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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.

As part of the ARGOS social objective, causal mapping was used to document how the participating dairy farmers described and explained the factors involved in their farming systems, broadly defined to include economic, social and environmental factors. Participants identified which factors in the 41 provided were important to the management and performance of their farms and linked these together in the form of a map.

The 20 dairy farmers who were available first completed a Q sort of 41 factors to identify the more important ones, then used these to create their 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 indicated the importance of each factor. An overall or group map was produced by taking an average across the individual farm maps and this map characterised the overall farm system. A similar process was used for each of the two management systems being studied (conventional and converting to organic), and for each of the two groups of farmers identified from Q-sort analysis.

Group map
The overall group map shows that dairy farming involves the management and response to a wide variety of factors, including economic, environment and social ones. At the core of the map are personal (farmer decision maker and satisfaction) and production factors surrounded by soil, environmental, climatic, family and financial factors. True to the family farm structure of much of New Zealand farming, the map shows the closely integrated role of family in the farming system expressed as family needs. The map is not insular since there are connections extending outwards including other people and related factors, especially the marketing or processing organisation and considerations of time in farm work. There is a strong production orientation in the map with some of the strongest connections from farmer decision maker to fertiliser and soil fertility health and to production. However, the environment is also important, reflected in farm environmental health and, to a lesser extent, farm environment as a place to live. The sources of satisfaction (production, fertiliser and soil fertility health, farmer decision maker, family needs, farm environment as a place to live and net profit before tax) are quite varied and reflect the broad mix of factors at the core of the map.

Other data rounded out the general findings. Just over one half of dairy farmers reported that quality of production, rather than quantity of production, was most important and just of over one third said both. A modest majority stated that their farms were below average in terms of level of inputs per hectare. Farm environmental health was defined in terms soil, streams, sustainability, ecosystem, system, variety and balance. The farmers expressed a flexible attitude to change on their farms. Farmers also stated that a resilient farm had financial flexibility or was adaptable in other ways.

Many of the core factors in the map are connected with bidirectional arrows so they are in a dynamic and complex relationship with each other. Changes in one factor would necessitate changes in nearby factors. These dairy farmers are juggling many factors in the day-to-day and longer-term planning and management of their farms. It is because of this complexity of

factors shown at the generic level for all 20 farmers that farmers create specific ways through the complexity by developing a strategy or approach that makes sense to them and appears to meet their needs. These different strategies mean that there are distinctive ways that farmers combine and relate factors despite having some core similarities. The maps for the panels and the Q-sort types illustrate these different strategies.

Panel maps

- The map for the conventional panel shows an emphasis on factors of production and financial factors.
- The map for the converting panel shows an emphasis on biodiversity, environment, off-farm product quality, and specific influences on farmer decision maker.

Q-sort maps

- The map for the Q-sort type 1 shows an emphasis on factors of production and financial factors.
- The map for the Q-sort type 2 shows an emphasis on biodiversity, environment, off-farm product quality, farmer decision maker, family needs and satisfaction.
- The results for Q-sort types are similar to the panel maps but the second type is a stronger expression of the conversion type.

Comparison to sheep/beef results

The overall group maps for the dairy and sheep/beef sectors were very similar. However, there are some differences, as follows.

- The dairy map had three additional factors but not advisors and consultants.
- Dairy farmers had the connection between farmer decision maker and expenses in the opposite direction compared to sheep/beef farmers.
- Dairy farmers had customer requirements connected to Fonterra; for sheep/beef it was connected to farmer decision maker.
- Dairy had weather/climate connected to farmer decision maker at four: for sheep/beef it was seven.
- Dairy had more connections to farm environmental health.
- Dairy had stocking rates connected to quality and quantity of production at five; for sheep/beef it was three.
- Dairy had quality and quantity of production connected to net profit, and net profit was connected to satisfaction.

For the panel maps, there were some similarities between the dairy converting map and the sheep/beef organic map: both had high centrality scores for farm environmental health and high map densities. Both included off-farm product quality.

For the Q-sort maps there were strong similarities between the dairy Q-sort type 2 and sheep/beef Q-sort type 4 results. They have similar Q sort arrays, some similar significant centrality scores and similar maps. In addition, there are similarities between sheep/beef combined Type B and dairy Q-sort type 2. They share three statistically significant centrality scores and one map characteristic.

Acknowledgements

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Chapter 1
Introduction: Background, Research Objectives and Method

1.1 Background and research objectives

The social research objective of the Agriculture Research Group on Sustainability (ARGOS) research programme has already documented important information about farmers and orchardists (Hunt et al., 2005, Hunt et al., 2006; Rosin et a.l, 2007a and Rosin et al., 2007b). One theme in this research has been separate studies of each sector using a causal map method. The first study was of kiwifruit management and was completed in 2006 (Fairweather et al., 2006). The causal mapping showed factors important in kiwifruit orcharding and how orchardists think about and manage their orchards. The second study was for the sheep/beef farms (Fairweather et al., 2007) and it developed the method by introducing an initial Q sort of factors which provided an efficient means for farmers to select the important factors for mapping. These prior reports fully document the literature on causal mapping and the development and application of the methods. The present report focuses only on the core results for the dairy sector rather than repeating the detailed accounts in the earlier reports. Readers seeking a fuller explanation of the method will need to refer to the earlier reports.

The main research objective for the causal mapping of the dairy sector farmers was to document how farmers participating in our ARGOS research describe and explain the management of their farm system broadly defined and 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 perceptions of management across the two different management systems under study (conventional and converting to organic). Meeting this objective also entails consideration of the ways that the panels may be similar. In addition, we shall see if there are other groupings of farmers and test if there are differences in the maps that are derived from these groups. Results for the dairy sector will be compared with the results from the sheep/beef sector.

1.2 Method

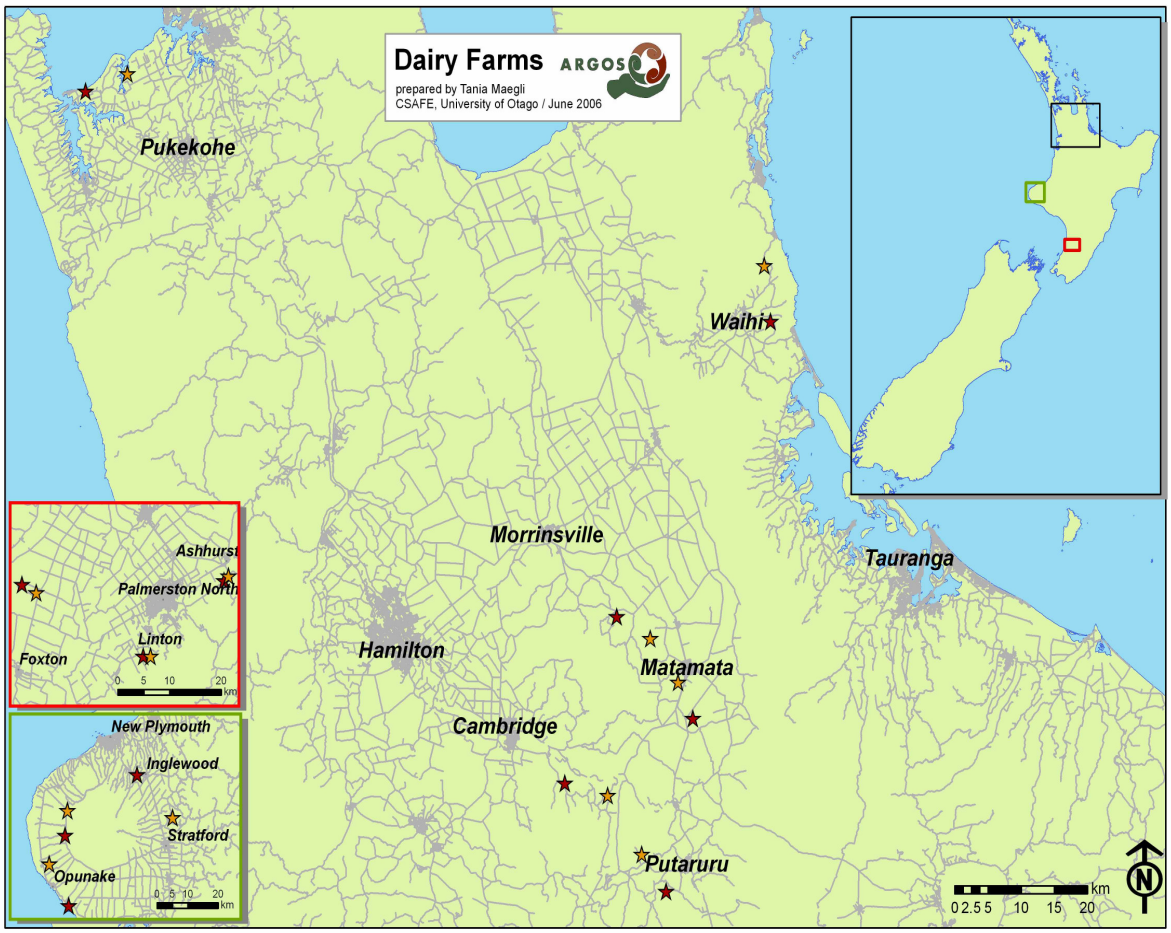
The method used was very similar to the method used for the sheep/beef study. The same list of 41 factors used in the sheep/beef study was used in this dairy study, as shown in Table 1. Q methodology was used to allow farmers to identify the important factors prior to using them to make their causal maps. The data from the Q sorting provided the basis for identifying an additional grouping of farmers, labelled as Q-sort type 1 and Q-sort type 2. Interviews were conducted in May 2007 using the same interview procedure as earlier. Only 20 of the 24 ARGOS dairy farmers were available to be interviewed at this time. The farms were located in the North Island of New Zealand, extending from South Auckland to the Manawatu. Figure 1 shows the farm location map. Data were analysed in the same way as for the sheep/beef study.

