated sheep/beef maps and the Gold kiwifruit maps.

Suffice to say that Table 14 shows that there are many differences across sectors that occur only within one Q-sort type and not the other. Here we will concentrate only on those differences that are common to both Q-sort types and therefore show what could be considered to be generic differences between sectors. Hopefully these reflect what we have already found, with the proviso, mentioned above, that these results are for the full data set incorporating both integrated sheep/beef farmers and Gold kiwifruit orchardists. Kiwifruit orchardists place greatest importance on the links to and from the factors to do with advisors

and consultants, and contractors and labour. The higher value placed on decision maker has already been discussed. This sector also has the highest number of transmitter only factors. The sheep/beef and dairy sectors place the highest value on fertilisers and soil fertility and these sector maps have more connections per factor, and a greater map density. The sheep/beef sector had the most hierarchical maps and compared with the kiwifruit sector, the most double arrows. These findings match most of the findings from Table 12 indicating that adding in the integrated management and kiwifruit Gold systems produces similar patterns.

Table 14: Comparison of centrality scores and map characteristics for Q-sort types across sectors

Factor		Sector			
	Management	Sheep/beef	Dairy	Kiwifruit	Interaction
Advisors, consultants etc.	Q-sort 1	6.0	1.1[b]	16.1[a]	
	Q-sort 2	5.8	0.0[b]	14.0[a]	n.s.
	Mean	5.9[b]	0.6[b]	15.1 [a]	
Net profit before tax/Cash orchard surplus	Q-sort 1	32.4	32.8	35.5	
	Q-sort 2	19.3[b]	18.1[b]	40.4[a]	n.s.
	Mean	26.4	26.1	37.8	
Contractors/contractors and labour	Q-sort 1	2.3[b]	4.3[b]	17.8[a]	
	Q-sort 2	6.9	4.1[b]	13.0[a]	n.s.
	Mean	4.4[a]	4.2[b]	15.6[a]	
Customer/ supermarket requirements	Q-sort 1	3.6	4.0	12.4	
	Q-sort 2	17.2[a]	1.6[b]	8.0	p=0.036.
	Mean	9.8	2.9	10.4	
Customer/Supermarket satisfaction	Q-sort 1	3.3[b]	5.7	14.6[a]	
	Q-sort 2	19.3[a]	3.9[b]	4.2[b]	p<0.001
	Mean	10.6	4.9	9.9	
Farmer/grower decision maker	Q-sort 1	138.9[a]	116.1[a]	73.1[b]	
	Q-sort 2	157.6[a]	142.9[a]	94.9[b]	n.s.
	Mean	147.4[a]	128.3[a]	83.0[b]	
Farm/orchard environmental health	Q-sort 1	16.1	22.4	23.4	
	Q-sort 2	55.3[a]	57.0[a]	26.6[b]	p=0.016
	Mean	33.9	38.2[a]	24.8 (p<0.1)	
Fertiliser and soil fertility/health	Q-sort 1	37.7	47.2[a]	26.3[b]	
	Q-sort 2	53.3[a]	40.9	27.9[b]	n.s.
	Mean	44.8[a]	44.3[a]	27.0[b]	
Quality and quantity of plants and/or livestock / Fruit yield and quality	Q-sort 1	75.2	81.6	71.1	
	Q-sort 2	86.5[a]	77.8	58.8[b]	n.s.
	Mean	80.3[a]	80.0[a]	65.5[b] (p<0.10)	
Government policies	Q-sort 1	4.9	0.9[b]	11.0[a]	
	Q-sort 2	2.7	5.4	4.1	n.s.
	Mean	3.9	2.9	7.9	
Improve equity/land size	Q-sort 1	12.2[a]	6.6	2.2[b]	
	Q-sort 2	6.0	5.3	8.8	p=0.092
	Mean	9.4	6.0	5.2	
Marketing/processing organisation /ZESPRI	Q-sort 1	12.8[b]	25.5	37.4[a]	
	Q-sort 2	23.7	14.0	33.1	n.s.
	Mean	17.7[b]	20.2[b]	35.4[a]	
Off-farm product/Post harvest quality	Q-sort 1	7.9[b] (p<0.10)	6.2[b]	20.3[a]	
	Q-sort 2	23.2	10.0	11.0	p=0.016
	Mean	14.9	7.9	16.0	

