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DECISION-PROCESSES OF
ADOPTERS AND NON-ADOPTERS
OF AN INNOVATION

A thesis
submitted in partial fulfilment
of the requirements for the degree
of
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by

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There have been some concerns about the low uptake of new technologies by farmers. One of the ways of addressing this issue is by understanding the perspectives of different groups of decision makers, particularly non-adopters. There were four groups of non-adopters: discontinued, wait-and-see, constrained and would never adopt. These groups have not been previously studied in farm management research. The main objective of this research was, therefore, to explore the cognitive structures of the adopters and non-adopters of an innovation.

In order to achieve the above objective, personal construct theory and the repertory grid technique with its computer software programme, the RepGrid, was used to elicit and analyse the interview data for a non-random sample of 25 dairy farmers in the Canterbury region. This research was exploratory in nature and focused on farmers who have used or not used heifer synchronisation.

The results of the study show the importance of farmers' personal construct systems in their decisions to adopt or not to adopt an innovation. The adopters and non-adopters used different constructs in their decisions to adopt or not adopt. Furthermore, the four groups of non-adopters also construed and behaved in different ways. Within each group of decision makers individuals generally construed and behaved similarly to each other. It was also found that farmers would not accept any information or an innovation which did not fall within their own conceptual construct framework or outside the range of convenience of their cognitive structures.

In other words, farmers operate both as heterogenous and homogenous groups for a particular innovation. First, the adopters and non-adopters have used different constructs and behaved differently from each other; that is, they have used contrasting constructs in their decision. Second, the individuals within each group of adopters and non-adopters have used one to three shared constructs and behave in similar ways; that is, they have used consensus constructs in their decision. Third, three groups of non-adopters (discontinued, wait-and-see and constrained) have used one shared construct and behave differently from each other; that is, they have used conflicting constructs in their decision. Fourth, within each of the four groups of non-adopters, there are both shared and different constructs but, within a group, farmers still behave in similar ways; that is, they have used corresponding constructs to reach the same decision.

These groups of decision makers are dynamic in nature which is illustrated by the types of constructs. Some individuals might change if they have permeable constructs or construe in a loose manner. Other individuals might not change or remain in the group if they have impermeable constructs or construe in a tight fashion.

These findings have wider implications for farm management research and extension. They are important in terms of understanding farmers' circumstances, particularly the different groups of non-adopters. The findings are also useful for extension in trying to develop some policies and strategies for increasing the uptake of new technologies by farmers. In other words, exploring the personal constructs of the adopters and the various groups of non-adopters provides useful guidelines to the development of effective technology transfer programmes in order to increase the uptake of these new technologies by farmers.

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TABLE OF CONTENTS

	Page
Abstract	ii
Acknowledgements	iv
Contents	v
List of Figures	viii
List of Tables	xii
Glossary	xiii
CHAPTER 1: INTRODUCTION	1
1.1 General Introduction	1
1.2 Research Problem	3
1.3 Research Objectives	3
1.4 Outline of Thesis	4
CHAPTER 2: SOME MODELS OF FARMERS' DECISION MAKING	5
2.1 Introduction	5
2.2 Research on Technology Transfer in New Zealand	5
2.3 Subjective Expected Utility Theory	7
2.3.1 Preference ordering using SEU theory	7
2.3.2 Underlying axioms	8
2.3.3 Some limitations of SEU theory	9
2.4 Adoption-Diffusion Model	11
2.4.1 The innovation-decision process	11
2.4.2 Categories of adopters	16
2.4.3 Factors influencing adoption	21
2.4.4 Some limitations of the adoption-diffusion model	30
2.5 Ethnographic Decision Tree Modelling	34
2.5.1 General principles	34
2.5.2 Assumptions	35
2.5.3 Theory behind the decision model	35
2.5.4 The decision process as a decision tree	38
2.5.5 Discussion	39
2.6 Summary	43

CHAPTER 3: Personal Construct Theory and Repertory Grid Technique	44
3.1 Introduction	
3.2 The Individual as a Scientist	44
3.3 Fundamental Postulate and Corollaries	46
3.4 Eliciting Construct Systems	58
3.4.1 Techniques using individual constructs	58
3.4.2 Techniques using systems of constructs	61
3.5 Conclusion	76
CHAPTER 4: METHOD	77
4.1 Introduction	77
4.2 A Conceptual Model	77
4.3 The Study Area and Industry	80
4.3.1 The Study Area	80
4.3.2 Dairy Industry in Canterbury	81
4.4 Innovations in Dairying	82
4.4.1 Innovations	82
4.4.2 Selection of Elements	85
4.5 Sampling Procedure	85
4.5.1 Justification for a qualitative approach	86
4.5.2 Selection of samples	87
4.5.3 Sampling size and representation	87
4.6 Background Information of Subjects Interviewed	88
4.7 The Repertory Grid Technique	90
4.7.1 The RepGrid programme	90
4.7.2 Interview procedure	93
4.7.3 Elicitation of constructs	94
4.7.4 Repertory Grid Analysis	96
4.8 Summary	98
CHAPTER 5: RESULTS	99
5.1 Introduction	99
5.2 Adopters' Constructs	99
5.2.1 Subject 3	99
5.2.2 Subject 5	100
5.2.3 Subject 6	100
5.2.4 Subject 8	100
5.2.5 Subject 9	101
5.2.6 Summary of Adopters' Constructs	101
5.2.7 Socio Analysis of Adopters' Construct	103
5.3 "Discontinued" Constructs	105
5.3.1 Subject 1	105
5.3.2 Subject 2	105
5.3.3 Subject 4	105
5.3.4 Subject 11	106
5.3.5 Subject 12	106

5.3.6	Summary of “Discontinued” Constructs	106
5.3.7	Socio Analysis of “Discontinued” Constructs	108
5.4	“Wait-and-see” Constructs	108
5.4.1	Subject 10	110
5.4.2	Subject 13	110
5.4.3	Subject 17	110
5.4.4	Subject 19	110
5.4.5	Subject 22	111
5.4.6	Summary of “Wait-and-see” Constructs	111
5.4.7	Socio analysis of “Wait-and-see”	211
5.5	“Constrained” Constructs	114
5.5.1	Subject 15	114
5.5.2	Subject 16	114
5.5.3	Subject 18	114
5.5.4	Subject 21	115
5.5.5	Subject 25	115
5.5.6	Summary of “Constrained” Constructs	115
5.5.7	Socio analysis of “Constrained” Constructs	118
5.6	“Would never adopt” Constructs	118
5.6.1	Subject 7	118
5.6.2	Subject 14	118
5.6.3	Subject 20	120
5.6.4	Subject 23	120
5.6.5	Subject 24	120
5.6.6	Summary of “Would never adopt” Constructs	120
5.6.7	Socio Analysis of “Would never adopt” Constructs	122
5.7	Summary of results for each group of decision makers	124
5.8	Conclusion	131

CHAPTER 6: DISCUSSION AND CONCLUSIONS **133**

6.1	Introduction	133
6.2	Comparison of Results for Different Groups	134
6.2.1	Comparisons between adopters and non-adopters	134
6.2.2	Comparisons between groups of non-adopters	138
6.2.3	Other findings	142
6.2.4	Overview of comparisons	142
6.3	Discussion with reference to existing literature	143
6.3.1	Interpretation in terms of Kelly’s personal construct theory	143
6.3.2	Interpretation in terms of other research	151
6.4	Implications for Farm Management Research and Extension	154
6.5	Research Limitations	157
6.6	Suggestions for Future Research	158
6.7	Summary and Conclusions	159

REFERENCES	161
APPENDIX 1	174
Results of Analyses of the Repertory Grids of Adopters and Non-adopters	
A1.1 Introduction	174
A1.2 Adopters' Constructs	174
A1.2.1 Subject 3's Constructs	174
A1.2.2 Subject 5's Constructs	180
A1.2.3 Subject 6's Constructs	188
A1.2.4 Subject 8's Constructs	198
A1.2.5 Subject 9's Constructs	205
A1.3 "Discontinued" Constructs	212
A1.3.1 Subject 1's Constructs	212
A1.3.2 Subject 2's Constructs	219
A1.3.3 Subject 4's Constructs	223
A1.3.4 Subject 11's Constructs	228
A1.3.5 Subject 12's Constructs	235
A1.4 "Wait-and-See" Constructs	240
A1.4.1 Subject 10's Constructs	240
A1.4.2 Subject 13's Constructs	246
A1.4.3 Subject 17's Constructs	253
A1.4.4 Subject 19's Constructs	257
A1.4.5 Subject 22's Constructs	262
A1.5 "Constrained" Constructs	268
A1.5.1 Subject 15's Constructs	268
A1.5.2 Subject 16's Constructs	273
A1.5.3 Subject 18's Constructs	277
A1.5.4 Subject 21's Constructs	283
A1.5.5 Subject 25's Constructs	288
A1.6 "Would Never Adopt" Constructs	295
A1.6.1 Subject 7's Constructs	295
A1.6.2 Subject 14's Constructs	299
A1.6.3 Subject 20's Constructs	304
A1.6.4 Subject 23's Constructs	309
A1.6.5 Subject 24's Constructs	315
 Appendix 2	
RepGrid Programme	321
 Appendix 3	
Summary of Percentage of Variance in the First Principal component	326

List of Figures

Figures

1	A decision tree model to adopt the new sheep breeds	40
2	A conceptual model	78
3	Socio construct links for adopters	104
4	Socio construct links for “Discontinued” non-adopters	109
5	Socio construct links for “Wait-and-See” non-adopters	113
6	Socio construct links for “Constrained” non-adopters	119
7	Socio construct links for “Would Never Adopt” non-adopters	123
A1.1	Focused grid for subject 3	175
A1.2a	PrinCom analysis for subject 3	181
A1.2b	Principal components for subject 3	181
A1.3	Focused grid for subject 5	183
A1.4a	PrinCom analysis for subject 5	189
A1.4b	Principal components for subject 5	189
A1.5	Focused grid for subject 6	191
A1.6a	PrinCom analysis for subject 6	197
A1.6b	Principal components for subject 6	197
A1.7	Focused grid for subject 8	199
A1.8a	PrinCom analysis for subject 8	204
A1.8b	Principal components for subject 8	204
A1.9	Focused grid for subject 9	206
A1.10a	PrinCom analysis for subject 9	211
A1.10b	Principal components for subject 9	211