Table 1: List of factors used in the kiwifruit, sheep/beef and dairy studies

Kiwifruit	Sheep/beef and dairy
Farmer or grower decision maker	**Farmer decision maker**
Quality and quantity of plants and/or livestock	Quality and quantity of plants and/or livestock
Orchard gate returns	**Cash farm income**
Marketing organization (ZESPRI)	**Marketing/processing organization-produce buyers**
Production expenditure	**Farm working expenses**
Contractors and packhouse	**Contractors**
Cash orchard surplus	**Net profit before tax**
Satisfaction	Satisfaction
Fertiliser and soil fertility	Fertiliser and soil fertility/health
Weed and pest management	Weed and pest management
Labour	Labour
Farm/orchard environmental health	**Farm environmental health**
Post harvest quality	**Off-farm product quality**
Regulation	Regulations
Time in farm work	Time in farm work
Weather/climate	Weather/climate
Farm/orchard environment as place to live	Farm environment as place to live
Improve equity/land size	Improve equity/land size
Plant and machinery	Plant and machinery
This location	This location
Advisors, consultants etc.	Advisors, consultants etc.
Soil type/topography	Soil type/topography
Customer requirements	Customer requirements
Exchange rate, macro economy	Exchange rate, macro economy
Family needs	Family needs
Government policies	Government policies
Information	Information
Off-farm activities	Off-farm activities
Neighbours	Neighbours
Grower groups or orgs	**Farmer groups or organisations**
Off-farm work	Off-farm work
Retirement	Retirement
Future generations	Future generations/succession
Community	Community
Smallholding/subdivision	Smallholding/subdivision
Family history and background	Family history and background
	Customer satisfaction
	Increasing plant and animal biodiversity
	Stocking rates
	Water supply and quality
	Stream health

Note: bolding identifies changes in the wording of the factors used for sheep/beef and dairy.

Figure 1: Location of the dairy farms



Chapter 2
Dairy Results

2.1 Introduction

In this chapter, data are presented for the group map for all 20 farmers, followed by the group map showing panel differences, then the group map showing Q-sort type differences. The main task here is to understand group maps, those that are formed from the data from all farmers or from particular breakdowns of the whole group. At this aggregate level we can develop an understanding of the general properties of farming systems, as seen by farmers. 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 reflects both the number of arrows and the weightings of the arrows.

2.2 Group map data for all 20 farmers

When the data for all 20 cases had been entered into individual Excel worksheets 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 shows that for the average group map there were a total of 194 separate connections between factors, considerably short of the theoretical maximum of 41 times 40 or 1,640 connections (12 per cent), but 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 dairy group map. These data include the averages for all 20 cases, then the averages for the two panels, then the averages for two Q-sort types. The table shows four groups of centrality scores, and those with the highest scores are at the top of the table. These groupings are an attempt to simplify the data based on a somewhat arbitrary criterion of taking the top three, then the next four which had somewhat similar scores, followed by the next five scores.

The factor with clearly the highest centrality was the decision maker with an average score of 129. Next in order of centrality were quality and quantity of plants and/or livestock, with an average of 81, and satisfaction with an average of 52. After these top three factors there was a second tier of four factors with average centrality scores ranging from 35 to 50. These include: fertiliser and soil fertility/health (50), family needs (42), cash farm income (38) and farm environmental health (35). These factors with high centrality (as shown by having a score of 35 or above which is well over the average of 21) show that at the heart of farming is the decision maker, production and satisfaction, followed by fertiliser and soil fertility health, family, weather and financial aspects (represented by cash farm income and farm working expenses).

Table 2: Average centrality for all 20 cases, all panels and all Q-sort types

Factor	All 20	Panels		Q-sort types	
		CV	CVTG	1	2
Farmer DM	129	131	127	117	142
Quality & quantity	81	81	81	77	78
Satisfaction	52	50	54	38	73
Fertiliser and soil fertility/health	50	45	55	46	54
Family needs	42	41	42	31	60
Cash farm income	38	44	31	38	36
Farm environmental health	35	22	48	19	59
Farm working expenses	30	33	27	36	19
Net profit before tax	28	38	18	33	20
Water supply and quality	24	18	30	13	31
Weather/climate	22	23	22	13	24
marketing or processing organisation	22	26	18	27	15
Stocking rates	21	21	21	22	22
Increasing plant and animal biodiversity	20	6	34	12	29
Farm environment as a place to live	19	14	25	5	42
Time in farm work	18	20	17	20	18
Weed and pest mgmt	17	16	17	13	17
Labour	14	15	12	12	20
This location	12	9	14	9	18
Future generations/succession	11	14	8	7	15
Stream health	9	9	9	6	16
Plant and machinery	9	6	11	11	7
Off-farm activities	8	8	8	4	17
Off-farm prod quality	8	4	12	6	9
Regulations	7	6	9	8	7
Soil type/ topography	7	10	4	8	5
Exchange rate, macro economy	6	7	5	9	2
Information	6	4	8	6	6
Improve equity/land size	6	9	3	6	6
Customer satisfaction	6	9	3	7	5
Community	6	4	8	1	15
Contractors	4	4	5	5	5
Retirement	4	5	3	6	1
Family history & background	4	4	4	4	5
Customer requirements	4	6	2	5	2
Government policies	3	6	0	1	6
Off-farm work	3	3	3	1	7
Neighbours	3	1	4	1	7
Farmer groups or orgs	2	1	4	2	0
Smallholding/subdivision	2	2	1	3	0
Advisors, consultants	1	1	1	2	0

There is third tier of factors with average centrality ranging from 22 to 30. These include: farm working expenses (30), net profit before tax (28), water supply and quality (24), weather and climate (22) and marketing or processing organisation (22). The remainder of the factors had centrality scores lower than 22. These were often background or contextual factors such as the exchange rate/macro-economy or goals to be achieved such as retirement. It is noteworthy that among the lowest rated factors are social factors such as future generations/succession, community, family history and background, neighbours and farmer groups or organisations.

In comparing dairy and sheep/beef, Table 3 shows similar centrality scores for the top 12 factors. Sheep/beef farmers gave more importance to weather and climate and to farm environment as a place to live (25) which was 15th on the dairy list.

Table 3: Comparison of dairy and sheep/beef top-ranked factors

Factor	Dairy	Sheep-beef
Farmer DM	129	150
Quality & quantity	81	82
Satisfaction	52	55
Fertiliser and soil fertility/health	50	46
Family needs	42	42
Cash farm income	38	38
Farm environmental health	35	40
Farm working expenses	30	32
Net profit before tax	28	24
Water supply and quality	24	22
Weather/climate	22	36
Marketing or processing organisation	22	19

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 we tried some arbitrary minimum average connection scores to see at which point the map appeared to show the main causal linkages. Using a score of three was suitable for showing the important connections without getting overwhelmed, and this map is the main one we have chosen to present here. Note that the causal connection score from one to ten was explained to the farmers to indicate that from one to three meant 'low', four to six meant 'medium' and seven to ten meant 'high'. However, these average data do not correspond exactly to this scale. To achieve the same level of meaning as an individual farmer's rating would require all farmers to have linked the same two variables. This was not the case. For example, some farmers did not link quality and quantity of plants and/or livestock with cash farm income. Many of those who did linked it with a score of nine or ten. But since not everyone linked it the average score is six.