Factor	Management	Sector			
		Sheep/beef	Dairy	Kiwifruit	Interaction
Regulation	Q-sort 1	1.9[b]	8.0	10.8[a]	
	Q-sort 2	1.3	3.4	5.2	n.s.
	Mean	1.6[b]	5.9	8.3[a]	
Retirement	Q-sort 1	5.8	6.4	0.0	
	Q-sort 2	3.7	1.0[b]	11.4[a]	p=0.010
	Mean	4.8	3.9	5.2	
Smallholding/subdivision	Q-sort 1	0.0	3.0	1.0	
	Q-sort 2	0.0[b]	0.0[b]	4.1[a]	p=0.069
	Mean	0.0	1.6	2.4	
Soil type/topography	Q-sort 1	5.7	5.2	8.6	
	Q-sort 2	15.5[a]	4.5[b]	4.8[b]	p=0.072
	Mean	10.3	4.9	6.8	
Weather/climate	Q-sort 1	28.8	20.0	16.6	
	Q-sort 2	41.4[a]	23.8[b]	27.2[b]	n.s.
	Mean	34.6[a]	21.7[b]	21.4[b]	
Total	Q-sort 1	685.7	695.0	684.9	
	Q-sort 2	999.5[a]	866.8	824.9[b]	
	Mean	828.7	773.3	748.7	
Increasing plant and animal biodiversity	Q-sort 1	8.1	13.9	6.4	
	Q-sort 2	9.2[b]	31.0[a]	10.0[b]	n.s.
	Mean	8.6[b]	21.7[a]	8.0[b]	
Map characteristic					
Connections/factor	Q-sort 1	2.4[a]	2.3	1.8[b]	
	Q-sort 2	3.0[a]	2.9[a]	2.0[b]	n.s.
	Mean	2.7[a]	2.6[a]	1.9[b]	
Connections	Q-sort 1	49.1	50.7	42.3	
	Q-sort 2	66.7[a]	58.1	50.2[b]	n.s.
	Mean	57.0[a]	54.0[a]	45.9[b]	
Density	Q-sort 1	0.13[a]	0.11	0.08[b]	
	Q-sort 2	0.14[a]	0.15[a]	0.08[b]	n.s.
	Mean	0.13[a]	0.13[a]	0.08[b]	
Doubles	Q-sort 1	9.9[a]	6.1	4.8[b]	
	Q-sort 2	12.7[a]	9.4[a]	4.8[b]	n.s.
	Mean	11.2[a]	7.6[b]	4.8[b]	
Hierarchy Index	Q-sort 1	0.13[a]	0.05[b]	0.05[b]	
	Q-sort 2	0.15[a]	0.10[b]	0.07[b]	p=0.045
	Mean	0.14[a]	0.07[b]	0.07[b]	
Receiver factors	Q-sort 1	1.5	1.7	2.6	
	Q-sort 2	2.0[b]	0.9[b]	4.3[a]	p=0.010
	Mean	1.7[a]	1.3[a]	3.4[b]	
Total number factors	Q-sort 1	20.5	22.0	23.7	
	Q-sort 2	22.4[b]	20.6[b]	26.7[a]	n.s.
	Mean	21.3[b]	21.4[b]	25.0[a]	
Transmitter factors	Q-sort 1	4.6[b]	6.7	8.2[a]	
	Q-sort 2	3.8[b]	4.0[b]	7.6[a]	n.s.
	Mean	4.2[b]	5.5[b]	7.9[a]	.

3.8 Comparisons across management systems that are common to Q-sort types – Q-sort effects

The second set of questions it is relevant to ask about the Q-sort results is whether there are any differences between Q-sort types that are common across all sectors. If so then this indicates that regardless of sector there is an effect due to the Q-sort types. If the Q-sort types demonstrate some consistent differences across sectors then we can validate our more general claim that Q-sort 1 is more indicative of a business orientation and Q-sort 2 indicative of an environmental and family orientation. Table 15 shows the results for these comparisons. It shows that the factors family needs, farm orchard environment as a place to live, water supply and quality and future generations/succession and weather and climate are all being picked up as more important across all sectors for those classified as Q-sort 2 type.

Table 15: Comparison of centrality scores and map characteristics for Q-sort type within sectors

Factor	Q-sort Type	Sector				Interaction
		Sheep/beef	Dairy	Kiwifruit	Mean	
Customer/ supermarket requirements	1	3.6[b]	4.0	12.4	6.9	p=0.036.
	2	17.2[a]	1.6	8.0	10.1	
Customer/Supermarket satisfaction	1	3.3[b]	5.7	14.6	8.0	p<0.001
	2	19.3[a]	3.9	4.2	10.1	
Exchange rate, economy	1	11.8[a]	9.4[a]	13.7	11.9[a]	n.s
	2	4.7[b] (p<0.10)	2.0[b] (p<0.10)	9.8	5.9[b]	
Family needs	1	28.3[b]	27.1[b]	13.0[b]	22.4[b]	n.s.
	2	46.2[a] (p<0.10)	47.1[a]	47.2[a]	46.8[a]	
Farmer/grower decision maker	1	138.9	116.1	73.1	109.3[b]	n.s.
	2	157.6	142.9	94.9	131.1[a]	
Farm/orchard environment as place to live	1	7.6[b]	4.6[b]	6.9[b]	6.6[b]	n.s.
	2	32.7[a]	41.3[a]	31.2[a]	34.2[a]	
Farm/orchard environmental health	1	16.1[b]	22.4[b]	23.4	20.3[b]	p=0.016
	2	55.3[a]	57.0[a]	26.6	45.1[a]	
Fertiliser and soil fertility/health	1	37.7[b]	47.2	26.3	35.8	n.s.
	2	53.3[a]	40.9	27.9	41.0	
Future generations/succession	1	2.8	7.1	1.9	3.5[b]	n.s.
	2	11.1	17.0	11.0	12.5[a]	
Off-farm activities	1	7.8	4.0[b]	3.1[b]	5.2[b]	n.s.
	2	16.5	15.3[a]	17.0[a]	16.4[a]	
Off-farm product/Post harvest quality	1	7.9[b]	6.2	20.3	12.0	p=0.016
	2	23.2[a]	10.0	11.0	15.5	
Retirement	1	5.8	6.4	0.0[b]	3.8	p=0.010
	2	3.7	1.0	11.4[a]	5.9	
Satisfaction	1	31.6[b]	34.9[b]	26.0	30.3[b]	n.s.
	2	69.8[a]	71.5[a]	47.2	61.9[a]	
This/Orchard location	1	9.7	7.5	5.9[b]	7.7[b]	n.s.
	2	12.0	15.8	17.6[a]	14.9[a]	
Weather/climate	1	28.8	20.0	16.6	22.2[b]	n.s.
	2	41.4	23.8	27.2	31.9[a]	
Stream health	1	4.8[b]	6.9	1.9	4.3[b]	n.s.
	2	19.4[a]	13.1	8.7	14.0[a]	
Water supply and quality	1	17.6	19.7	11.4	15.8[b]	n.s.
	2	24.7	31.6	23.6	25.9[a]	
Total	1	685.7[b]	695.0[b]	684.9	687.6[b]	n.s.
	2	999.5[a]	866.8[a]	824.9	903.5[a]	
Increasing plant and animal biodiversity	1	8.1	13.9[b]	6.4	8.9	n.s.
	2	9.2	31.0[a]	10.0	14.7	
Map characteristics						
Connections/factor	1	2.4[b]	2.3[b]	1.8	2.2[b]	n.s.
	2	3.0[a]	2.9[a]	2.0	2.6[a]	
Connections	1	49.1[b]	49.1	42.3	46.6[b]	n.s.
	2	66.7[a]	58.1	50.2	58.6[a]	
Density	1	0.13	0.11[b]	0.08	0.11	n.s.
	2	0.14	0.15[a]	0.08	0.12	
Hierarchy Index	1	0.13	0.12[b]	0.05	0.10[b]	n.s.
	2	0.15	0.26[a]	0.07	0.15[a]	
Ordinary factors	1	14.4	13.5	12.9	13.6[b]	n.s.
	2	16.5	15.8	14.7	15.7[a]	
Receiver factors	1	1.5	6.0[a]	2.6[b]	3.0	p=0.010
	2	2.0	4.0[b]	4.3[a]	3.3	
Transmitter factors	1	4.6	6.7[a]	8.2	6.4	n.s.
	2	3.8	4.0[b]	7.6	5.2	