A1.11	Focused grid for subject 1	213
A1.12a	PrinCom analysis for subject 1	218
A1.12b	Principal components for subject 1	218
A1.13	Focused grid for subject 2	220
A1.14a	PrinCom analysis for subject 2	224
A1.14b	Principal components for subject 2	224
A1.15	Focused grid for subject 4	226
A1.16a	PrinCom analysis for subject 4	229
A1.16b	Principal components for subject 4	229
A1.17	Focused grid for subject 11	231
A1.18a	PrinCom analysis for subject 11	234
A1.18b	Principal components for subject 11	234
A1.19	Focused grid for subject 12	236
A1.20a	PrinCom analysis for subject 12	239
A1.20b	Principal components for subject 12	239
A1.21	Focused grid for subject 10	242
A1.22a	PrinCom analysis for subject 10	247
A1.22b	Principal components for subject 10	247
A1.23	Focused grid for subject 13	248
A1.24a	PrinCom analysis for subject 13	252
A1.24b	Principal components for subject 13	252
A1.25	Focused grid for subject 17	254
A1.26a	PrinCom analysis for subject 17	258
A1.26b	Principal components for subject 17	258
A1.27	Focused grid for subject 19	259

A1.28a	PrinCom analysis for subject 19	263
A1.28b	Principal components for subject 19	263
A1.29	Focused grid for subject 22	264
A1.30a	PrinCom analysis for subject 22	267
A1.30b	Principal components for subject 22	267
A1.31	Focused grid for subject 15	269
A1.32a	PrinCom analysis for subject 15	272
A1.32b	Principal components for subject 15	272
A1.33	Focused grid for subject 16	274
A1.34a	PrinCom analysis for subject 16	278
A1.34b	Principal components for subject 16	278
A1.35	Focused grid for subject 18	279
A1.36a	PrinCom analysis for subject 18	284
A1.36b	Principal components for subject 18	284
A1.37	Focused grid for subject 21	285
A1.37a	PrinCom analysis for subject 21	289
A1.37b	Principal components for subject 21	289
A1.38	Focused grid for subject 25	291
A1.39a	PrinCom analysis for subject 25	294
A1.39b	Principal components for subject 25	294
A1.40	Focused grid for subject 7	296
A1.41a	PrinCom analysis for subject 7	299
A1.41b	Principal components for subject 7	299
A1.42	Focused grid for subject 14	302
A1.43a	PrinCom analysis for subject 14	305

A1.43b	Principal components for subject 14	305
A1.44	Focused grid for subject 20	307
A1.45a	PrinCom analysis for subject 20	310
A1.45b	Principal components for subject 20	310
A1.46	Focused grid for subject 23	310
A1.47a	PrinCom analysis for subject 23	311
A1.47b	Principal components for subject 23	313
A1.48	Focused grid for subject 24	316
A1.49a	PrinCom analysis for subject 24	319
A1.49b	Principal components for subject 24	319

List of Tables

Tables

1	Some innovations in the dairy industry	83
2	Summary of background information of subjects	88
3	Summary of adopters' constructs	102
4	Summary of "discontinued" constructs	107
5	Summary of "wait-and-see" constructs	112
6	Summary of "constrained" constructs	116
7	Summary of "would never adopt" constructs	121
8	Summary of comparison between adopters and non-adopters	135
9	Summary of comparison among groups of non-adopters	140
A3.1	Summary of Percentage of Variance	326

Glossary

Conception rate

It is defined as the number of cows pregnant to a single service per hundred served.

Breeding Worth (BW)¹

The expected ability of an animal to breed replacements which are efficient converters of feed into profit.

Production Worth (PW)¹

The expected lifetime ability of a cow to convert feed into profit.

¹ New Zealand Dairy Industry: Animal Evaluation User Guide, 1995

CHAPTER 1

INTRODUCTION

1.1 General Introduction

There have been some concerns about the low uptake of new technologies by some farmers. For example, in New Zealand some scientists have expressed their concerns about the low uptake of new technologies from research institutions by farmers (Parker, Hight and Cullen, 1977; McRae, 1993; Belgrave and Woodfield, 1996). Many of these studies have focused on the identification of factors that influence farmers' behaviour. Murray-Prior (1994) and Frank (1995b) have noted that less work has been undertaken on the actual decision-making processes used by farmers themselves. More importantly the issues related to the non-adopters have rarely been addressed in farm management research although such understanding is important in increasing the uptake of new technologies.

One of the models which has been used to explain farmers' decision-making is the subjective expected utility (SEU) theory (e.g., Schoemaker, 1982; Quiggin, 1988). It is an economic model which assumes that farmers assign probabilities to the occurrence of uncertain events. They also give their personal valuations of potential outcomes. The SEU theory assumes that the prospect with the highest expected utility is considered as the most preferred option. Although SEU theory has been popular in the literature, some authors have raised doubts about the use of the theory to predict farmers' actual behaviour under uncertain conditions. In the real world situation, farmers may not go through the decision processes suggested by the SEU theory (e.g., Lewis and Thiele, 1981; Gladwin, 1977 & 1989; Murray-Prior, 1994).

In the adoption literature, the classical adoption-diffusion model of innovation has also been used to understand the decision-making processes of farmers when they consider new practices. This model consists of a sequence of actions and choices made by individuals over time and consists of five stages: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. The basic assumption of this model is that the spread of new ideas and the propensity to adopt rely on (1) the relative innovativeness, and (2) the personal attributes of farmers (see Rogers and Shoemaker, 1971; Rogers, 1983) with some farmers adopting innovations much more quickly than others. It is conceptualised that the new practices can be spread to other farmers by a "progressive farmer" strategy where the

practices of the early adopters are copied by the late adopters. The adoption-diffusion model therefore assumes that information generated from research is inherently valuable, desirable and suitable to farmers as a means of increasing farm production and productivity. However, experience has revealed that in the real world situation this conceptualisation of information transfer does not normally occur (Arnon 1987 & 1989; Nitsch, 1988; Davies, 1988). Frank (1995b) notes that the classification of adopters based on the degree of innovativeness is often "misleading and derogatory" to the later adopting or non-adopting individuals classified as laggards. In fact, Frank argues that this concept is one of the main reasons for the slow adoption of the new ideas. Similarly, Mortiss (1993) argues that even though adopting farmers are innovators over a number of innovations each of them may be a laggard in respect to other innovations. According to Mortiss, it is difficult to generalise by grouping some farmers as laggards and others as innovators and hence each type of innovation has to be considered separately.

An alternative model of decision-making which has appeared in the literature is the ethnographic decision tree modelling. Gladwin (1989) explicitly rejects the SEU theory and suggests a cognitive approach to farmers' decision making which she considers would better reflect how farmers actually make their decisions. She calls this as the ethnographic decision tree modelling. By using this decision model Gladwin is able to identify the decision criteria used by the decision makers. Jangu (1993) also used a similar method to identify the decision factors whether to adopt or not to adopt the new sheep breeds. Using the decision tree, Jangu was able to categorise some farmers into one group of adopters and three groups of non-adopters: wait-and-see, constrained and would never adopt.

However, the main limitation of this ethnographic approach to decision making is that it does not provide a psychological explanation of the choice of the decision criteria. Murray-Prior (1994) provided a technique for filling this gap, to some extent, by using personal construct theory concepts such as laddering to gain information on the decision criteria. However, the researcher considered this laddering technique was inappropriate in the study of non-adopters because he was concerned about the participation from the researched subjects. It was then decided to opt for a less probing form of personal construct theory's elicitation of systems of construct such as the repertory grid technique in an attempt to understand the cognitive structures of non-adopters rather than specifically aimed to identify the decision paths that got them there.

1.2 Research Problem

Many factors seem to influence farmers in their decisions to adopt or reject certain innovations. Many studies have used different theories of decision making to study the adoption behaviour of farmers. However, the issues relating to non-adoption by some farmers have not been fully addressed in the literature.

The SEU model seems to be an unrealistic depiction of farmer behaviour. Similarly, the adoption-diffusion model does not provide a plausible explanation of non-adopter behaviour. Although the ethnographic decision tree model can be used to categorise farmers into groups of adopters and non-adopters, it does not provide an explanation of the underlying mental constructs that would lead to the decision to adopt or not to adopt.

The main aim of this research is, therefore, to identify and apply an alternative approach, personal construct theory, that could advance some explanations or insights into the decision processes of the adopters and non-adopters of an innovation. In doing so, understanding of non-adoption may be enhanced, thereby increasing knowledge on impediments to the uptake of new technology.

1.3 Research objectives

The general aim of this study is to examine the decision-making processes of the adopters and four groups of non-adopters (discontinued, wait-and-see, constrained and would never adopt) of an innovation. Emanating from this, the objectives of this research are:

- (1) to identify and justify an approach which can be used to examine the decision processes of adopters and non-adopters of an innovation,
- (2) to use the selected approach, personal construct theory and the associated repertory grid technique to elicit and analyse the cognitive structures or mental constructs of these adopters and the four groups of non-adopters to see whether there is homogeneity within the group that follows the same decision path, and

- (3) to elicit and analyse the cognitive structures or mental constructs of these adopters and the four groups of non-adopters to see whether there are differences between the groups that follow different decision paths.

The issues related to the decision behaviour of the non-adopters have rarely been addressed in farm management research. Therefore, this research is focused primarily on the behaviour of the non-adopters. The practical implications of understanding the cognitive structures of adopters and non-adopters is that such knowledge could assist in understanding the uptake of new technologies by farmers. In other words, for effective transfer of new technology it is essential that those involved in research or in the transfer of new technology should understand how the farmers actually construe the events in their environment. The implications of this perspective will be examined in this study.