The derived group map is shown in Figure 2. The figure shows some arrows with double arrowheads and two numbers on the line. The number nearest to the arrowhead applies to that arrowhead.

The map was created by taking the three top-tier factors and placing them in triangular fashion in the centre of the map. Then the next two tiers of factors were placed around these in no particular position but in ways that minimised the number of crossing arrows. Finally, the remaining factors were added in closest to the factors that they connected to.

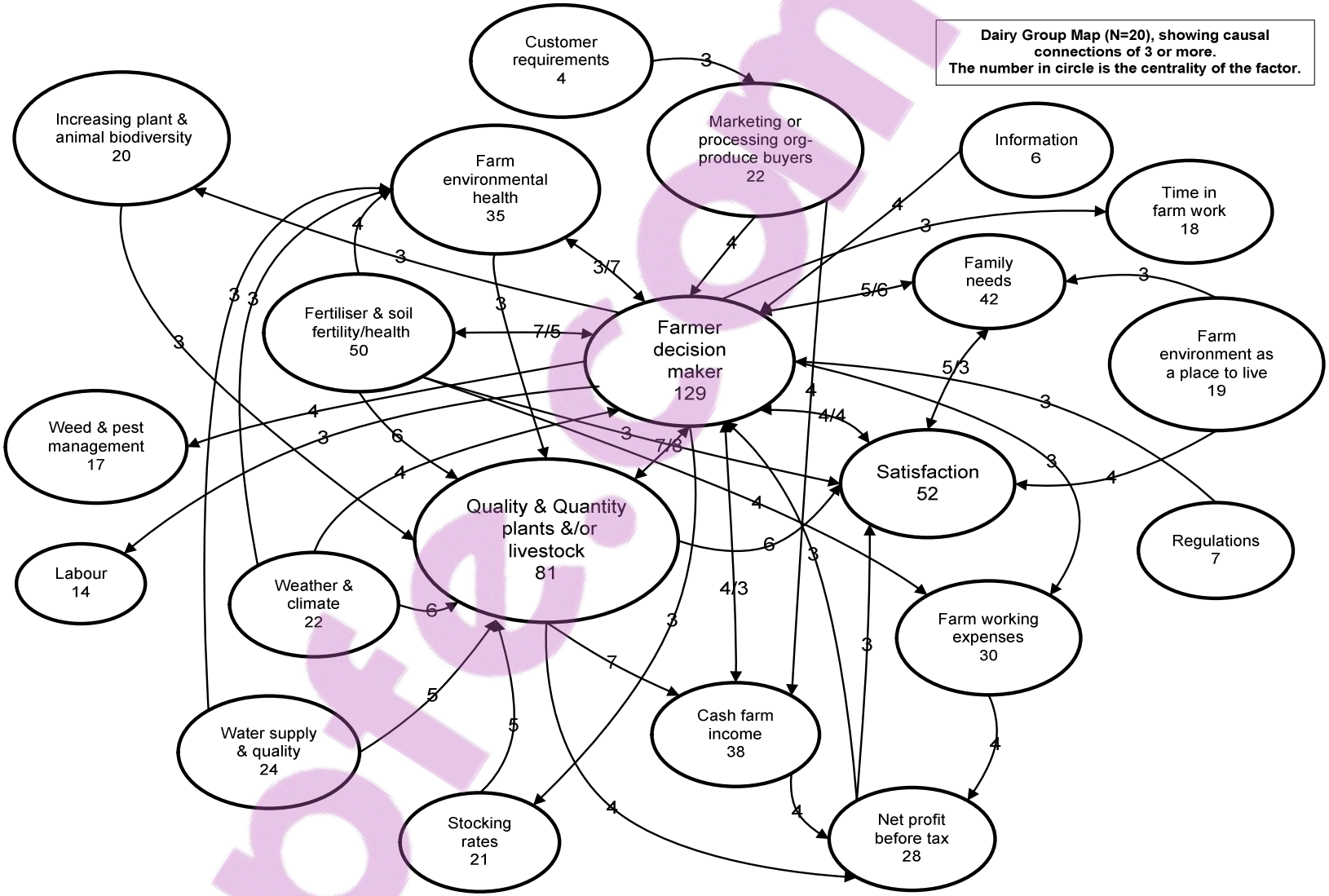
At the core of the map are farmer decision maker, quality and quantity or plants and/or livestock (subsequently referred to as production), and satisfaction. Farmers in a market economy have to produce and sell products and their returns are based on the quantity and quality of production so the importance of this production factor is unexceptional. Perhaps less expected was the high centrality rating of satisfaction, suggesting that quality of life considerations are important to dairy farmers. Further, farmer decision maker is dynamically linked with two-way arrows to production and to satisfaction meaning that these latter two factors have an important bearing on farmer decision maker and it in turn has an important bearing on them. There is not quite a perfect interacting circle of factors here because satisfaction does not influence production directly (the score for this connection is zero) but it can have an influence indirectly through farmer decision maker.

Moving out to consider the next tier of factors, the map shows that farmer decision maker is linked with bidirectional arrows to fertiliser and soil fertility/health, farm environmental health and family needs. Thus the farmer decision maker both influences these factors and in turn is influenced by them. Most influence is extended to fertiliser and soil fertility health with a score of seven. Of these three factors, farm environmental health has the largest influence on farmer decision maker.

The other links among these central factors show that production is influenced by fertiliser and soil fertility health and farm environmental health, and that the former influences the latter. Satisfaction affects family needs, as does farmer decision maker, and this latter connection is bi-directional. Beyond these factors mentioned there is weather and climate having an effect on production, farmer decision maker and farm environmental health. In terms of financial factors the main links are from production, decision maker and marketing or processing organisation to cash farm income. Farm working expenses are largely derived from fertiliser and soil fertility/health. Net profit before tax is influenced by production, cash farm income and farm working expenses

Overall then the group causal map is showing that at the core of farming are production, farmer decision maker and satisfaction. Closely linked to these are environmental, family and financial factors, and weather. There are six two-way arrows, five of which link to farmer decision maker. The remaining one is between family needs and satisfaction.

Figure 2: Dairy group map - causal arrows with scores of three or more



In comparison to the sheep/beef group map, the dairy group map has three additional factors of increasing plant and animal biodiversity, time in farm work and regulation. Dairy farmers readily talked about alternative pasture species such as plantains and this is mainly what they meant by biodiversity (see Table 1.2 in the Appendix). Time in farm work was a more important factor for dairy farmers because they have more demands on their time with daily milking. Regulation is more important to dairy farmers because the quality of their milk is constantly tested and any shortfalls are reflected in their payout. The sheep/beef group map included the factor of advisors and consultants with a low centrality of six but a connection of three to farmer decision maker while for the dairy group map the connections was with a score of one. Presumably dairy farming management is better known or else better communicated to dairy farmers such that consultants are less important.

In terms of connections between factors, when comparing dairy and sheep/beef maps it is relevant to focus on those connections with a difference of two or more. The sheep/beef map had a connection of five from farm working expenses to farmer decision maker while for dairy farmers this link was much lower at two. Clearly, expenditure is a factor for dairy farming but it is not watched as carefully as sheep/beef farmers. In recent years the latter have not had such good returns as dairy farmers. The sheep/beef map had a connection from customer requirements to farmer decision maker while the dairy map has this link going to marketing and processing organisation. The sheep/beef map has weather and climate connected to farmer decision maker at seven rather than four, reflecting greater vulnerability to weather. The dairy map has more connections to farm environmental health: there is a link from water supply and quality, and the link from it to farmer decision maker is higher at seven not four. Stocking rates are linked to production at five compared to three, and there is a link from production directly to net profit before tax. Net profit is linked to satisfaction. Finally, family needs has some stronger connections: from farmer decision maker the link is six compared to four, and the link to satisfaction is five not three.

Despite some differences in the maps, in general terms, the group maps are remarkably similar.

Data from the questions asked after the mapping

Data from the other questions asked at the end of the interview showed some general characteristics of dairy farmers. There was a general emphasis on quality of production. Table 4 shows the importance of either quality of quantity of production. It indicates that 62 per cent of farmers stated that quality of production was more important than quantity of production. Only 15 per cent stated that quantity was more important than quality, while 24 per cent stated both. These results are broadly similar to those for sheep/beef, also shown in the table.