The farmer/grower as decision maker is also more important to those in Q-sort 2. This analysis therefore justifies the family orientation assertion of the difference between the types and suggests that the farm environment as a place to live with a family is the emphasis of this group. Q-sort 2 placed no greater emphasis on the farm/orchard environmental health than those in Q-sort 1. Q-sort 2 also had the highest number of ordinary factors.

The sheep/beef sector and dairy sector did share some differences across the Q-sort types. Q-sort 2 had the highest values placed on the factors farm/orchard environmental health and satisfaction. These sectors also had a higher total centrality score and more connections per factor, whereas Q-sort 1 had the highest centrality for exchange rate and economy, indicating a greater awareness of the impact of external economic factors on their businesses. Q-sort 1 had more receiver only variables, again indicating an awareness of the impact of often external factors over which they had no control, on other factors. The dairy and kiwifruit sectors shared the greater emphasis placed on off-farm activities by Q-sort 2.

As differences between the Q-sort types have already been reported within individual sectors in other ARGOS reports we will not go into these here except to say that not all of the differences between Q sorts within sectors reported on in earlier and in other reports show up on this analysis because the variances used in the calculations now come from an analysis which uses the data from all sectors.

So overall we can say that across the sectors Q-sort 1 and 2 were differentiated on the following factors: family needs, farm orchard environment as a place to live, weather and climate and farmer/grower as decision maker, with the Q-sort 2 type placing greater importance on these in their maps than the Q-sort 1 type. The claim of a greater economic orientation of Q-sort 1 is not supported by this analysis.

3.9 Overall sector comparisons

The last set of comparisons, shown in Table 16, involves looking at the centrality scores and map characteristics across all sectors studied (kiwifruit, sheep/beef, dairy and high country). This is a basic comparison just taking the overall average of each sector which means that all sectors but high country include organic farmers, and integrated farmers are included in the sheep/beef sector and Gold orchardists in the kiwifruit sector. Essentially, this analysis is looking for any standout characteristics of the sector that show up regardless of the panels included. These results will be relevant to an interpretation offered later in this chapter. The columns are arranged in the order from high country, sheep/beef, dairy and kiwifruit to reflect the increasing intensity of production used in each sector. We hypothesised that with increasing intensity farms/orchards can be subject to greater control by the farmer/orchardist and the emphasis on high levels of production per hectare, usually of a single product, means that the farm system is less diverse or complex. Therefore, high country and sheep/beef, at the lower end of intensity, could be expected to have more complex systems and this would be reflected in their causal maps.

Table 16: Cross sector comparisons of centrality scores and map characteristics

Factor	Sector				Mean
	High Country (8)	Sheep/beef (34)	Dairy (20)	Kiwifruit (30)	
Advisors, consultants etc.	6.2	6.2[a]	1.0[b]	15.0[a]	8.0
Net profit before tax/Cash orchard surplus	26.1	23.8[b]	27.1	37.7[a]	29.3
Contractors/contractors and labour	13.5	5.5[b]	4.4[b]	16.9[a]	9.7
Community	16.0[a]	6.0	5.6	3.0[b]	5.8
Exchange rate, economy	6.6	7.4	6.3[b]	12.4[a]	8.7
Family needs	68.2[a]	42.2[b]	37.2[bc]	24.7[c]	31.4
Farmer/grower decision maker	165.1[a]	149.6[a]	129.3[a]	79.4[b]	123.6
Farm/orchard environmental health	24.4	39.8[a]	35.1	25.0[b]	32.6
Fertiliser and soil fertility/health	42.1[a]	46.2[a]	44.4[a]	26.2[b]	39.0
Government policies	6.2	3.9[b]	3.0[b]	8.9[a]	5.6
Marketing/processing organisation	13.5[b]	19.0[b]	22.0[b]	36.1[a]	24.7
Off-farm product/Post harvest quality	5.1[b]	16.6	7.9[b]	17.3[a]	14.0
Satisfaction	46.6	54.6[a]	51.8	33.0[b]	46.3
Time working on farm/orchard	29.0[a]	15.2	17.6	8.5[b]	14.8
Weather/climate	41.4[a]	36.2[ab]	22.6[c]	20.4[c]	28.5
Map characteristic					
Connections/factor	2.3[bc]	2.8[a]	2.5[ab]	1.9[c]	2.4
Connections	68.9	59.5[a]	53.6	45.3[b]	54.4
Density	0.08[b]	0.13[a]	0.13[a]	0.08[b]	0.11
Doubles	18.1[a]	11.4[a]	7.4	4.9[b]	9.0
Hierarchy Index	0.05[b]	0.14[a]	0.07[b]	0.06[b]	0.09
Receiver factors	2.1	1.9	1.4[b]	3.1[a]	2.2
Total number factors	30.4[a]	21.6[c]	21.4[c]	25.0[b]	23.5
Transmitter factors	7.6	4.1[b]	5.6	8.3[a]	6.1