1.4 Outline of thesis

In Chapter 2 the current state of knowledge on technology transfer in New Zealand will be described before presenting a review of some decision-making models which appear in the literature. Chapter 3 reviews personal construct theory which was used in this research to explain the decision-making processes or cognitive structures of the adopters and non-adopters of an innovation. The repertory grid technique which was used to elicit constructs will also be described in this Chapter. Chapter 4 describes how the computer software programme, the RepGrid, be used to elicit and analyse the data. In Chapter 5, the results of the analysis using the three RepGrid sub-programmes will be presented. Finally, Chapter 6 will present a comparison of the different groups and some discussion with reference to the existing literature. Some research implications for farm management research and extension, research limitations and suggestions for future research will be presented. Some general conclusions from this study will be described at the end of this Chapter.

CHAPTER 2

SOME DECISION MAKING MODELS RELATING TO ADOPTION

2.1 Introduction

As stated in the previous chapter, the objective of this research is to understand the decision-processes of the adopters and non-adopters of an innovation. Many studies have been conducted on farmers' decision making related to the adoption of new technologies by agricultural producers. A number of decision-making models or theories have been used in these studies. These include subjective expected utility theory, the adoption-diffusion model and ethnographic decision tree modelling.

This chapter begins by presenting the current state of knowledge on technology transfer or the adoption of agricultural innovations in New Zealand. This is followed by a review of literature for each of these models and suggests which of the models or combinations of them would best explain the decision-making processes of the adopters and non-adopters of an innovation.

2.2 Research on technology transfer in New Zealand

There have been some concerns about the effectiveness of the traditional "trickle-down" approach to bring about change in farmers' attitude to speed the rate of adoption of new technologies not only in developing, but also in developed countries. In New Zealand, similar forms of critiques are expressed by some scientists in that many new technologies from research institutions in New Zealand have not been diffused widely (e.g., New Zealand Beef Council, 1989; McRae, 1993; Parminter and Parminter, 1994; Morris, Loveridge and Fairweather, 1995 and Reid, McRae and Brazendale, 1993). For example, Parker, Hight and Cullen (1977) have noted that over the past 30 years or so there have been some concerns among the agricultural scientists at the lack of uptake by farmers of new technology developed by research institutions in New Zealand. On hill country, there has been some comment at the low production of meat and wool which could possibly be increased by 50 per cent (Parker, Hight and Cullen, 1977). Similarly, Belgrave and Woodfield (1996) have noted that the uptake of new superior white clover cultivars has been slower than expected. Arising from these concerns, there have been a number of studies carried out looking at the

various factors influencing adoption or non-adoption of innovations by farmers in order to speed up the uptake of new technologies by the producers. Most of these studies focused on areas such as: (1) characteristics of farmers relating to age, education, motivation, goals and attitude (e.g., Fairgray, 1979; Stewart, 1979; Greer, 1982; Fairweather, 1992; Parminter, Power and Shaw, 1993; Valentine, Hurley and Glass, 1993), (2) characteristics of innovations (e.g. New Zealand Beef Council, 1989; Parminter, 1994; Brazendale, Reid and McRae, 1994; Belgrave and Woodfield, 1996; Reid, Coulson and Cameron, 1996), (3) effectiveness of information sources (e.g., Fairgray, 1979; Kampanellas, 1981; Moore, 1990; Parminter and Greaves, 1993); and (4) farmers' constraints, learning styles, and farm circumstances (e.g., Phillips, 1982; Moore, 1990; Fairweather, 1992; Jangu, 1993; Paine, 1993; Reid, McRae and Brazendale, 1993; and McRae, 1993).

To some degree, all these researchers give emphasis on factors that influence why some groups of farmers are earlier to adopt while some are later to adopt but less emphasis is given to the non-adopters and the differences between them. Although Jangu (1993) did identify some different groups of non-adopters, this study provided no information on the decision processes of each group or whether those individuals within the group have similar decision processes and those different groups have different decision processes.

In other words, most of the studies on farmers' adoption of new technologies are focused on the characteristics of farmers who are the end users and have adopted the innovations and the characteristics of innovations. Although some studies focused on the influence of personality variables on farmers' innovativeness (eg., Stewart, 1979; Greer, 1982) some others tend to move away from this concept of innovativeness, and instead argue that farmers' actions not to adopt as rational because of certain constraints (e.g., Fairweather, 1992; Jangu, 1993). McRae (1993) noted that there seems to be some lack of understanding among scientists pertaining to how farmers learn and make their decisions because they know very little of their farm circumstances. This view is shared by Reid, McRae and Brazendale (1993) who suggested that new technologies should address farmers' constraints and their circumstances in order to ensure that they are relevant to their farming systems. In other words, a better understanding of farmers' circumstances would provide a very good venue for future research (McRae, 1993). Parker and Townsley (1995) stated the importance of a qualitative approach to studying human behaviour pertaining to farmers' circumstances and goals on decision

making which reflect the close association between farm management and the disciplines of behaviour and social psychology.

In response to the critiques on the lack of understanding of farmers' circumstances and hence the slow uptake of new technologies by farmers, Massey University has introduced a new approach, *the Farmer First Research Programme*, to study farmers' circumstances, constraints and their involvement in the research process (McRae, 1993). However, the result of this new approach has not achieved its full potential because it has given little emphasis on farmers' perspective but more on management perspective (Morris, Loveridge and Fairweather, 1995). Although there is some information about the later adopters in this programme there is very little information or knowledge about the various groups of non-adopters which would play a very important role in research and extension in improving the uptake of new technologies.

In order to address the above issue, there is a need to review some of the farmers' decision making models relevant for adoption and to suggest which of the models or combinations of them would best explain the decision processes of the adopters and non-adopters of an innovation. The following models will be reviewed in this chapter: subjective expected utility theory, the adoption-diffusion model and the ethnographic decision-tree modelling.

2.3 Subjective Expected Utility Theory

Since the publication of the "Theory of Games and Economic Behaviour" by von Neumann and Morgenstern in 1944 until the mid 1980s, economic analysis of choice under uncertainty has been dominated by the expected utility (EU) model, or its derivative subjective expected utility (SEU). Initially, the model has been used as a normative approach to risky choice based upon an individual's belief or subjective probabilities on the occurrence of uncertain events and personal valuation of potential outcomes. However, the theory has also been used for descriptive and predictive reasons. The main elements of the SEU are described as follows.

2.3.1 Preference ordering using the SEU model

Savage (1954), cited in Murray-Prior (1994), used von Neumann and Morgenstern's (1953) expected utility model to incorporate a personal valuation of probabilities. This forms the basis of the SEU model. The model seeks to order risky prospects based on the preferences

or attitudes of the decision maker. The decision problem concerns maximising the subjective expected utility of the prospects which are then ranked by their expected utility index. The prospect with the highest utility is considered as the most preferred option.

2.3.2 Underlying axioms of the SEU model

The SEU model axioms comprise a series of behaviours which individuals are presumed to follow consistently. If these individuals conform, then the model can predict their choice behaviour under risk. These axioms, in mathematical terms, are a series of requirements of an individual's preference and related indifference relationships. Anderson, Dillon and Hardarker (1977) describes four commonly used of axioms for SEU theory: (1) ordering, (2) transitivity, (3) continuity, and (4) independence among choices.

Ordering

People can order prospects. For example, given any two risky projects, a_1 and a_2 , a decision maker either prefers a_1 to a_2 , prefers a_2 to a_1 , or is indifferent between them.

Transitivity of preference

The logical extension of ordering is transitivity of orderings for three or more risky prospects, e.g., a_1 , a_2 , and a_3 . If a decision maker prefers a_1 to a_2 (or is indifferent between them) and prefers a_2 to a_3 (or is indifferent between them), she will prefer a_1 to a_3 (or be indifferent between them).

Continuity

If a decision maker prefers a_1 to a_2 to a_3 , a subjective probability $P(a_1)$ exists, other than zero or one, such that she is indifferent between a_2 and a risky choice of receiving a_1 with probability $P(a_1)$ and a_3 with probability $1-P(a_1)$. It implies that, if a decision maker is faced with a risky prospect involving a good and a bad outcome, she will take the risk if the chance of getting the bad outcome is low enough. Continuity is therefore a reasonable requirement to demand of an orderly thinking person, but the axioms gives operational difficulties when the prospects consist of disparate alternatives.

Independence

If a_1 is preferred to a_2 , and a_3 is any risky prospect, a lottery with a_1 and a_3 as its outcomes will be preferred to a lottery with a_2 and a_3 as outcomes when $P(a_1)=P(a_2)$. It means that preference between a_1 and a_2 is independent of a_3 .

A decision maker whose preferences obey these axioms will have her utility function, $U(w)$, which associates a single real number or utility index with any risky prospect faced by the decision maker. For example, if the risky prospect a_1 is preferred to a_2 , then the utility index of a_1 is greater than the utility index a_2 , i.e., $U(a_1) > U(a_2)$.

The SEU model thus provides a mechanism for ranking risky prospects in order of preference. The most preferred prospect is the one which has the highest utility. The SEU theory, therefore, implies that maximisation of expected utility provides the empirical basis of the application of the theory.

2.3.3 Some limitations of SEU model

Proponents of the expected utility model argue that the approach is reasonable, rational and logical. For example, Anderson and Hardaker (1972), cited in Lewis and Thiele (1981), argued that the theory has been used widely in practice, such as by corporate business in the U.S. They commented:

Bernoullian decision theory stands or falls on the "reasonableness" of the basic axioms, and on the validity of the logic by which the operational theory is deduced from these axioms. We find it hard to suppose that many people will find either the axioms or the logic unacceptable.

However, in their detailed review of literature, Lewis and Thiele (1981) and Walker and Nelson (1977), cited in Lewis and Thiele (1981), showed that there was little evidence of the theory being used at the farm level. They pointed out that there was little evidence to suggest that the theory provided a reasonable approximation of decision making in practice by the decision makers. Lewis and Thiele (1981) highlighted two important related issues associated with expected utility theory: (1) the validity of the expected utility theory to approximate decision making in practice, and (2) the use of the expected utility theory in actual practice at the farm level. Others also pointed out that SEU theory has some limitations as normative,

descriptive and predictive models (Shoemaker, 1982; Fischhoff, Goitein and Shapira, 1983; Machina, 1987; Quiggin, 1988, cited in Murray-Prior, 1994).