Table 4: Importance of either quality or quantity of production

	Dairy		Sheep/beef	
Which factor is more important?	**No.**	**%**	**No.**	**%**
Quality	11	55	21	62
Quantity	2	10	5	14
Both quality and quantity	7	35	8	24
	20	100	34	100

Table 1.1 in Appendix 1 shows the full text of the responses to the other questions asked. There were no obvious differences in responses from the different panels across the question asked. In response to asking about the meaning of farm environmental health the

keywords mentioned were soil, streams, sustainable, ecosystem, system, variety and balance. Biodiversity (not asked of the first four farmers) meant new grass species, other pasture species such as plantains, and occasional reference to micro-organisms. The meanings were related to productive biodiversity. In terms of their farming system, when asked what they were trying to maximise, nine farmers mentioned income or profit, five mentioned satisfaction or happiness, four mentioned production and two mentioned time with family. When asked what they were trying to minimise, most farmers mentioned expenses, while some referred to time or poor health or stress. Again with reference to their farm system, when asked what was at the heart of it, the most frequent response was family and the other responses ranged across soil, grass, cows and production-related factors.

When it comes to the degree of change that farms can undergo, farmers were generally very positive that their farming system can change, that is, was not resistant to change. Generally, the comments show a positive attitude towards change. Farmers stated that the main driver of change as financial factors. Farmers also stated what, in their opinion, made for a resilient farm. One of the main themes among the responses was financial flexibility expressed in different ways (debt loading, equity, cash reserves etc.). However, the farmers also mentioned being flexible, being prepared or having reserves in place, decision making, and good soil, plant, stock and environmental health. The themes reported here are very similar to the themes reported by sheep/beef farmers.

In terms of the level of inputs per hectare compared to other farms of a similar type, four farmers stated that it was above average, six stated it was average, eight stated it was below average and two did not know. This is different from the sheep/beef responses where the majority reported that their level of inputs was higher than average.

2.3 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 among the panels. To facilitate the analysis, the data from the individual maps were combined into one table that listed the 20 farmers and collated the 41 factors in 41 columns of data. These data were examined using ANOVA and the results are shown in Table 5[1]. Two of the significant levels are just over the 0.05 level. Bolding is used to show which panel has the higher average score for that factor.

[1] The numbers may differ slightly from those shown in Table 2 because during the ANOVA some adjustments were made, such as estimating missing data to balance the design and removing outliers, and these adjustments have affected the values.

Table 5: Statistically significant centrality means and map characteristics for each panel

Factors	All 20	Panels		
		CV	CVTG	Sign.
Exchange rate/macro-economy*	6	**9.6**	4.7	0.026
Farm environmental health	35	22.9	**45.9**	0.056
Increasing plant and animal biodiversity	20	3.1	**33.3**	0.038
Net profit before tax	28	**42.6**	17.3	0.010
Map characteristics				
Connections/variable	2.54	2.2	**2.8**	0.053
Map density	0.13	0.10	**0.14**	0.040
Number of ordinary variables*	14.5	14.2	**16.2**	0.044
Number of receiver variables*	5.6	**7.8**	4.3	0.001
Total number of variables*	21.5	**23.6**	21.8	0.010

Notes: 1.The mean centrality for the overall group of 20 farmers was 10, with a range from 0 to 129.
* indicates that location was significant in the ANOVA.

There were four out of the 41 factors with significant differences between the two panels. Conventional farmers gave more emphasis to the exchange rate/macro-economy, while it still has a very low score, gave more emphasis to net profit before tax. Converting farmers had higher centralities for farm environmental health and increasing plant and animal biodiversity. These results show that conventional dairy farmers focus on economic or financial factors more so than converting farmers. The latter give more emphasis to the environment and biodiversity, admittedly production biodiversity. In addition, the other variables used to characterise the maps showed some differences. The converting panel had significantly higher scores for the number of connections per variable, for map density (defined as the total number of connections divided by the square of the number of variables) and for the number of ordinary variables (that is, factors with arrows both entering and leaving). These data are showing that converting farmers' maps were more complex. In contrast, conventional farmers had more receiver variables, that is, factors which have only arrows going into them and none leaving the factor. This suggests that they see some of the factors in their farm as being a influenced by the system.

The above statistically significant differences give us good reason to conclude that the group maps for each panel have some distinctive characteristics. These panel differences were examined in detail. For each factor with a statistically significant panel difference the connections going into it or out from it were examined in order to find the ones for which the panel map scores were different from the overall average. Most of the connections showed factor differences and most had a difference of at least two. These results suggest that a difference in connection weight of two is important as a difference. The map data were then examined to locate all connections with a difference of two and these are shown in Figure 3. We do not argue that the specific arrows thus identified are statistically significantly different; however, they give a very good indication of fundamental differences in the maps for each panel. (It was not possible to do ANOVAs with the arrows data because there were too many

cells with zero scores.) [2] This approach helps to tease out the differences between panels beyond those indicated by the ANOVA.

The centrality scores for the overall group and for each of the panel group maps are shown within each circle in the map with the significant differences from Table 5 shown in bold. Circles that are new additions for the panel map are shown with hatched lines. Arrows that meet the criterion of being different by two or more, and thereby meet or exceed the score of three, but with an average link of less than two for the overall group map are also shown with hatched lines. Causal connections between factors that have different scores are shown on the lines: the first number is the overall group map score, the second number is for conventional farmers and the third number is for converting farmers.

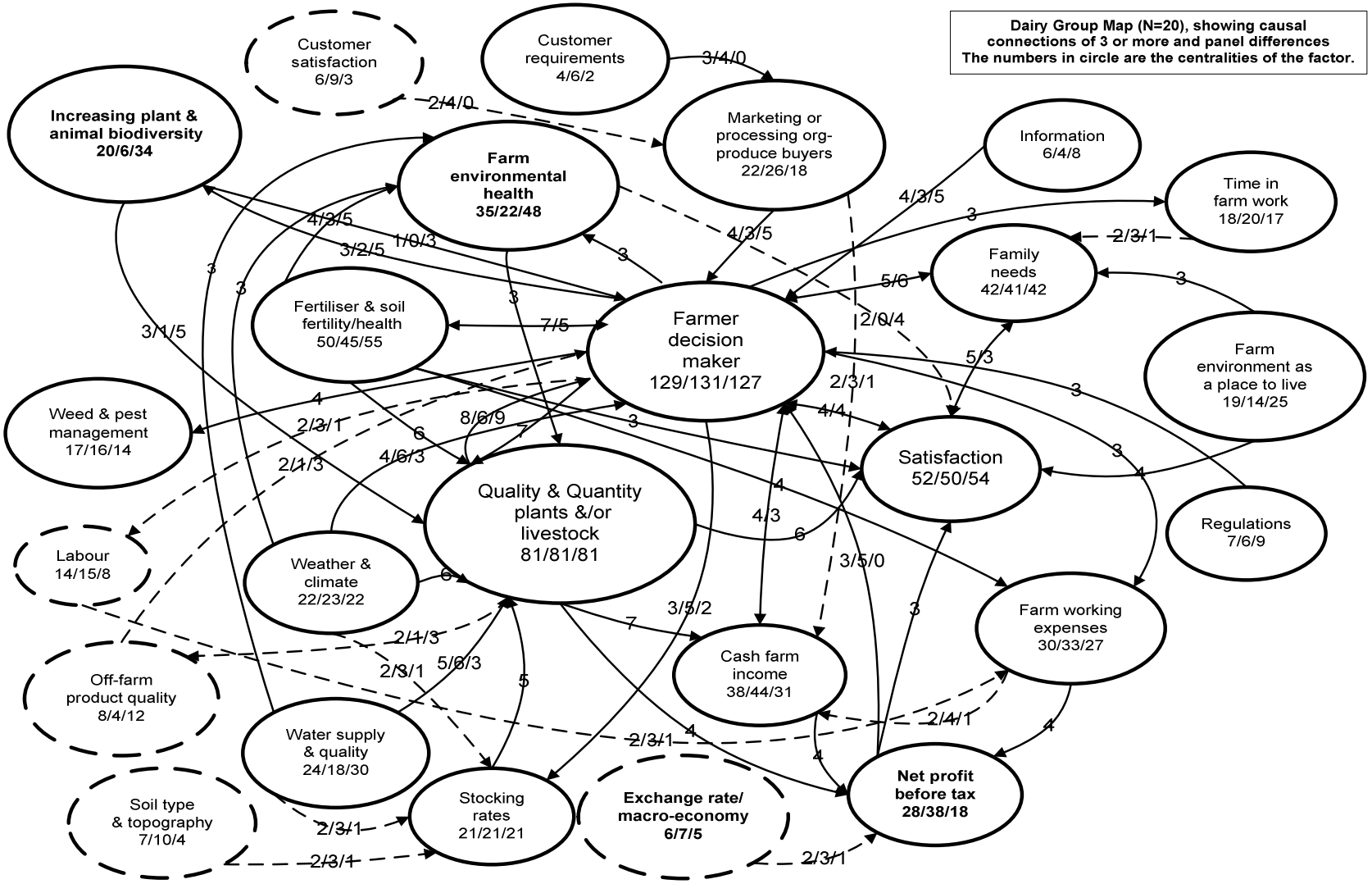
Figure 3 shows the group panel map and the features emphasised by each panel. Let us start with the connections emphasised by the conventional dairy farmers more than the converting farmers. Conventional farmers connected customer satisfaction and customer requirements to marketing or processing organisation but these links are not strong. Marketing and processing organisation is connected to cash farm income with a score of five (while the score is zero for converting farmers). Net profit before tax is more strongly connected to farmer decision maker with a score of five (rather than zero), as is weather and climate. Farmer decision maker is more strongly connected to stocking rates and labour, the latter then connecting to farm working expenses. Farm working expenses influence cash farm income. Stocking rates is more strongly influenced by weather and climate, water supply and quality and soil type and topography. Water supply and quality is more strongly connected to production. Exchange rate and macro-economy influences net profit. Finally, time in farm work influences family needs. The themes among the more heavily weighted connections include factors of production (labour, water supply, soil type, stocking rates) and financial factors (cash farm income, exchange rate, net profit, working expenses).