For all of the factors and map characteristics showing significant differences the kiwifruit sector had either the highest or the lowest result. This sector produced the highest results compared with one or more of the other sectors, for factors which impacted on the orchard systems from 'outside' – advisors, consultants, contractors/labour, marketing, processing organisation (ZESPRI), exchange rate, government policies, and off-farm product quality/post harvest quality. It placed the most value on net profit before tax and least value on social factors such as satisfaction, family needs, community and time at work which may indicate that orchardists gained satisfaction from sources not referred to in this research.

The kiwifruit sector was significantly different from all the other sectors for three factors. It had the highest score for marketing and processing and the lowest scores for fertiliser and soil health, and farmer/grower as decision maker. The reasons for the latter result have already been discussed. Because kiwifruit orchards are considerably smaller in size than farms, it may be that soil fertility can be more easily managed than in the pastoral sector.

The kiwifruit sector also differed over other factors in different combinations. It had the highest scores compared with sheep/beef and dairy for contractors and labour and government policies. The high country and dairy sectors had a significantly lower emphasis on off-farm product quality than kiwifruit, again showing up how needs of the market have more effectively filtered down to the producer level in the kiwifruit sector than in the other sectors.

Two factors, family needs and weather and climate showed the same ordering of importance across the sectors with high country highest through sheep/beef, dairy to kiwifruit as the lowest. Weather/climate appears to be a less important factor in the more intensive systems probably because the locations are selected for particular kind of farm/orchard because they have suitable weather (relatively reliable rainfall for dairy) or have irrigation to counteract rainfall problems, or frost protection systems (for kiwifruit). While the impact of weather and

climate is a factor over which the more extensive farming systems can exercise less control. The importance of family needs is more likely to relate to the stage in the life cycle of farmers. The maps also show that family is more important in the less intensive farming systems. This is likely to be because many of the kiwifruit orchardists are further on in their life cycle than the others, having taken up kiwifruit orcharding later in life,[13] and both dairy farms and orchards are in places with higher population densities and closer to towns which puts less stress on families in terms of access to education and other amenities and activities. High country and sheep/beef farmers also tend to be more concerned about succession, and education for their children is a problem, particularly as they have been going through financially difficult times. They also place a greater importance on time working on the farm and this is likely to link into family issues as well.

Only one factor, advisors and consultants, showed a different grouping with the sheep/beef and kiwifruit sectors placing more importance on these people than those in the dairy sector.

Overall, the dairy and sheep/beef sector maps placed less importance on external factors. The sheep/beef sector maps indicated greatest importance was placed on factors difficult for farmers to control. Compared with kiwifruit maps, they also placed the most importance on satisfaction perhaps indicating a greater awareness of it in their lives in the difficult times sheep/beef have been experiencing. Also compared with kiwifruit maps, these maps also had the fewest and lowest value links to net profit before tax, which indicates that 'success' is more likely to be measured by production or income rather than considering expenses.

The high country sector, in contrast to all the other sectors, placed greatest importance on social factors such as community, family needs and time spent working - the latter which, of course, relates to having time and resources for family and community. These maps also placed importance on factors which have impacts difficult for high country farmers to control. These maps, like the dairy maps, gave least emphasis to off-farm product quality and marketing, processing organisation, though probably for different reasons. They are factors the dairy farmers can take for granted as attended to by Fonterra and for high country farmers the NZ Merino company handles most of the marketing of merino wool, and in relation to livestock sales, most animals are sold as stores to other farmers not a processor/exporter.

For most of the map characteristics there is not an order effect based on increasing intensity. Only for the number of connections, double arrows, and ordinary factors is the order as we predicted, and for these characteristics some of the differences are not significantly different.

The high country farmers, the lowest end of the intensification spectrum, had the highest number of factors and (along with sheep/beef) the highest number of double arrowed factors. This indicates that they were linked of a lot of things in their farming system illustrating their interdependence.[14]

The sheep/beef sector with the lowest number of factors (alongside the dairy sector) has the highest number of connections between factors, connections per factor and double arrowed factors (with dairy), which ties in with having (with dairy) the highest map density. It would seem that within the sheep/beef farmers' map system, which is more 'enclosed' or limited to the farm than the maps for the other sectors, sheep/beef farmers are able to see more links between their factors than those in the other sectors, and presented their farm system as more complex. Their maps are also slightly less democratic which could indicate that they are less open to change than those in the other sectors.

The dairy sector tended to be in the middle of the other sector results and was either similar to sheep/beef or kiwifruit.

[13] Less than 50 per cent of the ARGOS kiwifruit orchardists have children still at home, whereas at least 75 per cent of the ARGOS sheep/beef farmers do.

[14] As the statistical analysis used can only compare relationships between two factors we cannot comment on interactions/loops/networks between more than two factors except in a more observational way.