For example, Murray-Prior (1994) in his comprehensive review of literature on subjective expected utility theory noted that the theory failed to perform as a descriptive and a predictive model. Murray-Prior explains that SEU fails to perform as a descriptive model of people's behaviour based on the following aspects: (1) violations of the SEU axioms, (2) people do not consider the wide range of options, neither do they maximise utility as proposed by the model, (3) some individuals do not use numerical probabilities to overcome uncertainty; and (4) the theory also does not take into account some psychological factors of individuals such as the information processing limitations, information processing distortions, and aversion, which influence the ways in which individuals make judgements and choices. The SEU theory also gives inaccurate predictions about people's behaviours in situations involving ambiguity about probabilities and outcomes, framing of decisions as gambling or insurance, and other framing problems. Similarly, McGregor *et al.* (1996) in their review article also indicated that the economic model of decision making has failed to perform as a predictive model because it is assumed that farmers have a single objective of maximising income. In reality, maximum production or profitability does not rank highly among farmers' goals (e.g., Valentine, Hurley and Glass, 1993). Gladwin (1989) in her studies of farmers' decision making explicitly rejects the SEU theory. According to Gladwin, people do not normally consider all the details of the options because of their limited processing capacities and are using simplifying procedures instead. She concludes that SEU theory is "not empirically grounded" and is also "not a cognitively realistic model of the choice behaviour" (p. 10).

The opponents of the SEU theory argue that the utility approach has serious difficulties in its practical application. They argue that the theory provides little information about the decision processes of the decision makers themselves. The theory is neither predictive nor descriptive. Therefore, in this research this model was not chosen to assist in the understanding of farmers' decision making. The next option is to review the potential of the adoption-diffusion model in understanding the decision-processes of the adopters and non-adopters. This will be reviewed in the next section.

2.4 Adoption-diffusion model

The classical adoption-diffusion model (Rogers, 1962 and 1983; Rogers and Shoemaker, 1971) or the linear Transfer and Technology model is also a decision making model because it also includes the element of decision-making in the decision whether to adopt or not to adopt an innovation (Jiggins, 1993; Reid, McRae and Brazendale, 1993). In view of its dominance in the literature on farmers' decisions to adopt or reject innovations in agriculture, there is a need to look at the current state of knowledge associated with this model. It appears that in the recent years there have been some critiques or limitations highlighted with regard to some elements of the model which suggests justification for further investigation.

The following aspects of the model will be presented by incorporating recent studies and findings associated with the model: (1) the innovation-decision process, (2) categories of adopters, (3) factors influencing adoption of innovations and (4) some limitations of the model. In doing so, recent studies and findings associated with the model will be presented.

2.4.1 The innovation-decision process

In view of the importance of the innovation-decision process in the decision whether to adopt or reject certain innovation (Rogers, 1983), there is a need to present a comprehensive discussion on this process. The discussion will include the following: (1) a definition of the innovation-decision process; (2) a description of each of the stages; (3) a presentation of some of the results of findings associated with each of the stage in the innovation-decision process; and (4) an innovation-decision period.

Definition of an innovation

Rogers (1983:135) defines an innovation as "an idea, practice, or object that is perceived as new to an individual or another unit of adoption". According to Rogers the focal point is the perception of the idea which seems new to an individual. But Tornatzky and Fleischer (1990) extend the meaning of newness to include a situational quality and hence innovation is also situational. They suggest that if something is new in a given situation it can be regarded as an innovation even if to another elsewhere it is outdated. Similarly, Bayer and Melone (1989), also argue that an innovation "can be a new idea such as structured programming, or a new hardware technology". They point out that "not all innovations are single items; they may be part of interdependent technology". For example, office automation represents a set of related

technologies which are regarded as a technology cluster. However, Van den Van (1986) gives a broad definition of an innovation in this way: "An innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order. This definition focuses on four basic factors: new ideas, people, transactions, and institutional context."

Stages of the innovation-decision process

In his first edition of *The Diffusion of Innovations*, Rogers (1962) terms a decision to adopt or reject an innovation as the "adoption process" which is a decision-making process involving a period of time during which an individual goes through a number of mental stages before making a final decision to adopt or reject an innovation. However, in the second edition *Communication of Innovations* (Rogers and Shoemaker, 1971) and the third edition of *The Diffusion of Innovations* (Rogers, 1983) the decision process is called the "innovation-decision process". This is defined as "the mental process through which an individual or other decision-making unit passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision"(Rogers, 1983:163). This process consists of sequential stages of actions and choices made by individuals over time. The individuals evaluate the new idea and make a decision whether to adopt or reject the new idea. According to Rogers the "perceived newness of the innovation and the uncertainty associated with this newness" is a distinctive aspect of the innovation-decision process. Rogers conceptualises five stages in the innovation-decision process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. They are described as follows.

Knowledge Stage

The knowledge stage is regarded as the awareness stage or the starting point of the innovation-decision process. At this stage, the individual becomes aware of a new practice and gains some understanding of how it functions. There are three types of knowledge about an innovation: (1) the "awareness" knowledge, (2) the "how-to" knowledge, and (3) the "principles" knowledge. Awareness that an innovation exists is called an "awareness-knowledge". It motivates an individual to seek how-to knowledge and principles knowledge before she considers the knowledge. The how-to knowledge consists of information necessary to use an innovation properly, and the principles knowledge comprises information which concerns the functioning principles of how the innovation work.

Associated with this knowledge of innovation, Rogers (1983) also presents some of the results of the findings regarding early versus late knowing about an innovation. The analysis of the results shows that early knowers have on average more years of education, higher social status, greater exposure to mass media channels of communication, frequent change agent contact, higher social participation and are more cosmopolite than later knowers of innovations.

Persuasion Stage

The second stage is known as the persuasion stage. At this stage the individual forms a favourable or unfavourable attitude toward the innovation. The individual becomes more psychologically involved and actively seeks information about the new idea. When defining a favourable or unfavourable attitude toward a new idea, she mentally applies the idea to the existing or future situation before making decision whether to adopt or reject it which Rogers terms a "vicarious trial". Rogers argues that "all innovations carry some degree of uncertainty for the individual who is typically unsure of the new idea's results and thus feels a need for social reinforcement of her attitudes toward the new idea" (1983:170). The most convincing social reinforcement, according to Rogers, is sought by most individuals from the near-peers.

Decision Stage

The third stage in the innovation-decision process is known as the decision stage. At this stage the individual becomes involved in activities which result in a choice whether to adopt or reject the innovation. According to Rogers most individuals will not adopt an innovation unless they have tried it first on temporary basis to see how useful it is in their own situation. The small-scale trial is considered as part of the decision to adopt. It is important because it provides a means to decrease the perceived uncertainty of the new practice. Rogers (1983) suggests that innovations that can be put on trial by individuals are generally adopted more rapidly.

Rogers also observes the element of rejection at any stage in the innovation-decision process. Rejection of an innovation can occur at the above three stages: knowledge, persuasion and decision stage. There are two types of innovation rejections observed: (1) active rejection, which consists of considering adoption (including its trial) of the innovation but then deciding not to adopt, and (2) passive rejection, which consists of never really considering the use of the innovation.

Implementation Stage

The fourth stage of the innovation-decision is the implementation stage. At this stage an individual puts an innovation into use. A certain degree of uncertainty about the expected consequences of the innovation still exist. At this stage active information seeking takes place: (1) the individuals would like to know where to obtain the innovation, (2) how to use it and (3) the operational problems that might arise.

One of the more recent observations on the implementation stage of the innovation process is the existence of re-invention (Rogers, 1983). Re-invention is the degree to which an innovation is changed or modified by the user in the process of its adoption and implementation. Based on the analysis of the results of the findings from the studies of re-invention Rogers (1983) suggests that re-invention occurs at the implementation stage for certain innovations and for certain adopters.

Confirmation Stage

This is considered as the final stage in the innovation-decision process of the diffusion model. At this stage an individual or other decision-making unit seeks reinforcement for a decision already made. According to Rogers, although an individual has made the confirmation to adopt the new idea she may reverse the decision if there are some conflicts in the messages about the new idea.

The confirmation stage continues for an indefinite period in time. This is because an individual tries to get rid of a state of dissonance or rejection occurs. Rogers describes this rejection process as discontinuance which consists of two types: (1) replacement, which is a decision to reject an idea in order to adopt a better idea that supersedes it, and (2) disenchantment, which is a decision to reject an idea as a result of dissatisfaction with its performance. Based on the results of the findings from the analysis of six studies of discontinuance among the adopters, Rogers (1983) suggests that later adopters are more likely to discontinue innovations than are earlier adopters. All these studies analysed by Rogers support this proposition. The results suggest that discontinuance among the later adopters occurs when: (1) they have less education, (2) they have lower socio-economic status, and (3) they have less change agent contact. Rogers and his proponents also observe that these discontinuers have similar characteristics as “laggards” who are traditional farmers unlikely to adopt an idea.

While Rogers and his proponents argue that discontinuers are common among later adopters, others have different views on this aspect of discontinuance. For example, Hawkins, Dunn and Cary (1982) and Mook (1987) argue that all types of farmers are subject to disenchantment or cognitive dissonance if they are not satisfied with the innovation or if such innovation is found to be not appropriate to their farming systems.

One other important aspect of the innovation-decision process noted by Rogers (1983) is the innovation-decision period. This period is the length of time required to pass through the innovation-decision process. Based on the results of the findings from the studies of the innovation-decision period of the five-adopter categories, Rogers (1983) suggests that earlier adopters have a shorter innovation-decision period than later adopters. The analysis of six studies show that five studies (84 percent) support the proposition while one study does not. Rogers (1983) argues that earlier adopters need a shorter period because they have more favourable attitude toward an innovation and thus are less resistant to change. However, there is no empirical evidence to support the contention that earlier adopters have more a favourable attitude to change than non-adopters. Chamala (1987) argues that farmers' adoption (whether early or late) of an innovation is consistent to their needs, socio-economic status and attitudes toward different practices. Therefore, it is not clear whether the attitudinal variable is the main reason for the difference in the innovation-decision period between the early and later adopters.