The connections emphasised by converting farmers are fewer in number and reflect different themes. Converting farmers emphasised both links between farmer decision maker and increasing plant and animal biodiversity, and the link from biodiversity to quality and quantity. In turn, quality and quantity influenced off-farm product quality. Increasing biodiversity, off-farm product quality, quality and quantity of production, marketing or processing organisation and information all have stronger links to farmer decision maker. Note that the total centrality for farmer decision maker is similar for both panels so this is a particular combination of influences on farmer decision maker which they relate to product quality, Fonterra/information and biodiversity. These are the sort of factors likely to be involved in converting to organic production. Farm environmental health was more influenced by fertiliser and soil fertility health and had a stronger link to satisfaction. The themes among the more heavily weighted connections include biodiversity, environment, quality of product, specific influences on farmer decision maker and satisfaction.

Each of the panels shows a coherent set of themes shown by detailed analysis of the connections and this supports the approach of analysing the connections in addition to showing the significantly differenct centrality scores.

[2] Note that when comparing maps, an average connection on one map may be the product of few connections at higher weightings, or the product of many connections at low weightings. However, most farmers used high scores rather than low scores so it is unlikely that former combination occurred.

Figure 3: Group map showing panel differences



Comparing dairy panel maps to sheep/beef panel maps is difficult because the latter included the three panels of conventional, integrated and organic farming. There are a few similarities in the statistically significant centrality scores: both the converting dairy map and the sheep/beef organic map had high scores for farm environmental health and higher map density. In the maps, the dairy converting panel included off-farm product quality as did the sheep/beef organic panel. A difference in the maps was that the dairy converting panel gave less emphasis to customer requirements.

2.4 Group Data for Each Q-sort type

The Q-sort data provided the basis for an examination of groups of farmers 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 farmers being associated with each type. Table 6 shows the number of farmers who loaded significantly on each factor. Q-sort type 1 had 12 significant loaders and Q-sort type 2 had eight significant loaders. The table shows that Q-sort type 1 has a small majority of conventional farmers and Q-sort type 2 was mainly converting farmers.

It is usual in Q-sort analysis to examine the type arrays, 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 6: **Numbers of significant loaders on each Q-sort type**

	Q-sort type		
	1	**2**	**Total**
Conventional	7	3	10
Converting	5	5	10
Subtotal	12	8	20

The ANOVA results for centrality differences between the two Q-sort types are shown in Table 7. There are seven factors for which statistically significant differences were found but in two cases the significance levels were between 0.05 and 0.10. Statistically significant centrality scores show that Q-sort type 1 emphasises the financial factors of exchange rate/macro-economy and farm working expenses. In contrast, Q-sort type 2 emphasises the environment and satisfaction. There is a suggestion that Q-sort type 2 also emphasises farmer decision maker and off-farm activities. The map characteristic variables show that Q-sort type 2 has more connections per variable and there is a suggestion that this type also has greater map density (more causal relationships between variables). There is a suggestion that Q-sort type 1 has more receiver variables.

Table 7: Statistically significant differences in centrality scores and map characteristics for Q-sort types

Factor	Total (20)	Q-sort type 1 (12)	Q-sort type 2 (8)	Sign.
Exchange rate/macro-economy*	6	**9.2**	2.0	0.006
Farmer decision maker*	129	120.3	**142.9**	0.081
Farm environment as a place to live	19	4.9	**41.3**	0.011
Farm environmental health	35	20.5	**57.0**	0.003
Farm working expenses	30	**37.4**	19.1	0.038
Off-farm activities*	8	3.7	**15.3**	0.076
Satisfaction	52	38.7	**71.5**	0.037
Map characteristics				
Number of connections/variable	2.5	2.3	**2.9**	0.030
Density	0.13	0.11	**0.15**	0.092
Number of receiver variables*	5.6	**6.7**	4.0	0.083

Note: * indicates that location was significant in the ANOVA.

Returning to the Q sort data themselves, it is possible to characterise each Q-sort type in terms of distinguishing items and the overall type array. Table 8 shows the distinguishing items which have a statistically significant difference in score of at least two. Q-sort type 1 gives more emphasis to net profit before tax and farm working expenses and less emphasis on community, future generations/succession, family history and background and increasing plant and animal biodiversity.

Table 8: Distinguishing items for Q-sort type 1

Factor	Type 1	Type 2
Community	-3**	1
Future generations/succession	-2**	2
Family history and background	-3**	1
Net profit before tax	4**	0
Exchange rate/macro/economy	1**	-2
Farm environmental health	0**	2
Off-farm activities	-1**	1
Marketing or processing organisation	1**	-1
Farm environment as a place to live	0**	2
Increasing plant or animal biodiversity	-2**	0
Farm working expenses	2**	0
Labour	0**	-2
Plant and machinery	0**	-2

Note: * significance at $p<0.05$ and ** at $p<0.01$.

The type array for Q-sort type 1 confirms these characteristics. Table 9 shows the top nine factors and their corresponding Z scores derived from the Q-sort raw scores ranging from -4 to 4. The top factor is net profit before tax. Farm working expenses is important but

secondary to a number of other factors, including family needs. Most of the factors relate to production and financial considerations however.

Table 9: Highly rated factors for Q-sort type 1

Factor	Z score
Net profit before tax	1.7
Family needs	1.6
Farmer decision maker	1.5
Weather/climate	1.5
Quality and quantity of production	1.4
Fertiliser and soil fertility health	1.4
Cash farm income	1.3
Satisfaction	1.2
Farm working expenses	1.2

The data in Table 8 above show that Q-sort type 2 gives more emphasises to future generations/succession, farm environmental health and farm environment as place to live. The type array for Q-sort type 2 confirms these characteristics. Table 10 shows the highest rated factors for Q-sort type 2. The highest item is family needs, followed by fertiliser and soil fertility health and production. However, aside from these two production-related factors the remaining ones refer to satisfaction, the environment and social or personal factors such as decision maker, time in work and future generations.

Table 10: Highly rated factors for Q-sort type 2

Factor	Z score
Family needs	2.2
Fertiliser and soil fertility health	1.7
Quality and quantity of plants and/or livestock	1.6
Satisfaction	1.5
Farm environmental health	1.4
Farm environment as a place to live	1.2
Farmer decision maker	0.9
Future generations/succession	0.8
Time in farm work	0.7

Figure 4 shows the causal map for Q-sort types 1 and 2. As before, the maps for each Q-sort types were prepared to show the connections with differences for each type. With more factors having statistically significant centrality score differences compared to the panel comparisons, it follows that there are more connections with different scores. In some cases the differences are more than a score of two; in one case the difference is five.