In contrast to the sheep/beef sector, the kiwifruit sector at the high end of the intensification spectrum had the lowest values for most of the measures for which sheep/beef was highest, a possible result of having more factors than all sectors but high country. In contrast the kiwifruit maps had more receiver and transmitter factors, meaning that they saw more factors as being endpoints or starting points in the orchard system. They were also slightly more democratic, demonstrating that orchardists (along with high country and dairy farmers) saw themselves as having more options in dealing with problems. This sector had a more open system which attributed more influence to factors off the orchard. In addition to having fewer double arrows overall, there are no double arrows at the core of the kiwifruit causal map, that is, among the top six factors, indicating that the kiwifruit orchardists tend to see their orchard system in terms of a network and one-way influences rather than relationships between two factors only.

3.10 Conclusion

This chapter has presented results on the overall group map for kiwifruit including comparisons to the 2005 results. It gave a detailed analysis of that map before examining group maps for the panels and for the Q-sort types. The chapter compared centrality scores and map characteristics for conventional and organic panels across and within sectors, and compared Q-sort types across and within sectors. Finally, it compared centrality scores across all four sectors.

Chapter 4
Key Findings and Discussion

4.1 Introduction

This conclusion, which return to our focus on the kiwifruit sector, provides a summary of our research approach, the objectives, and the results. It then interprets the results on a number of dimensions.

4.2 Summary of approach

This research had four objectives:

- To document how orchardists participating in our ARGOS research described and explained the management of their farm system.
- To assess the results for any patterns in the way orchard systems are seen and understood.
- To assess the degree of change in orchardist perception of their orchard system. This objective is necessarily limited by the fact that since the method was modified, we cannot be certain if any changes are due to the change in method, due to changes in the orchardists or due to the different interviewer.
- To compare the 2008 results with the results from the other sectors studied.

Changes to the method in 2008 meant that there were 41 factors rather than 36, a Q-sort enabled orchardists to identify the more important factors, and orchardists made their own maps rather than working with a generic map. Three of the orchardists in 2005 were no longer in the ARGOS panels in 2008.

The data were used to prepare a group causal map for all 30 orchardists by focusing mainly on the centrality of the factors. This map showed the key factors and their inter-relationships and demonstrated the fundamental nature of kiwifruit orcharding. After working with the data for all 30 orchardists, attention was given to the group map for each of the three panels. Then the Q-sort data were analysed using standard Q-methodology factor analysis to identify two groups of orchardists. Maps were prepared for each Q-sort type.

4.3 Summary of results

The main characteristics of the maps are as follows:

The factors with the highest-rated centrality scores were similar in both years.

Factor	2008	2005
Decision maker	79	168
Fruit yield and quality	67	61
Orchard gate returns	55	42
Vine health	39	
Cash orchard surplus	38	31
Marketing organisation (ZESPRI)	36	41

While most of the centrality scores were similar in the two years, some factors received significantly different scores.

Factor	2008	2005
Decision maker	79	168
Orchard gate returns	55	42
Cash orchard expenditure	28	38
Family needs	25	11
Regulation	9	19
Time working on orchard	9	19

Group map
The group causal map shows the central role of the orchardist as decision maker, with an emphasis on productions factors such as fruit yield and quality, vine health, fertiliser and soil fertility, and ZESPRI, and the financial factors orchard gate return and cash orchard surplus.

The 2005 and 2008 maps have 19 out of 30 similar connections with most of the new connections relating to the new factors. The distinctive new connections unrelated to the new factors are orchard location to fruit yield and quality and links to and between satisfaction and family needs. There were four double arrows in 2005 and one in 2008.

Analysis of goals and change questions
While the majority of orchards were in a similar if not identical position in 2008 compared to 2005, a minority were in a different position. The 2008 causal mapping results cannot be expected to be identical to 2005 results.

Panel results

- There is a very close match between the Green panel and the overall average.

- Organic orchardists had the most distinctive group map, and emphasised orchard gate returns, satisfaction and family needs compared to Green, fertiliser and soil fertility compared to Green and Gold, orchard environmental health and vine health compared to Gold.

- Distinctive Organic connections included stronger connections from fertiliser and soil fertility to vine health, fertiliser and soil fertility to fruit yield and quality, cash orchard surplus to satisfaction, and orchard environment as a place to live to family needs.

- Gold orchardists emphasised packhouse compared to Organic, post harvest quality and family needs compared to Green.

- Distinctive Gold connections included stronger connections from packhouse to post-harvest quality, packhouse to orchard gate returns, orchard gate returns to cash orchard surplus, and exchange rate/macro-economy to orchard gate return.

- These results reflect our assertion that the ‘commodity chain’ is a strong determinant of practice in that Organic and Gold Orchardists tend to be people who are more willing to push the boundaries compared with the more ‘middle of the road’ Green orchardists (see our descriptions of ‘ovoid’ types of orchardists derived from our first qualitative interviews (Hunt et al., 2005: 101-106)).

Comparisons of panel results over time

The panel differences found in the causal maps from 2005 were quite different from those found in 2008. There were two similar results and five dissimilar results for 2008 not found in 2005. Further, three significant differences were found in 2005 that were not found in 2008.

In both 2005 and in 2008 the Green panel maps were similar to the overall group map. In 2005 for the organic map there was only one factor with a higher centrality score – farm/orchard environmental health and this also occurred in 2008. However, a number of additional connections were highlighted as stronger in 2005.

There were few similarities between the distinctive attributes of the Gold panel in 2005 and 2008.

Compared to 2005 there were many clear distinctions for the organic panel.

Q-sort groups

The analysis of the initial ranking of the factors by each orchardist produced two different Q-sort groups.