There is also no consensus on the number of stages. The number of stages varied from three to seven (Rogers, 1962; Rogers and Shoemaker, 1971; Rogers, 1983; Dasgupta, 1989). In addition there is also a wide variation in the sequence of stages. For example, based on the results of the findings from the studies on the sequence of stages of the process, Rogers and Shoemaker (1971) suggest that traditional individuals are more likely to skip functions in the innovation-decision process than are modern individuals. All the three studies analysed support the proposition that traditional farmers are likely to skip the trial stage. They argue that traditional farmers do this because they can observe the innovation in use at their neighbours' farms before they make the decision to adopt. But the sample size suggests these studies are limited and do not seem to provide sufficient empirical evidence to support such a proposition. Hence, there is an issue of reliability and validity of the findings. In fact Dasgupta (1989) states that "a farmer may decide to adopt or reject an innovation at any stage of the adoption process or may skip one or several stages" (p.49-50). Similarly, an overview of the

issues concerning the barriers to adoption of new ideas by Vanclay (1992) suggests that modern farmers also skip the trial stage in the adoption of innovations because it is not always possible to trial the new technology. For example, the innovation may be new management plans for the farm, and thus need adoption without a trial stage. Therefore, based on the observation by Dasgupta and Vanclay, it seems that there is no consistency on the number and sequence of stages in the innovation-decision process.

2.4.2 Categories of adopters

One other important element of the adoption-diffusion model is the classification of individuals in a social system. All individuals in a social system do not adopt a new idea at the same time and thus they can be grouped differently (Rogers and Shoemaker, 1971). This is called adopter categories. The following aspects will be discussed by incorporating other studies related to the adopter categories: (1) the s-shaped diffusion curve, (2) categories of adopters and their characteristics, (3) characteristics of earlier and later adopters. Other alternative ways of categorising adopters will also be presented.

The adoption of an innovation has been shown empirically to follow a normal, bell-shaped curve when plotted over time on a frequency basis (Rogers and Shoemaker, 1971). If the cumulative number of adopters is plotted, the result would follow an S-shaped diffusion curve.

Similarly, in a number of innovation diffusion studies in marketing, there is evidence to suggest that new product diffusion follows the S-shaped curve in terms of the cumulative number of adopters over time (Midgley, 1977; Gatignon and Robertson, 1989; Engel, Blackwell and Minard, 1993).

There are variations in the S-shaped curve (Rogers, 1983). According to Rogers these variations are brought about by differences in the potential adopter categories. Rogers uses the element of innovativeness (the degree to which an individual is relatively earlier in adopting new ideas than other members of a social system) to classify individuals in a social system. Based on this innovativeness aspect, and the mean and the standard deviation of a normal distribution, five categories of adopters are observed: (1) innovators, (2) earlier adopters, (3) early majority, (4) late majority, and (5) laggards. According to Rogers these

five categories are "ideal types and are conceptualisations based on observations of reality and designed to make comparisons possible" (p.247).

Rogers conceptualises few dominant characteristics of each of the category of adopters. The innovator is venturesome, eager to try new ideas and has a more cosmopolite outlook. The early adopter is localite in the outlook but has the greatest degree of opinion leadership in a social system. He is well respected by the potential adopters and also by his peers. He is the "man to check with" before using a new practice. The early majority adopt new ideas just before the average number of a social system. The late majority are categorised as sceptical and adopt new ideas just after the average member of a social system. Laggards are termed as traditional individuals who are the last to adopt a new idea.

However, Rogers and Shoemaker (1971) and Rogers (1983) when presenting detailed research findings on the characteristics of adopter categories do not describe the findings for each of the five adopter categories. Instead, they confine the research findings to two groups of adopters - the earlier adopters and later adopters. However, problems arise when Rogers describes these early and later adopters. From the analyses of the research findings of all the studies associated with the characteristics of the earlier and later adopters, they suggest that there are differences between them based on three main attributes: (1) socio-economic status, (2) personality variables, and (3) communication behaviour.

From the analysis of various studies, Rogers suggests that one of the main differences between the early and later adopters of innovation is in terms of socio-economic status. Rogers summarises the findings and states that earlier adopters (1) have more years of education, (2) are more likely to be literate, (3) have higher social status, (4) have a greater degree of upward social mobility, (5) have larger-sized farms, (6) are more likely to have a commercial (rather than a subsistence) economic orientation, (7) have a more favourable attitude toward credit, and (8) have more specialised operations than do later adopters.

One of the propositions as suggested by Rogers (1983) is that early adopters have on average larger farm size and are more innovative compared to the later adopters. However, Stewart (1979) on his study of behaviour and attitudes among farmers in Otago, New Zealand found that farm size is not significantly related to innovative attitude, thereby showing that there is

no evidence to suggest that earlier adopters are more innovative because of larger farm size and that later adopters are less innovative because of smaller farm size.

Another difference between the earlier and later adopters is in terms of personality attribute. From the analysis of the findings of the studies related to the personality variables, Rogers puts forward some propositions that earlier adopters (1) have greater empathy, (2) are less dogmatic, (3) have a greater ability to deal with abstractions, (4) have greater rationality, (5) have greater intelligence, (6) have a more favourable attitude toward change, (7) are more able to cope with uncertainty and risk, (8) have a more favourable attitude toward education and science, (9) are less fatalistic, (10) have higher levels of achievement motivation, and (11) have higher aspirations such as for education and occupations than do later adopters.

Although Rogers stated these propositions, he also reveals the problems associated with research on these personality variables and the extent of such research. According to Rogers, research on these particular variables has not received much attention. The main reason is because of difficulties of "measuring personality dimensions in field interviews".

One of the propositions suggested by Rogers is that earlier adopters have more years of education and thus have a high degree of innovativeness. However, a study by Stewart (1979) on the relationship between the level of education and innovativeness does not seem to indicate any significant relationship between them.

The other personality attribute which has shown to have a positive relationship between innovativeness is rationality. Previous studies have suggested that earlier adopters are more rational and thus have a higher degree of innovativeness than later adopters (Vanclay, 1992). This attribute of rationality, however, seems to be very controversial, subjective and contextual. An overview of issues related to barriers to adoption of innovations by Vanclay (1992) suggests that failure to adopt has been proven to be objectively rational for the farmer. This reasoning is consistent with the finding from a study of farmers' decisions to plant trees by Fairweather (1992) who found that non-adopters of the innovation are also rational when they decided to reject the new practices.

The other characteristic which is used to differentiate between earlier adopters and later adopters is communication behaviours. From the analysis of various studies on the

relationship between communication behaviour and innovativeness, Rogers makes several propositions that earlier adopters (1) have more social participation, (2) are more highly interconnected in the social system, (3) are more cosmopolite, (4) have more change agent contact, (5) have greater exposure to mass media communication channels, (6) have greater exposure to interpersonal communication channels, (7) seek information about innovations, (8) have greater knowledge of innovations, (9) have a higher degree of opinion leadership, and (10) are more likely to belong to highly interconnected systems than do later adopters. These variables merely describe the characteristics of the earlier and later adopters. Because of these characteristics, Rogers concludes that earlier adopters are more innovative than later adopters. However, the studies do not place any emphasis on the non-adopters of innovations, although, by implication they would be characterised as not innovative.

The above discussion was based on Rogers' conceptualisation of individuals' degree of innovativeness which then accounts for the classification of adopters in a social system. The characteristics of the early and later adopters were also emphasised. The degree of innovativeness of the early and later adopters are different because of their differences in the socio-economic characteristics, personality attributes and communication behaviour. However, the discussion does not show any understanding of the motivation of the non-adopters of innovations nor any recognition that non-adopters at one point may be adopters at later point in time. In other words, there is not much information or knowledge about the non-adopters of innovation, although a lot of studies on adoption have been highlighted by Rogers and other researchers. In Rogers' view non-adopters are not viewed favourably in terms of attitudes although others have disagreed with this.

One suggestion to simplify Rogers' classification of adopters categories is from Blake and Litterski (1991). They suggest to classify farmers into three groups: (1) *proactive*, (2) *reactive*, and (3) *open*. Blake and Litterski state that proactive farmers are similar to those innovators. These farmers stay current with the latest developments in agriculture by talking to their farmer neighbours, watching what works for others, reading farm magazines, and searching out new product information. They seek variety and will switch to a new innovative product if they think that will make their businesses more successful. The *reactive* farmers are generally uninterested in new products. Their attitude is, "If it ain't broke, don't fix it." They are loyal to products and suppliers, believing that what has served them well in the past will continue to do so. This group of farmers fits well to the classic stereotype of the so called

laggards as described by Rogers. The *open group* farmers, like the proactive group, are among the first to try recently introduced products. They differ from proactive farmers and from the innovators in that they do not actively search for information about the new products. They do keep up with what is new in agriculture, but no more than the typical farmer. They do not read every available farm publication, nor do they attend numerous seminars and farm shows. They are also less inclined to seek variety than are proactive. This group of farmers is similar to the *earlier adopters* in Rogers' classification.

Similarly, from the perspective of businesses and organisations as explained by distinctive competencies theories in businesses, there are some similarities of those typologies of human behaviour observed with that of the classical adoption model (Snow and Hrebiniak, 1980; Miles and Snow, 1978). For example, Miles and Snow identify four different types of organisation: (1) defenders, (2) prospectors, (3) analysers, and (4) reactors. Each of this type of organisation has its own unique characteristics and behaviour in response to changes in environmental conditions. They are described as follows:

Defenders

These organisations are highly specialised and formalised in structure. They prefer to create and maintain a stable form of organisation. They focus on a narrow product-market domain; they have a limited area of operation or a limited range of products and customers. They have little capacity to identify new product or market opportunities in response to changing market situations.

Prospectors

These firms continuously search for new product and market opportunities. Their activities are not limited to their existing domain and therefore they are often the creators of change and uncertainty. The main weaknesses of the organisations are: (1) overextending of products and markets, and (2) inefficient use of technology and resources.