Q-sort type 1 farmers connected customer satisfaction and customer requirements to marketing or processing organisation, again at a very low level of causal strength, which then has a stronger connection to cash farm income. Among the factors of production given more emphasis are soil type and topography (which influences fertiliser and soil fertility), plant and machinery (which is connected to farm working expenses), water supply and quality (influenced by fertiliser and soil fertility and influencing quality and quantity of production, and stocking rates (influencing quality and quantity of production). Fertiliser and soil fertility health has a strong influence on quality and quantity of production. The financial factors

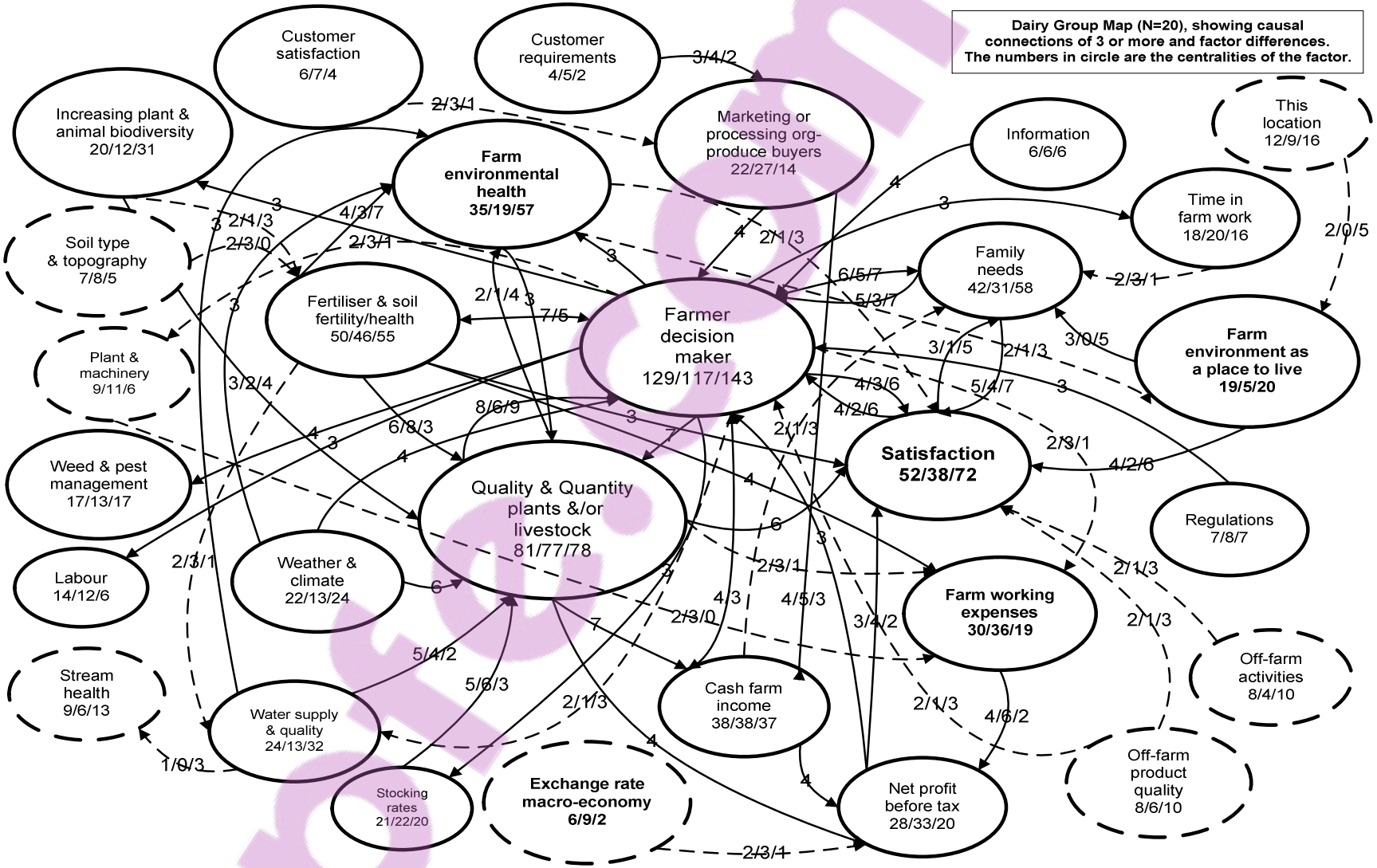
emphasised include the connection from exchange rate/macro-economy, and from farm working expenses, to net profit before tax which in turn influences satisfaction. Finally, farmer decision maker influences farm working expenses and time in farm work influences family needs. The themes among the more heavily weighted connections include factors of production (soil type, plant and machinery, water supply, stocking rates) and financial factors (exchange rate, cash farm income, net profit, working expenses). These emphases are the same as those identified for the conventional panel.

The connections emphasised by Q-sort type 2 focus on the environment, including a stronger link between increasing plant and animal biodiversity and fertiliser and soil fertility health, and from increasing plant and animal biodiversity to production. There are stronger links from both fertiliser and soil fertility health and production to farm environmental health. Farm environment health is linked to farm environment as place to live which is also linked to family needs with a score of five not zero Production is linked strongly to farmer decision maker. In turn, farmer decision maker influences water supply and quality (which then is linked to stream health), family needs and satisfaction, with the latter also strongly linked back to farmer decision maker. Satisfaction has stronger links to and from family needs, from farm environment as a place to live and from off-farm activities and off-farm product quality. Off-farm product quality also connects to farmer decision maker. The only financial factor emphasised is the link from cash farm income to family needs. Finally, this location is linked to farm environment as a place to live. The themes among the more heavily weighted connections include the biodiversity, environment, off-farm product quality, farmer decision maker, family needs and satisfaction. These emphases are very similar to those identified for the converting panel except that family needs is included here and there are more significant centrality scores showing greater importance to farmer decision maker, satisfaction, and farm environment as a place to live. These are characteristics making Q-sort type 2 a stronger expression of this viewpoint.

Having characterised the Q-sort types it is possible now to compare the dairy Q-sort results with the sheep/beef Q-sort results. The sheep/beef Q-sort type 4 results are similar to the dairy Q-sort type 2 results. Among the nine top-ranked factors in each Q sort there were seven factors in common and the first two were in identical order. The three centrality scores significant within the 0.05 level for dairy Q-sort type 2 were significant for sheep/beef Q-sort type 4. Both maps gave more emphasis to off-farm product quality, farm environmental health, satisfaction and farm environment as a place to live. While the sheep/beef map had a significantly higher score for weather and climate, and for fertiliser and soil fertility health, the tendencies in the dairy centrality scores were in the same direction.

The sheep/beef study simplified the four Q-sort types into two, calling each one Combined Type A and Type B, and found that for nine factors the combined Type B had statistically significant differences. Three of these are matched by the dairy Q-sort type 2, including: farm environment as a place to live, farm environmental health and satisfaction. In terms of map characteristics, both types had a higher number of connections per variable.

Figure 4: Group map showing Q-sort type differences



2.5 Conclusion

This chapter has presented results on the overall group map for dairy farming. It gave a detailed analysis of that map before examining group maps for the panels and for the two Q-sort types. For the latter there were two sets of data, one to characterise the Q-sort types and the other to characterise the maps for each type.

Location effects were found and they occurred for ten factors and four map characteristics.

Chapter 3
Key Findings and Discussion

3.1 Summary of results

The main characteristics of the maps are as follows:

Group map
The overall group map shows that dairy farming involves the management and response to a wide variety of factors, including economic, environment and social ones. At the core of the map are personal (farmer decision maker and satisfaction) and production factors surrounded by soil, environmental, climatic, family and financial factors. True to the family farm structure of much of New Zealand farming, the map shows the closely integrated role of family in the farming system expressed as family needs. The map is not insular since there are connections extending outwards including other people and related factors, especially the marketing or processing organisation and considerations of time in farm work. There is a strong production orientation in the map with some of the strongest connections from farmer decision maker to fertiliser and soil fertility health and to production. However, the environment is also important, reflected in farm environmental health and, to a lesser extent, of farm environment as a place to live. The sources of satisfaction (production, fertiliser and soil fertility health, farmer decision maker, family needs farm environment as a place to live and net profit before tax) are quite varied and reflect the broad mix of factors at the core of the map.

Other data rounded out the general findings. Just over one half of dairy farmers reported that quality of production, rather than quantity of production, was most important and just of over one third said both. A modest majority stated that their farms were below average in terms of level of inputs per hectare. Farm environmental health was defined in terms soil, streams, sustainability, ecosystem, system, variety and balance. The farmers expressed a flexible attitude to change on their farms. Farmers also stated that a resilient farm had financial flexibility or was adaptable in other ways.

Many of the core factors in the map are connected with bidirectional arrows so they are in a dynamic and complex relationship with each other. Changes in one factor would necessitate changes in nearby factors. These dairy farmers are juggling many factors in the day-to-day and longer-term planning and management of their farms. It is because of this complexity of factors shown at the generic level for all 20 farmers that farmers create specific ways through the complexity by developing a strategy or approach that makes sense to them and appears to meet their needs. These different strategies mean that there are distinctive ways that farmers combine and relate factors despite having some core similarities. The maps for the panels and the Q-sort types illustrate these different strategies.