- Q-sort type 1 (kiwifruit business, n=20) emphasised post harvest quality, and supermarket/customer satisfaction.

- Q-sort type 2 (kiwifruit lifestyle, n=9) emphasised water supply and quality, orchard environment as a place to live, orchard location, family needs, off-orchard activities and retirement.

- Distinctive Q-sort type 2 connections included stronger connections from decision maker to family needs, and from cash orchard surplus to off-orchard activities.

Hence, these two groups contrasted a more business-like orientation with one emphasising family, and attributes to do with the orchard's location.

4.4 Discussion and Interpretation of Results

How the orchard system works

Kiwifruit orchardists focus on fruit yield and quality. This important element of production is influenced by decision maker and vine health and it leads directly to orchard gate returns then cash orchard surplus. In addition, ZESPRI has an important effect on orchard gate returns and decision maker. These are the essential and important elements of kiwifruit orcharding.

Green orchardists share this view of the essentials of orcharding. Organic orchardist follow this pattern but in addition see fertiliser and soil fertility more strongly connected to vine health and fruit yield and quality. They also emphasise satisfaction, in part derived from cash orchard surplus and orchard gate return, and family needs, in part derived from orchard environment as a place to live. Organic orchardists get satisfaction from more sources than the others, indicating that their wellbeing is likely to have a stronger basis. They also see orchard environmental health as affected by more things and it is also a source of satisfaction. There are two two-way connections on the group map indicating that each influences the other – a co-dependent relationship. As with the Green map, there is two-way relationship between decision maker and vine health. In addition, there is feedback between family needs and orchard environment as a place to live. These distinctive aspects of organic kiwifruit production reflect ideas typical of organic farming practice and philosophy. The stronger connections from the two financial factors to satisfaction for organic orchardists

were not expected. Perhaps organic orchardists are more aware of these connections because they struggle to generate the yields necessary to get good returns and when they do they are more satisfied. Perhaps also it reflects their lack of control over orchard gate returns because of external factors. Another explanation may be that organic orchardists take great pride in achieving important financial goals using an alternative system. With more of the Green orchardists, on the other hand, being older and less likely to still have families at home, they may be more financially secure and carrying less debt.

Gold orchardists also follow the general pattern but in addition see that the packhouse plays a crucial role with stronger connections from it to post-harvest quality and to orchard gate returns. They also emphasised the effect of the exchange rate/macro-economy on orchard gate returns. These distinctive aspects of Gold production reflect the characteristics of gold kiwifruit – they have to be handled more carefully right through the growing, picking and storing processes because they are more apt to deteriorate in quality compared to green fruit, hence the concern about packhouse and post-harvest quality

Comparing kiwifruit results over time

The basic centrality data showed that the top-rated factors were similar in 2005 and 2008. However, there were some differences in the centrality scores of some factors and if we assume that these reflect orchardist changes rather than changes in method, then the 2008 results suggest that orchardists were paying more attention to orchard gate returns and less attention to cash orchard expenditure. Family needs was more important in 2008, and regulation less important. We are not able to explain the increased emphasis on family needs but the reduced emphasis on regulation may be because orchardists have become used to the requirements of the GlobalGAP reporting process have become normalised among the orchardists.

In general terms, the group map was basically similar in both years, even though there were differences at the panel level. It showed a strong production emphasis. The overall results give us some confidence that the method was recording some unchanged basic characteristics of kiwifruit orcharding. In particular, the panel results, which were more detailed in 2008, vindicate the use of the revised method and affirm that it allows for a greater variation in response. However, the differences found raise the question of what has caused the changes. Were they due to orchardists changes or due to changes in method?

The fact that there were differences in the results is not surprising given the changes in the orchardists and in the method. Changes in goals for five orchardists, and the presence of three orchardists new to ARGOS meant that the causal map results could not be identical to the 2005 results, even if the method were unchanged. It seems very likely that some of the distinctive results in 2008 are reflecting differences in the composition of the orchardists.

One of the unusual results in 2008 was the low centrality score (approximately one half of the 2005 level) for decision maker. We expected that since decision maker was of central importance in the map it would be connected to a similar number of factors and therefore have a similar score in both years, and would be similar to those recorded in the other studies. While at first glance the low centrality score might be an outcome of the use of a different method, this explanation is unsound. The same method was used in the sheep/beef, dairy and high country sectors and produced centralities for decision maker of 150, 129 and 165 respectively. Neither is it likely that the three different orchardists in 2008 contributed to this particular result. Perhaps the different interviewer meant that there was an interviewer effect and the orchardists did not insert as much detail into the map as they did in 2005. With less detail, there were fewer connections for decision maker. If this explanation were true we would expect that the centrality scores in 2005 would, on average, be higher. Table 3 does show that while many of the factors of lesser importance had a higher score in 2005, factors of greater importance mainly had lower scores. The overall average of the centrality scores was 25 in 2005 and 30 in 2008 which does not support this interpretation. It seems plausible

there was an interviewer effect and the discrepancy in the scores across sectors for decision maker supports this interpretation. However, a different interviewer was also used for the high country research, but this interviewer did not have the long relationship with those interviewed as did the interviewer of the kiwifruit orchardists. It may have been that orchardists were jaded the second time around and experienced respondent fatigue. However, there was no evidence of any lack of willingness or commitment to the mapping process. They occurred at least three years apart and it appeared that orchardists had little recollection of the first mapping. We do not have a compelling explanation for the low centrality score for decision maker in 2008.