Analysers

These organisations operate in two types of product-market domains: (1) stability, and (2) change. They operate routinely and efficiently by using formalised structures and processes. However, they look for and adopt new ideas quickly. The organisations minimise risk while maximising profit opportunity. They combine the strengths of both the prospector and the

defender into a single system. They also maintain the balance between (1) locating the new product and market opportunities and a stable core of existing products and customers, and (2) conflicting demands for technological flexibility and stability.

Reactors

These firms do not have a consistent and stable pattern of adjustment to the environment. They are, therefore, unstable organisations. They respond inappropriately to environmental change and uncertainty. In short, these organisations have lack of distinctive competence. As a result their performance will be poor and will cause failure.

Miles and Snow have given the characteristics of the three successful groups in business and therefore is relevant from the management point of view. There are parallels between the business and adoption studies and the same broad types seem to emerge, but the business literature suggests that they are utilising their distinctive competencies, that is, it is not a continuum from innovators to laggards with the pro-innovation bias, but supports the idea that they are all rational responses based on distinctive competence. Blake and Litterski seems to provide a useful classification of farmers without a pro-innovation bias, even though they do not provide detailed attributes of each category. However, they have nothing to say about the characteristics of any non-adopters' group.

2.4.3 Factors influencing adoption or rejection

The other most important element of the adoption-diffusion model is those factors that influence the adoption or rejection of the new idea. There are considerable number of factors associated with adoption or rejection of an innovation. For example, Glaser, Abelson and Garrison (1983) has listed comprehensive lists of factors which can influence adoption or rejection of innovation. However, a number of those factors were also described by Rogers. In this review particular emphasis will be given to those listed by Rogers because of what Rogers considered as their direct relevance in the adoption-diffusion model. The results of the findings of other studies on similar factors and the perception of the early and later adopters on these factors will also be incorporated into the discussion.

Rogers (1983) suggests that there are six important factors which influence the rate of adoption of an innovation: (1) perceived attributes of the innovation, (2) personality variables of individuals, (3) communication channels, (4) the nature of social system, (5) opinion

leadership, and (6) the extent of change agents' efforts in promoting the use of the innovation. These factors will be discussed as follows.

Perceived attributes of innovations

One of the most important factors influencing the rate of adoption is the innovation itself - its perceived attributes (Rogers, 1962; Rogers and Shoemaker, 1971; Fliegel and Kivlin, 1966; Kivlin and Fliegel, 1967 and 1968; and Ostlund, 1974). There are five main attributes of the innovation which are considered as important: (i) relative advantage, (ii) compatibility, (iii) complexity, (iv) trialability, and (v) observability (Labay and Kinnear, 1981; and Rogers, 1983). These will be described as follows.

Relative Advantage

Relative advantage is considered as one of the most important attributes of innovation (Rogers, 1983). According to Rogers relative advantage is described as the degree to which an innovation is perceived as being better than the idea it supersedes. He outlines the following factors which are used to assess the relative advantage of an innovation: (1) economic profitability, (2) lower perceived risk, (3) savings in time and effort, (4) a decrease in discomfort, and (5) immediacy of the reward.

Rogers (1983) suggests that the relative advantage, as perceived by members of a social system, is positively related to its rate of adoption. According to Rogers most of the diffusion studies that involved US commercial farmers reveal that earlier adopters' motivation for adoption were focused on the economic aspects of relative advantage. Based on the analysis of results of the findings from the studies associated with the earlier and later adopters, Rogers suggests that earlier adopters (1) have larger-sized farms, (2) are more likely to have a commercial (rather than a subsistence) economic orientation, (3) have a more favourable attitude toward credit, and (4) have more specialised operations than do later adopters. These socio-economic aspects therefore differentiate the early and later adopters. Thus, earlier adopters are considered as more motivated to adopt the new idea compare to the later adopters.

Similarly, other researchers also reported that innovations perceived as most profitable, rewarding and involving less risk and uncertainty are accepted most rapidly (Fliegel and Kivlin, 1966; Green and Heffernan, 1987; Nowak, 1987; Evans, 1988; Sturm and Smith,

1993; Martin, 1994). Relative advantage also includes a psychological factor. As noted by Glaser, Abelson and Garrison (1983:57): "Psychologically, an innovation also may have consequences for prestige, convenience, and satisfaction that are perceived as advantageous by the adopter."

However, profitability is not necessarily the main motivating factor. For example, Kivlin and Fliegel (1967) argue that relative advantage in farming is not always motivated by economic considerations. The results from their study which involved US small-scale farmers who are less-profit oriented shows that a decrease in discomfort, but not economic profitability, is positively related to the rate of adoption.

A study by Fliegel *et al.* (1968), cited in Dasgupta (1989), among Punjab farmers in India reveals that farmers "attach greater importance to social approval and less to financial return". Similarly, Muhamad, Teh, and Idris (1995) in their study on the utilisation of cocoa technology by cocoa farmers in Malaysia showed that farmers' socio-economic status is one of the major factors explaining their low utilisation of cocoa technology. Dasgupta (1989: 2) in his study of agricultural diffusion of innovations in Village India says: "An agricultural practice with obvious economic advantages may be rejected outright by farmers for its perceived incompatibility with the existing structure by social relationships, habits, or values." Reid, Coulson and Cameron (1996) in their study on the adoption of new technologies by dairy farmers showed that relative advantage is influenced by the circumstances that prevail on farmers' farms. For example, they said, some dairy farmers rejected heifer synchronisation because it had increased the extra time and labour needed to artificially inseminate their heifers which were grazed at some distance from the home farm. Other studies also showed that some farmers also place a high value on farming as a lifestyle rather than economic profitability (Gasson, 1973; Greer, 1982; Carlson, 1988; Fairweather and Keating, 1994).

Compatibility

The other attribute of innovation is compatibility. Rogers describes compatibility as the degree to which an innovation is perceived as consistent with the existing values, past experience, and needs of potential adopters. He concludes that the compatibility of an innovation, as perceived by members of a social system, is positively related to its rate of adoption. A new practice can be compatible or incompatible with (1) socio-cultural values and beliefs, (2) previously introduced ideas, or (3) client needs for the new practices.

Innovations are more acceptable if they are compatible with the potential adopters' originally established values, norms and facilities (Rogers, 1962 & 1983; Dasgupta, 1989).

Rogers also observes that a "functional interrelatedness" between innovations also influences compatibility and hence the rate of adoption. He terms this as a *technology cluster* or an *innovation package* which "consists of one or more distinguishable elements of technology that are perceived as being closely interrelated" (p.226). He proposes that individuals do not normally perceive innovations as a single entity but as a package or interrelated bundle of new ideas. In other words, the adoption of one innovation triggers the adoption of other innovations. To elaborate on this idea, Arnon (1987) notes that an appropriate package of complementary production practices with appropriate practices such as transport and finance will enhance the adoption of new technologies.

Complexity

Complexity is also an important attribute of innovation that influences adoption or rejection of an innovation. Complexity refers to the degree to which an innovation is perceived as relatively difficult to understand and use. The meanings of some innovations are clear to potential adopters while others are not. Rogers (1983) concludes that the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption. In general terms, the more complex the new practice, the greater will be the resistance to innovate (Vanclay and Lawrence, 1995). Vanclay and Lawrence also note that the reasons for preferring to adopt less complex technologies over more complex ones is rational from farmers' perspective.

Trialability

Trialability is also regarded as one of the factors in the decision to adopt or reject a certain innovation. Trialability refers to the degree to which an innovation may be experimented with on a limited basis. New practices that can be tried reduce the perceived risk of the new ideas and lessens resistance (Rogers, 1983). Rogers concludes that the trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption.

Observability

Lastly, but not the least, the other important attribute of an innovation that influences adoption or rejection of the new idea is observability. Observability is the degree to which the

results of an innovation are observable to others. The results of some new practices are easily visible and disseminated to others while some are more difficult to observe. Rogers (1983) suggests that, in general, the observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption.

A recent study by Reid, Coulson and Cameron (1996) using Rogers' (1983) attributes of innovations to study the adoption of new technologies by dairy farmers showed that they failed to give a satisfactory framework for understanding farmers' perceptions towards the new technologies.

In summary, this discussion has noted the influence of the perceived attributes of innovations on the adoption of innovations by members in a social system. These perceived attributes are: relative advantage, compatibility, complexity, trialability and observability. While some researchers argue that these attributes are important factors influencing adoption, others argue that they fail to provide a satisfactory framework for explaining farmers' perceptions of new technologies. They argue that Rogers' attributes do not take into account the circumstances of farmers.

Personality variables

The other major factor which is considered as important influencing the adoption or rejection of an innovation is the personality variables of an individual. These personality variables include such aspects as attitude, motivation, aspiration and the like. Rogers and Shoemaker (1971) carried out an analysis of the results of the findings of various studies on the influence of personality variables on the adoption or rejection of an innovation. Based on these analyses, Rogers shows that there are some differences in the personality variables of early and later adopters. These differences are summarised as follows. According to Rogers, earlier adopters have (1) greater empathy, (2) greater ability to deal with abstractions, (3) greater rationality, (4) greater intelligence, (5) a more favourable attitude toward change, (6) a more favourable attitude toward education and science, (7) higher levels of achievement motivation, (8) higher aspirations such as for education and occupations, and are also (9) younger, (10) less dogmatic, (11) more able to cope with uncertainty and risk, and (12) are less fatalistic, than later adopters.

These studies suggest that earlier adopters have different personality attributes which predisposes them to be more innovative in comparison with later adopters. However, other studies based on some of these attributes do not seem to agree with these propositions. For example, a study by Stewart (1979) on farmers in Otago, New Zealand, does not show a positive relationship between education and innovativeness. Similarly, a study by Alonge (1993) on the impact of farming system research and extension on the adoption of agricultural technologies shows that farm size, education, income and age are poor predictors of farmers' adoption. However, other studies do support the propositions that younger farmers are more innovative than older ones (e.g., Fuglie, 1989; Sinden and King, 1990; Campbell and Junor, 1992). Greer (1982) in his study on sheep farmers' motivation on the adoption of new practices shows that earlier adopters emphasised increasing income, achievement, risk or future orientations whereas later adopters focused on social, intrinsic, self-esteem or fatalism orientations.