Panel maps

- The map for the conventional panel shows an emphasis on factors of production and financial factors.
- The map for the converting panel shows an emphasis on biodiversity, environment, off-farm product quality, and specific influences on farmer decision maker.

Q-sort maps

- The map for the Q-sort type 1 shows an emphasis on factors of production and financial factors.
- The map for the Q-sort type 2 shows an emphasis on biodiversity, environment, off-farm product quality, farmer decision maker, family needs and satisfaction.
- The results for Q-sort types are similar to the panel maps but are a stronger expression of the second type.

Comparison to sheep/beef results

The overall group maps for the dairy and sheep/beef sectors were very similar. However, there are some differences, as follows.

- The dairy map had three additional factors but not advisors and consultants.
- Dairy farmers had the connection between farmer decision maker and expenses in the opposite direction compared to sheep/beef farmers.
- Dairy farmers had customer requirements connected to Fonterra; for sheep/beef it was connected to farmer decision maker.
- Dairy had weather/climate connected to farmer decision maker at four: for sheep/beef it was seven.
- Dairy had more connections to farm environmental health.
- Dairy had stocking rates connected to quality and quantity of production at five; for sheep/beef it was three.
- Dairy had quality and quantity of production connected to net profit, and net profit was connected to satisfaction.

For the panel maps, there were some similarities between the dairy converting map and the sheep/beef organic map: both had high centrality scores for farm environmental health and high map densities. Both included off-farm product quality.

For the Q-sort maps there were strong similarities between the dairy Q-sort type 2 and sheep/beef Q-sort type 4 results. They have similar Q sort arrays, some similar significant centrality scores and similar maps. In addition, there are similarities between sheep/beef combined Type B and dairy Q-sort type 2. They share three statistically significant centrality scores and one map characteristic.

3.2 Discussion and Interpretation of Results

There are some general points among the results that bear a discussion similar to that provided in the sheep/beef report and can now be considered briefly. First, the preceding results confirm core similarities across panels. While we have emphasised the differences across panels and across Q-sort types, it is still the case that the maps have many factors which had similar levels of importance and are connected in similar ways. Second, the maps show the key role of family in farming. There are complex interactions among the central factors in the map and one of these is family needs. Thus, any change in family situation, such as a birth or a death, could affect family needs and this, in turn, has a major influence on farmer decision maker. Third, environmental factors were important in the maps. The emphasis on environmental factors is interesting because it did not come up in pre-testing. Fourth, the group map results also show that many dairy farmers see their farm as a complex system, although there is differentiation among farmers in their appreciation of farm complexity. Converting farmers and Q-sort type 2 farmers have more complex maps.

The differences in the overall group maps for dairy and sheep/beef can be explained by reference to characteristics of the particular sectors. Dairy farmers see farmer decision maker affecting expenditure while sheep/beef farmers see expenses affecting farmer decision maker because in recent years sheep/beef returns have been lower than in dairying and they are watching their expenditure thus showing on their maps that expenditure influences farmer decision maker. Dairy farmers see the link from customers to Fonterra rather than directly to farmer decision maker because this reflects their greater reliance on Fonterra to process and sell their milk. Sheep/beef farmers emphasise weather more because their farms are located in drier, South Island regions prone to drought. Dairy farming is located in areas with more reliable rainfall, or irrigation, to support regular pasture growth. Dairy farmers had more connections to farm environmental health because in recent years the industry has been responding to criticism that dairy farming is a major source of pollution. Therefore dairy farmers are very conscious of this factor in their farming system. Dairy farmers emphasised stocking rates because they are a more intensive system with a greater need to maximise production. This is confirmed by the direct link between production and net profit: for dairy farmers production is income but for sheep/beef farmers production does not necessarily lead to income as illustrated by recent very low prices for some types of wool. The importance of profit to dairy farmers operating an intensive system is reinforced by the stronger connection from it to satisfaction.

The sheep/beef report showed that a number of studies (Fairweather and Keating, 1994; Brodt et al., 2006; Burton and Wilson, 2006) identified different types or styles of farm management. Table 11 below shows how the results from these studies and the sheep/beef and the dairy studies align. The table shows a theme of broad similarity across the studies for each of three broad areas. The first theme is a production oriented type and this theme is represented consistently across the studies although for the sheep/beef study it was the integrated management panel that best aligned to it. The second theme is some alternative to a production emphasis and it manifests in slightly different ways in each study. Flexible Strategists sought to maximise returns by paying attention to careful marketing of farm products rather than production per se. Networking Entrepreneurs show less interest in earning a living from the farm and have more interest in off-farm activities and social interaction. Diversifiers seek to make income from on-farm diversification schemes. This second theme is reflected in sheep/beef Q-sort types 2 and 3, both of which emphasise off-farm connections, work or activities, but is not reflected among dairy farmers. The third theme includes environment, conservation or ecological ideas. The environmentalist was distinguishable by the importance given to environmental awareness and conservation. Environmental Stewards emphasised environmental stewardship. The conservationist were creating new wildlife habitats and had conservation schemes on their farms. In the sheep/beef study, organic farmers and Q-sort type 4 farmers emphasised the farm environment and its quality. In this dairy study, the converting panel and Q-sort type 2 emphasised environment.

Table 11: Alignment of studies of farmer types

Earlier work: Fairweather and Keating (1994)	California: Brodt et al. (2006)	UK: Burton and Wilson (2006)	Sheep/beef	Dairy
Dedicated Producer	Production Maximisers	Agricultural producer Agribusinessperson	Integrated management	Production (Conventional or Q-sort Type 1)
Flexible Strategist	Networking Entrepreneurs	Diversifier	Q-sort type 3 – External Q-sort type 2 – Off-farm work	
Environmentalist	Environmental Stewards	Conservationist	Organic management Q-sort type 4 – Ecological	Environment (Converting or Q-sort type 2)

The main findings of the dairy study have some policy implications for the dairy sector. The occurrence of a production and an environmental type among dairy farmers means that farmers who emphasise production more than the environment are less likely to consider converting to organic farming. Their focus is on the factors of production and financial factors. They see organic farming as emphasising the environment and jeopardising production. To make the conversion option more appealing to conventional farmers with a production orientation it would be necessary to focus on net returns, which, because of the premium, may be as good as or better than conventional dairying. Farmers who emphasised the environment could make the transition to organic farming. To make the conversion option more appealing to conventional farmers with an environmental orientation it would be necessary to focus on technical issues relating to how to farm in an environmentally friendly way.

The research has identified a number of sources of satisfaction and Table 12 shows the strengths of the connections linking to satisfaction for each Q-sort type. These sources are important goals for farmers, assuming that they reasonably respond to the positive feedbacks (satisfactions) in their system and have some freedom to choose different sources of satisfaction. Q-sort type 1 gives the same score as Q-sort type 2 to production as a source of satisfaction and a higher score for net profit before tax but all the other connections are weaker. Farmers of this type presumably emphasise factors that contribute to these sources of satisfaction (production and profit) and therefore are motivated to achieve these goals. Q-sort type 2 emphasises farmer decision maker and farm environment as a place to live as much as production, and also strongly connects family needs.

Table 12: Key sources of satisfaction

Link to satisfaction	Q-sort type 1	Q-sort type 2
Farmer decision maker	3	6
Production	6	6
Net profit before tax	4	2
Family needs	1	5
Farm environment as place to live	2	6
Farm environmental health	1	3
Off-farm activities	1	3
Off-farm product quality	1	3

Farmers in the converting panel may have been the easy farmers to encourage to organic production because of their environmental orientation. Farmers in the conventional panel, with its emphasis on production and financial factors, are less likely to consider converting because they believe that an organic system will jeopardise both production and returns. Against these considerations is the finding that there are three conventional farmers among those loading on Q-sort type 2, and five converting farmers on Q-sort type 1. This suggests that the distinction between conventional and converting farmers, and the matching characteristics in the Q-sort types, is not so straightforward. However, we need to consider the specific circumstances of the farmers not appearing to fit the patterns.