Q-sort distinctions

The Q-sort results highlighted a different set of distinctions compared to the panel analysis. There was a majority of orchardists who emphasised the production of kiwifruit in terms of both quality and quantity but in addition emphasised post-harvest quality and supermarket customer satisfaction. Q-sort type 1 shows greater propensity to place more importance on the demands of the supply chain in the business of kiwifruit production. There are two-way connections between ZESPRI and customer satisfaction, and there are connections between fruit yield and quality and post harvest quality, and between decision maker and post harvest quality. These qualities are not surprising given that ZESPRI has had a long-established policy of emphasising market demand.

Q-sort type 2 shared an emphasis on quality and quantity of production of kiwifruit but in addition emphasised qualities of the lived environment. This group put a greater emphasis on 'place' with the implications that the orchard was important as a place to live, for family life, for retirement and its situation in a particular area was important for recreational activities. This type has more sources of satisfaction and therefore their wellbeing is likely to be more resilient than Q-sort type 1 because if something was not going well in one area of their life there is a greater likelihood that something else would be going well. Q-sort type 2 family needs are linked in two-way connections to decision maker and to the orchard as a place to live, indicating their interdependence. The orchard as a place to live is also impacted on by many factors, indicating its importance to the system, probably because the orchardist and family live on the orchard. Many orchardists have moved from other farming sectors to maintain involvement in primary production, often explicitly as part of retirement planning, and these orchardists would contribute to the lifestyle group.

It is worth noting that neither of these groups placed a greater emphasis on environmental health, indicating that this grouping of orchardists differs from the distinctions made between Green, Gold and Organic orchardists in our first interviews. This indicates the possibility of defining orchardists in a way not related to environmental sustainability.

This distinction between production and lifestyle has been found in other research on New Zealand and overseas farmers (e.g., Fairweather and Keating, (1994), Brodt et al., (2006), and Burton and Wilson, (2006)). In terms of the proportions of the two types found among the ARGOS orchardists, a comparison to another study is relevant. The Colmar Brunton (2007) analysis of data from 400 randomly selected orchardists found that half had a lifestyle focus and the other half a business focus. Comparison of the Q-sort results with the Colmar Brunton results suggests that ARGOS orchardists have a greater proportion with a business orientation.

Some implications of the maps from a resilience point of view

Having described the essential elements of the kiwifruit orchard system and how it works, we take a step back and look at the system with a more critical eye from a resilience point of view. Resilience theory, when applied to farming, emphasises the following points (Moller, 2008).

A resilient farmer:

- goes with the flow rather than towards a target state
- focuses on strength and flexibility, rather than on vulnerability
- has a big picture perspective, including:
    - an agro-ecosystems and ecological landscapes view
    - sees people as embedded in the system and defining reality
    - accepts surprise, uncertainty, dynamism
    - is aware that there can be sudden changes and tipping points
    - practices adaptive management.

Hence the rules of thumb for farmers and orchardists wishing to build a more resilient farm are to:

- take a systems approach
- be transdisciplinary
- maximise relevant information to identify choices
- have the capacity to apply any of a variety of choices in a manner that contributes to multiple goals
- stay flexible through retaining diversity and redundancy
- learn and adapt, but keep a steady hand
- learn to live with uncertainty
- build strength in what you yourself can control
- build transformative rather than just shock resilience.

Some other relevant aspects taken from Darnhofer et al. (ND) are related to orchardists. Resilient orchardists:

- must keep trying and change, and adapt to and prepare for change
- manage conditions to expand future opportunities.

Other points made are:

- resilience is strengthened or weakened by orchard/orchardist interactions
- resilience is achieved by engaging with the social, ecological and economic environment which together form the networks of the orchard system.

The key themes of the above characteristics of resilient farmers and orchardists are that they are dynamic, flexible, adaptive, and that they have a broad view of their system, learn, build in redundancy, and engage in interactions between the farm and its social, economic and environmental context. From the above resilience ideas it is clear that a resilient farmer/orchardist is one who includes people in the system, emphasises farm-farmer or orchard-orchardist interactions, and takes a big-picture perspective which integrates the social, economic and environmental aspects of the farm/orchard. We explore these ideas for the kiwifruit maps.

The group map for all orchardists could be seen to suggest relative powerlessness on the part of the orchardist. The decision maker has less influence on packhouse (2), ZESPRI (0) and orchard gate returns (2) than what packhouse (3), ZESPRI (4) and orchard gate returns (3) have on decision maker. However, the decision maker does receive information from these sources, two of which are outside the actual orchard. Further, the decision maker receives little feedback from family needs (1), contractors/labour (2) and from the state of the orchard's environmental health (0). The first of these is not surprising since many orchardists are running a commercial operation and family considerations may not be viewed as particularly relevant important. The weakness of the connection from contractors/labour is

more surprising since they play an important role in production. This is acknowledged by the strong connection of five from contactors/labour to fruit yield and quality. However, labour is usually contracted and may even be managed by the packhouse, and could be considered to be at a distance from the decision maker. Also, orchardists have spoken of the difficulties of getting pruners, for example, to utilise non-standard pruning practices. The absence of a connection from orchard environmental health to decision maker shows that it is not a factor that actually influences the decision maker even though it is acknowledged in a modest way as influencing fruit yield and quality (2), vine health (2) and satisfaction (2). With the success of the KiwiGreen integrated management system for spray use and now its incorporation into GlobalGAP environmental health may be taken for granted. It should also be noted that at present there is only one issue relating to environmental health that is confronting the kiwifruit industry and that is the use of bud break sprays. Kiwifruit orchards are not challenged about the state of their orchard environment in the way that dairy farmers are, for example.