While these studies emphasise personality variables as the yardsticks for the degree of innovativeness, others have argued that farmers do not adopt or are late to adopt, not because they lack innovativeness, but because they consider it is as objectively rational not to do so (Vanclay, 1992; Fairweather, 1992; Jangu, 1993; Guerin and Guerin, 1994; McRae, 1993). Frank (1995a) pointed out that late adopters or laggards may be satisfied with their situation, and have valid reasons for deciding not to adopt. The aspects of personality characteristics as a measurement for innovativeness have also been challenged by Tornatzky and Fleischer (1990). They pointed out that although individual attributes can make some difference, it is still not clear whether they genuinely cause the behaviours, or because individuals in certain kinds of positions and roles could become certain kinds of people. Tornatzky and Fleischer argued that the main limitation on the use of personality characteristics is in terms of differentiating between adopters and non-adopters. They indicated that personal characteristics of individuals may be equally or more important than group or organisational aspects. This means that even if the environment is conducive for decision-making processes, it will likely to be a failure if rigid and timid people are around. The converse is also true which suggests that the best and the brightest individuals do not guarantee success.

Communication channels

The channels of communication also play a very important part in the adoption or rejection of innovations. Strategies of using communication channels implicitly assume that once farmers

are aware of the innovation they will take appropriate action and adopt (Rogers and Shoemaker, 1971). In a study of the influence of Farm Advisory Officers on the diffusion of agricultural innovations, Fairgray (1979) showed that farmers' adoption of new practices was influenced by communication behaviour. He found that those farmers who secured information from mass media and extension agents had not only received a substantial amount of reliable information but also had a higher adoption rate than those who obtained their information from other farmers.

However, recent studies have shown that not all farmers will consider and adopt even though they have an extensive knowledge of the problem and the new practices to overcome the problems (Heffernan and Green, 1981; Green and Heffernan, 1987). Green and Heffernan (1987) in their studies on the relationship between a soil erosion problem and farmers' perception of the problem found that farmers' perception of the problem, was based not only on awareness, but also on the structural constraints which they identified as social (education and age) and economic (costs and profitability). This finding is consistent with earlier studies which identified similar constraints influencing adoption of the new practices (Goss, 1979; Heffernan and Green, 1986).

Other studies also stress the importance of homogeneity in the transfer of technologies in a social system. For example, Onsrud and Pinto (1991) argue that the individuals would adopt faster in a social system where there is a higher degree of interpersonal and informal communication networking. These individuals have the similar beliefs, social status, education and the like. Similarly, Kaine and Lees (1994) also stress the importance of homogenous groups of farmers based on their concordance of interests in relation to technology transfer. This is what Rogers' (1983) terms as *homophilous communication* where individuals share common meanings and beliefs for effective communication in contrast to *heterophilous communication* where individuals are exposed to messages that are not consistent with each others beliefs. In other words, innovations would be accepted better between individuals with similar values and beliefs because they share similar meanings with each other.

However, Greer (1982) in his study of farmers' motivation expressed his concern that although accurate and reliable sources of information influenced adoption of the new practices, there were farmers who had accepted inaccurate or incomplete information about the practices and hence decided not to adopt. In other words, while some studies have shown

that mass media and extension agents are responsible for increasing the rate of adoption, others also show that individuals with similar interests and beliefs also enhance transfer of new technologies. Furthermore, inaccurate information also acts as a barrier to the adoption of innovation.

The nature of social systems

The nature of social systems has also been found to influence the adoption or rejection of an innovation (Rogers and Shoemaker, 1971; Dasgupta, 1989). The nature of a social system includes such aspects as norms, beliefs, values and also communications patterns.

Rogers and Shoemaker (1971) described the characteristics of two different social systems, a traditional and a modern social system, which have a significant influence on the adoption or rejection of new ideas. A traditional social system has the attributes of (1) less developed or simple technology, (2) a relatively low level of education, (3) little communication with outsiders and (4) lack of favourable orientation to change. Rogers and Shoemaker suggest that with these attributes of the traditional system the rate of adoption among farmers is very low. Dasgupta (1989) also notes that socio-cultural factors act as barriers in the adoption of an innovation. According to Dasgupta, incompatibility of the new idea with local norms, values and habits leads to the rejection of the new recommended practices by the farmers. Rogers also suggests that a modern social system has the following aspects: (1) a well developed technology with complex division of labour, (2) a high value on education and science, (3) rational and business-like social relationships, (4) a cosmopolitan outlook, and (5) a generally positive attitude to change.

Opinion leadership

Opinion leaders who exist in a community have also been found to exert some influence in the adoption of agricultural innovations (Rogers and Shoemaker, 1971; Rogers, 1983; Dasgupta, 1989; Onsrud and Pinto, 1991). Rogers describes these opinion leaders as those few individuals or innovative farmers from whom other members of the community seek information and advice regarding agricultural innovations. They obtain information from outside sources, diffuse the information and influence other members to act upon the information they disseminate.

From the analysis of the findings of research studies regarding the roles of opinion leaders, Rogers (1983) suggests that they tend to be (a) more exposed to external communications, (b) more cosmopolite, (c) of somewhat higher social status, (d) more innovative, and, perhaps most significantly, (e) at the centre of the interpersonal communication network of the peer group. These characteristics seem to suggest that all opinion leaders in a community are from the early adopter categories. But studies of opinion leadership by Bose and Saxena (1966) and Deb and Sharma (1968), cited in Dasgupta (1989), show that about two-thirds of the opinion leaders are from the early adopter categories and one-third from the late adopters. Therefore, the characteristics attached to the opinion leaders do not seem to justify that only the earlier adopters can be the opinion leaders.

Change agents' promotional efforts

Extension agents provide one of the most important sources of information and therefore play a very important part in the adoption of innovations, particularly in the developing world (Rogers, 1983; Dasgupta, 1989). They are used in almost every stage of the innovation-decision process. They provide a communication link between two or more social systems or between a change agency and the client social system or a direct contact with the farmers. One of the major roles of the change agent is to facilitate the flow of innovations from a change agency to the clientele. Effective communication is achieved if the selected innovations meet the needs and problems of the client.

In the process of introducing the new practices, Rogers (1983) outlines seven major roles of the change agent: (1) develops needs for change, (2) establishes an information-exchange relationship, (3) diagnoses farmers' problems, (4) creates intent to change in the client, (5) translates intent into action based on clients' needs, (6) stabilises adoption and prevents discontinuance, and (7) achieves a terminal relationship.

Some change agents are relatively more successful in introducing the new practices while others are not. Rogers (1983) outlines eight factors which can lead to success or failure in introducing the new ideas: (1) the extent of change agent effort, (2) client oriented rather than change agent oriented, (3) the degree to which his/her programme is compatible with the clients' needs, (4) empathy with clients, (5) homophily with clients, (6) the extent to which he/she works through opinion leaders, (7) credibility in the eyes of the clients, and (8) efforts in increasing the clients' ability to evaluate the new practices. However, others criticise the use

of these personality variables to stimulate adoption of an innovation, which they regard as having a psychological bias without taking into account other important factors, such as socio-structural, ecological and infrastructural. (Goss, 1979; Brokensha, Warren and Werner, 1980; Doorman, 1991).

Promotional effort by the extension agents is no doubt important in increasing adoption of innovations. But to overemphasise the importance of the personality attributes of the change agents in the adoption of innovation is regarded as bias because other factors, such as socio-cultural and ecological are also equally important. One important question which needs to be addressed in connection with the role of change agents in promoting adoption of innovations, is whether there is any difference between the early and later adopters in terms of promotional strategy used to increase adoption among them and what this implies for non-adopters. This question has not been addressed clearly by Rogers and by other studies.

There are, therefore, various factors which can influence adoption or rejection of innovations. The above factors can either act as stimulants or barriers of adoption of innovations. This list of factors are non-exhaustive but the main ones are: (1) the innovation itself, (2) human factors, (3) communication, (4) social factors, and (5) ecological. There are some inconsistencies and irregularities on the influence of each of these factors on the adoption/rejection of an innovation particularly among early and later adopters.

2.4.4 Some limitations of the adoption-diffusion model

In recent years there have been some criticisms or limitations with regard to some aspects of the adoption-diffusion model in explaining farmers' adoption behaviour. Because of the importance of the topic of adoption in this research, it is therefore necessary to briefly discuss what these limitations are. The discussion will cover the following aspects: (1) insensitivity to socio-structural factors, (2) the spread of an innovation based on the progressive-farmer approach, (3) pro-innovation bias, and (4) discontinuance of innovations. The first discussion will be on the socio-cultural factors.

Insensitivity to socio-structural factors.

One of the limitations of the classical diffusion model in explaining diffusion and adoption is that it is not sensitive to socio-cultural factors. The model gives more emphasis on the personal characteristics of the individuals and less on the socio-structural factors. For

example, Goss (1979) in his review article on diffusion theory notes that the diffusion model focuses mainly on the personality attributes of the farmers and less on the socio-structural factors which exist in a social system such as institutional, land, and credit. Goss terms this aspect of the model as "psychological bias". Goss's argument was consistent with those views from Aiken, Havens and Flinn (1974) and Havens and Flinn (1975) who noted that the diffusion model gives emphasis on psychological variables of the individuals. Similarly, Black and Reeve (1993) in their review of literature also observed that the diffusion model has placed greater emphasis to the social psychological variables in explaining adoption but under-emphasised social structural, institutional and ecological factors. According to Black and Reeves these socio-cultural factors such as institutional and ecological factors are also important in the diffusion and adoption of innovation.

Progressive farmer strategy

The other aspect of the criticism is on the "progressive farmer" strategy in the diffusion and adoption of the new practices. Rogers' model assumes that when the new practices are first adopted by progressive farmers or the innovators, later on these practices will be diffused throughout the farming community. The rationale behind this strategy is to give intensive assistance to a small group of innovative farmers expecting other farmers to get the effect of such assistance by the process of a trickle-down effect or a multiplier effect.