For the three conventional farmers who loaded on Q-sort factor 2, one has an organic kiwifruit operation so it is not surprising that the farmer has an environmental orientation. Of the other two farmers, one has considered organic farming but is put off by a nearby example of an untidy organic farm, and the other demonstrates a strong environmental orientation even though he has a large herd by ARGOS standards (620 cows). Thus the Q-sort type 2 factor is picking up the environmental orientation even if the farmer is conventional. This shows that conventional farmers can have a very positive environmental orientation, that it is not a characteristic exclusive to organic farmers. We note that farmers' ambitions to have large herds might make it harder for them to consider converting to organic production because they may perceive large herds to accentuate the technological or environmental challenges of dairy farming.

For the five converting farmers who loaded on Q-sort type 1, it is important to note that two of them also loaded onto Q-sort type 2 with a loading above 0.5 which is well above the level to obtain statistical significance (0.4). This means that while their Q sorts contributed to the characterisation of factor 1 they also helped characterise factor 2. In effect, they have characteristics of both types. Of the remaining three, one has been an organic farmer for a long time but has experienced poor financial performance in recent years and was seeking to improve financial performance by emphasising production. For the other two, there are characteristics which suggest that they are not strongly oriented to the environment even though they are converting to organic. They are likely to be pragmatic organic farmers. In one case the herd is large in size and the farmer appears to be traditional and, in the other, the person interviewed was the farm manager who presumably was trying to meet the ideals of the owner but may not have represented these ideals well.

The above considerations show that the broad distinctions found in this research can accommodate the less then precise allocation of ARGOS panellists to Q-sort types. They also suggest that both conventional and organic farmers can have a strong environmental orientation. Therefore, environmental research, practices and policies can appeal to both types. The presence of converting farmers on Q-sort type 1 suggests that at this point in time there are pragmatic organic dairy farmers moving into organic production and their

environmental orientation is not as strong as the other converting farmers and environmentally-oriented conventional farmers. This is not surprising given that organic dairy farming is relatively new in terms of total numbers. As time passes we expect that industry structures and supports will develop and encourage the pragmatic farmers to become committed organic farmers and take on a fuller view of the farm environment.

As earlier research on farmers' motivations for farming organically or not shows (Fairweather,1999) it is important for policy to show that organic farming is both technically feasible and economically profitable. Conventional farmers with concerns about the farm environment are more likely to consider converting to organic production.

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Appendix 1: Responses to questions asked after causal mapping

Table 1.1: Response to: What does farm environmental health mean?

Don't really understand, safety when spraying. Safe chemical storage, wearing earmuffs, safety procedures, warning people.
Its your farm, the livestock under the soil, like to get a lot of life going there. This helps animal health.
Like protecting the soil, streams, wildlife and bush.
If its not a healthy farm its not sustainable. A healthy farm is tidy and the stock are looking good.
How streams are kept. Hazardous goods etc.
Whole ecosystem, how healthy the soil is. Not fertiliser in drains.
Stream quality is most important.
Soil's the main thing, healthy so highly productive. High biodiversity and micro-organisms so ecosystem is working. Balance.
The sustainable balance of inputs and outputs of the farming system.
Healthy streams, any water, air, leaving farm (in good shape), any bi-product is as good as it can be. Healthy trees etc.
Our whole system being healthy, not affecting anybody else, not contaminating waterways.
Whole system is working well, from soil to stock, birds and bees to rabbits.
Fairly broad, include biodiversity, animals, plants, soil and streams. If things are working well, is how you tell, animals looking healthy and net profit but if low is OK as long as system is healthy.
(Not used as a factor, no strong meaning and not many waterways)
Seeing grass growing, variety of species in pasture, everything sustainable, healthy cows.
Health of soil and farm in general.
Everything is balanced.
Having healthy pasture and healthy animals. Don't get sick and live longer. No drugs.
Farm environment not polluted, improving soil and water quality. Custodians… not passing on farm in worse condition.
Free of chemicals.

Table 1.2: Response to: What does biodiversity mean?

No meaning
Introducing new grass species.
Don’t know
Producing organic milk.
Don't understand. GE?
Don’t know
Increase number of species of pasture, trees, types of livestock.
Plantains, pasture species and many pines.
Planting other species and not worrying about weeds. Plantains, herbal leys, increasing clover.
Different varieties of plants.
Helps with balance e.g., sheep, plantains, herbs and micro-organisms.
Different range of plants for animals to eat: herbs trees (nibble underneath), flaxes.
Number of species above and below ground is increasing including the non productive ones eg weed and 'pests' e.g., dandelion.
Leave that to nature, try to do things that don't impinge on other species.

Table 1.3: Response to: What are you trying to maximise?

Satisfaction
Generally, to produce as much income in a controlled, balanced traditional way.
Cash farm income plus satisfaction.
Net income before tax.
Production, but paid on quality, don't like demerit points and want to know why.
Profit.
Net profit.
Time with family, cash flow.
Happiness and opportunity to make choices.
Production, satisfaction and cash farm income.
Cash farm income
Make more efficient economically.
Satisfaction
Production.
Good place to live.
Production with lowest cost and good animal health.
Production.
Time between family.
Satisfaction
Cash farm income.

Table 1.4: Response to: What are you trying to minimise?

Bad effects, injury, bad debts, overdraft.
Go back to health, e.g., sore feet, empty rates.
Time in farm work.
An unhealthy farm.
Expenses, to make a profit without cutting corners.
Expenditure.
Expenses.
Work load, time in farm work.
Stress for others; for him (this) equals unhappiness.
Expenses, weed and pests, animal health problems.
Expenditure, chemicals (products that are detrimental to our system), work and stress.
The leeches - all the services industries.
Weeds.
Expenses.
Disasters.
Stress.
Amount of time, money and inputs to get production.
Weed and pest management, farm working expenses, time in farm work.
Expenses.

Table 1.5: Response to: What is at the heart of your system?

Family and sharing e.g., knowledge, working to live.
Soil and soil fertility.
Cows.
Satisfaction.
Me.
Production.
Age, family needs.
Balance between factors of farming, business, family, myself.
A cow which calves with no problems, eats lots and produces milk. An easy run farm.
Sustainable business, satisfaction.
Decision making and family.
Family.
Our son working as sharemilker.
Passion for farming.
Making sure kids are happy. You and me, which equals family, and stock.
Satisfaction and quality of plants and livestock.
Converting grass into money.

Table 1.6: Response to: To what degree can your farm change?

Never really locked in, could change.
Could change overnight e.g., increase cows and bring in feed.
Could change, e.g., once a day milking.
Could easily change.
Not really, 'spose could, not really. Waste if change to something else.
Change easily.
Could be changed.
Is changing, open to change, very flexible.
Very open to change.
System can change but owner is a limit.
Can be changed, but no reason to at present. Change now can have adverse effect.
Continually changing, not that resistant.
Resistant to change, I am, but anything is changeable.
Trying to change with irrigation, get better species of grasses.
Easy to change, open to ideas.
Open to change.
Can change quite a lot. Increase production, decrease expenditure, decrease time.
Can change.
Flexible yet robust i.e., some things easily change, some not easily.
Can change, in small ways. Were beef here.

Table 1.7: Response to: What is the main driver of change?

Money side is the main driver.
Time in farm work, financial.
Profit.
Financial.
Family needs, personal needs.
Profit and lifestyle.
Family needs and lifestyle, then stock health.
My decision making.
Economic
Discussion, information; money in bank.
Growth of farm size.
Family needs.
Imminent retirement.

Table 1.8: Response to: What makes for a resilient farm?

Quality and quantity of plants and livestock, good stock will handle bad weather. Resilient decision makers.
Strength of the systems in place, i.e., solid family, sharemilker, soil structure.
Ability to adapt, all-grass system and not highly stocked. Not a lot of staff, room to move.
Flexible e.g., take challenge on and adapt to them. All three have impact.
Money in bank. Economic cause.
Equity. Environment and economic.
Low debt, money.
Cash flow, understanding principles that farm operates on. Flexible decision making. Social, foot and mouth.
Flexibility and options, not tied into a particular system. Flexibility re. decision making between weather and cows. Social then economic.
Farmer/sharemilker relationship which is flexible, flexible decision making. Not social but economic.
Biology plus diversity, trying to achieve. Climate is the main potential effect.
To be able to handle… to have systems in place, animal health, e.g., lots of hay, time up sleeve. Drought, climate then financial.
Decision making. Environmental causes.
Get debt down. Economic has most impact.
Not great debts; knowing there is an end e.g., to rain.
Well set up, prepared, having supplementary feed on hand. Environment and economic.
Lots of diversity, e.g., plants, soil, good animal health. Weather and market.
Good health of everything, soil, pasture, animals. Relates to stocking rate. Weather and drought.
Decision making, farm environmental health. Economic and maybe others.
Good soil health and good equity. Weather.