Orchard environmental health is presented as mainly affected by the decision maker and is not seen to strongly impact on anything else. If orchardists developed an understanding of how orchard environmental health influences other aspects of the orchard system then acting on this understanding could produce a more resilient system.

The kiwifruit industry has survived demands for reduced use of sprays, increasing requirements for pest free fruit and higher dry matter. Are there indications on their causal maps of how they have been so quickly responsive? The maps show evidence of many outside influences on their system – information, advisors consultants, contractors/labour, exchange rate/macro economy, supermarket/customer requirements, ZESPRI, and postharvest quality via the packhouse. Though they indicate on their maps that they feel they have little influence on these things themselves they do indicate the many pathways which can impact to change practices. So while the results raise some legitimate questions about the level of resilience of kiwifruit orchardists they also demonstrate active pathways which produce change. Perhaps if these pathways were more often two way, with orchardists more able to influence some of the outside factors, resilience could be increased. For example, the industry could work with orchardists to establish flexible and do-able best practices for the management of pruning and pruners and the achievement of high dry matter fruit.

4.5 Conclusion

The causal maps are providing more interesting and informative information about the nature of how farmers and orchardists see their farm/orchard systems and the interactions they perceive among these factors thus complementing the material we have collected using other methods. By now having maps from four different agricultural sectors we are able to make useful comparisons and provide some explanations of why they might be different. This can then lead to more informed discussions about sustainability and resilience and how these qualities might be supported and encouraged in New Zealand agriculture.

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Appendix 1
Assessment of change in goals from 2005 to 2008

Goals in 2005	Goals in 2008	Orchardists' comment on changes	Assessment of degree of change
Love to average 7000 trays per hectare; its achievable.	Lift production but mainly quality.	Joining the focus orchard network, more outside input.	Little.
Gold production at 14,000 t/ha. High DM with SD less than 0.1. and low cost operation.	Improve production and OGR.	Moving towards using more composts and less P.	Little.
Increase prod/ha, soil fertility, soil life.	Getting trays per ha up in a sustainable manner.	Trunk girdling.	None.
Production of quality and quantity to requirements.	Increased production and COS.	Increased production, removed avocados, steel Agbeam, tried to buy another orchard.	Little.
Top 5%, high quality sustainable production, high economic return and lifestyle.	Healthy product that is sustainable and family to develop.	Ongoing innovation in orchard management.	None.
Get it up to max production and profitability.	Land banking.		Significant.
For gold, look at new information, to increase production, increase quality of fruit, for satisfaction.	Grow more healthier fruits, OGR.	Lost touch with whole orchard management because away most of the time, reliant on manager.	Little.
10,000 trays per hectare.	Get to 10,000 trays/ha consistently.	No major changes.	None.
Quality and quantity of production.	Increase fruit yields and quality.	All pergola now, all Hayward now; decrease in returns has forced owner to do more work.	None.
Reasonable quantity of good quality KF.	Maintain and improve fruit yield and quality while maintaining vine health.	No, but economic and political environment has changed.	None.
Produce as many perfectly shaped organic kiwifruit of good size and taste as I can.	To be in the upper quartile of producers.	No major changes; evolution; returns have dropped significantly.	Little.
Be in the top 5%, produce quality and quantity.	Increase OGR.	Changed pruning; now has significantly more ZESPRI shares.	Little.
Profit, plus maintain family and orchard health with good lifestyle.	COS, best organic orchard in Satara pool to get best bottom line surplus.	No.	Little.
Maximising crop and minimising cost.	Lifestyle and satisfaction.	New manager involves the owners a lot more.	Little.
Market to customer requirements, high dry matter, whilst maximising	Maximise yield and productivity.	T-bar to pergola, low vigour.	None.

production.			
Make money but maintain lifestyle and improve environment by being organic.	Maintain status quo, happy with how things are now.	Stopped using compost tea, adding cobalt.	Little.
This year big crop, low reject, high dry matter.	Keep in family (may be difficult because of urban development).	No changes because of threat of rezoning.	Moderate.
To freehold the property and earn a decent living.	Pay off mortgage.	No changes.	None.
Increase production but not to sacrifice land or whatever and performance.	Make profit.	Moved from lease to management situation; trying to retire. Strip male.	Little.
Achieve high quality product for customer, as economically as can, for sustainable long term, through Zespri via market. Best tasting, best keeping, plus as much as possible.	Maximise fruit yield and quality.	From pergola to T bar, change to low vigour.	None.
Increase yield per hectare.	Increase yield.	No major changes.	None.
Have to keep going ahead, can't stand still, margins always getting smaller.	Stay viable.	Changed pruning, improved vine management.	None.
Quality is money these days. Taste, size to get best money, not necessarily more fruit.	Become viable, to grow to be big enough to be viable and carry out subdivision plans.	Decreasing returns; cut back fertiliser; moved off orchard; leased orchard 06/07 season.	Significant.
Provide a quality product at an economic price. Quality means healthy, nutritious and environmentally sustainable.	Trying to leave the piece of the world I have direct influence on as a better place for who I leave behind.	Subdivision nearby, urban pressures, slipping finances.	Significant.
Comfortable living with good lifestyle.	To sell property, maintain maximise returns.	Drop in OGR, rising costs.	Significant.
Good Q&Q, good lifestyle, sustainable environment and lifestyle to enjoy.	Good product, profitable.	Pruning regime changed, fertiliser regime more consistent.	Little.
High yield and environmentally compatible.	Produce a product that meets marketing requirements and satisfactory financial outcome.	Much the same.	Little.
35,000 trays of size 35.	Produce quality crop of certified organic kiwifruit with higher yields.	Change to basic inputs, more bird life, more shelter. Decreased direct involvement (age and health).	Little.