However, other researchers revealed that this concept does not normally occur in farmers' situations (Röling, Ascroft and Chege, 1976; Davics, 1989; Russell *et al.*, 1989). Röling, Ascroft and Chege noted that giving intensive assistance to a small group of innovative farmers did not seem to give any advantage to the poor farmers. Russel *et al.* (1989) also noted that such a concept is considered as "out-of-date" not only in the agricultural field but also in the fields of health and education. The reason for this is that the small farmers are not able to make use of the new ideas being used by the innovative farmers because of resource constraints, such as land, credit and labour (McAllister, 1981; Röling, 1982; Arnon, 1987 & 1989). Arnon (1987), from his experience as a consultant on agricultural research in a number of least developed countries in Asia, Africa and Latin America observed that the new practices being used by the minority of innovative farmers do not necessarily become accepted and adopted by the small farmers as predicted by the progressive farmer approach. According to Arnon a majority of farmers do not adopt because they do not have the means to make use of the technology. As Arnon noted:

"Unfortunately, it is the Third World countries that the diffusion of innovations does not, as a rule, follow the implied in the progressive farmers' strategy. In these countries, the village community consists generally of a minority who are able to adopt an innovation, and need only to be made aware of its potential benefits and the vast majority of small farmers who lack the means needed to make adoption possible. Even after the progressive and richer farmers in their area have adopted a new practice, they do not follow suit. Instead of a minority of laggards, there is a majority who are non-adopters, not by choice, but by force of circumstances" (p.293).

Nitsch (1988) argued that this progressive farmer approach is considered out-of-date and without sufficient empirical validation. For example, Nitsch's reasoning is based on changes in patterns of agricultural production and social interaction in rural communities. He argues that a few decades ago the model might have some validity because at that time many farms shared similar production patterns. There were more chances for social interaction in rural communities which had limited exposure to information on new technology, and a progressive-farmer approach was then relevant. However, Nitsch argues that because of specialisation, the mode of production and the type of technology now differ from one farm to another. Technology used in agriculture has become more complicated and capital-intensive. There are also some changes in the patterns of social interaction among farmers. He then suggests that the progressive farmer approach in the adoption of new practices would not be valid any more in the present context. Chamala (1987) explains that farmers do not adopt all the technological innovations related to farm production that are available to them because they tend to select from the package of practices which are consistent with their needs and socio-economic status.

Pro-innovation bias

Pro-innovation bias is another weakness of the diffusion model. Rogers and Shoemaker (1971) and Rogers (1983) themselves still maintain that the diffusion model has a pro-innovation bias. As noted by Clark and Staunton (1989) the three basic assumptions of the model are that the new practices should be (1) spread and adopted by all members of a social system, (2) spread rapidly, and (3) should neither be modified nor rejected. The model also suggests that adoption is seen as positive and non-adoption as negative or an irrational choice by those which are resistant to innovation. It implies that adoption is associated with modernity and progress and non-adoption reflects backwardness. This suggestion, according to Clark and Staunton, leads to "overdependence on technological innovation to solve

complicated social problems. In this view technological change is uncritically linked with improvement" (p.132). Similarly, Nitsch (1989:55) also reports that the model has a "strong pro-change and pro-technology bias, narrows the focus of extension to technical problems and omits environmental, distributional, and other social consequences of extension work from consideration."

Discontinuance of innovation

The other aspect of criticism of the model as observed in the literature is the discontinuance of innovation. Rogers (1983) stated that discontinuance occurs at the confirmation stage of the innovation-decision stage. Individuals may seek a better idea or be dissatisfied with the existing idea and, therefore, decide to discontinue the practice which was adopted previously. Rogers and his proponents also suggest that there is a higher rate of discontinuance of innovation among the later adopters compare to the earlier adopters. But Bayer and Melone (1989) observe that the diffusion theory fails to integrate the aspect of discontinuance into current specification of the theory. They argue that much of what the theory asserts about discontinuance is based on the adopter categories and has a weak empirical support. They have noted: "What is perhaps worse is that the theory fails to consider the causes and cognitive processes underlying an individual's decision to reject a previously adopted innovation" (165). In other words, there is no emphasis on the study of non-adopters. Much of what have been said is concerning the earlier or later adopters. However, Bayer and Melone have raised a very important issue on the cognitive aspects of decision making which has not been addressed clearly by Rogers when he introduced the aspect of discontinuance of innovation.

This section has presented some aspects and limitations of the classical adoption-diffusion model. There is evidence to suggest that there is very little or rarely any focus on non-adopters of innovations. There are also some concerns over the effectiveness of the linear adoption model through the "trickle down" approach in bringing about change in farmers' attitudes to innovate. Although there is some dissension on the adoption-diffusion model, the model has provided some propositions and insights into the decision-making processes of farmers. Because of the limitations of the adoption-diffusion model, the next sub-section will review the potential of the ethnographic decision tree modelling to be used in this research to study the decision processes of the adopters and non-adopters.

2.5 Ethnographic decision tree modelling

This section describes the general principles, assumptions and theory behind the ethnographic decision tree modelling. It also describes the structure of the decision tree and also the applications of the model in agricultural decision making. The section also highlights some of the limitations of the model in explaining agricultural decision making, in particular, adoption behaviour.

2.5.1 General principles

Gladwin (1977, 1989) in her study of agricultural decision making explicitly rejects the SEU theory of choice which considers all or many of the options in the decision processes. Her reason is based on the argument that people have limited information processing capacities and use simplifying procedures instead. She then proposes an alternative approach - a cognitive approach to decision making better known as the ethnographic decision-tree modelling (EDTM). Gladwin (1989) argues that a cognitive approach to decision making reflects what the farmers believe to be important from their own point of view. The approach is a multi-stage hierarchical model which identifies the main decision criteria used in the decision processes and are then combined and reflected in the form of a decision tree.

The main element in EDTM is ethnography. Ethnography is the art and science of describing a culture from the native's or insider's point of view or seeing the insiders' world through the insiders' eyes (see Gladwin, 1989; Fetterman, 1989). Ethnography is widely associated with anthropological inquiry in rural development appraisal (e.g., Barlett, 1980; Lian, 1987; Axinn, 1992; Moris and Copestake, 1993; Pottier, 1993). For example, in agriculture, ethnography can be used to understand the farm family's rational reasons for farming the way they do and to describe the indigenous knowledge systems and logic behind farmers' reasons to adopt or not to adopt certain innovations (e.g., Brokensha, Warren and Werner, 1980; Rusten and Gold, 1991). However, Gladwin (1977) moves a step further by incorporating ethnography in the development of a decision model to investigate farmers' decision-making processes. The model uses ethnographic eliciting techniques like the "ethnographic interview" (Spradley, 1979) and "participant observation" (Spradley, 1980) to elicit the specific decision criteria used by the decision makers when making a real-world decision. The objectives are to understand the meaning of native expression and to elicit the decision rules and traditional strategies that farmers' use.

Therefore, the central tenet of the model is that it relies on these ethnographic fieldwork techniques to elicit from the decision makers the decision criteria which are then combined in the form of a decision tree, table, flowchart or set of "if-then rules". In other words, the decision processes of a group of people can be interpreted as hierarchical or treelike in nature which contains all the main criteria used in decision making.

2.5.2 Assumptions

Gladwin (1989) reveals that the main assumption of the tree model is that decision makers are the "experts" in their decisions. They use their own cultural meaning, terms and rules when making a real-world decision which are different from the researcher's point of view. The decision criteria used in their decisions contain emic categories (meaning drawn from the decision makers) and not etic categories (meaning from researcher's point of view) (Gladwin, 1989). Thus the decision makers themselves have their own rules and emic categories in their decision processes and these may be different from the researchers. The model, therefore, builds on eliciting procedures which elicit these rules and emic categories which are then used to build the decision tree model.

Gladwin also argues that decision makers make their decisions in a decomposed fashion involving the sequential comparison of the various alternatives based on a few attributes or aspects and not by ranking the options. She defines an alternative as "a set of characteristics or aspects", while an aspect is defined as "an attribute or dimension or factor or feature of an alternative". An aspect can be quantitative or qualitative values. For example, the aspect of a car (in a choice to buy a car) can be its cost, its appearance or its rate of petrol consumption. She suggests that people use decision criteria with discrete yes or no outcomes. The decision tree illustrates these criteria and procedures. She later points out that because of limited processing capacities, people use simplifying procedures or heuristics in making decisions under ambiguous or uncertain environment. There are various sources that support this view (Tversky and Kahneman, 1974; Janis and Mann, 1977; Bettman and Park, 1980; Simon, 1990; Grether, 1992; Bazerman, 1994).

2.5.3 Theory behind the decision tree model

Gladwin (1977) describes the EDTM as a two-stage decision process: (1) a pre-attentive or unconscious process, and (2) maximisation subject to constraints. These stages explain how

the decision makers behave in their decisions to choose a particular alternative. They are described as follows.

Stage 1: Preattentive or unconscious decision process

The Stage-1 decision process states that, when decision makers are given a large number of alternatives, they eliminate rapidly or pre-attentively (Gladwin, 1980; Murtaugh and Gladwin, 1980) all alternatives which have some unwanted aspects. For example, when a farmer has six possible crops to plant s/he will eliminate some of these crops rapidly or unconsciously or preattentively. S/he might eliminate vegetables because there is no irrigation, or potatoes because of a lack of knowledge of how to plant them. The farmer might not even think of planting apple because of unavailability of planting materials. In other words, when a specific aspect is selected all the alternatives which do not have the selected aspect will be eliminated. Gladwin (1977) states that the Stage 1 decision process is essentially similar to Tversky's (1972) Elimination-by-Aspects Theory of Choice which states that all the alternatives which do not have the selected aspects will be eliminated. The main difference, according to Gladwin, is that Tversky's theory stops when one alternative remains after getting rid of other alternatives. However, Gladwin (1977), departs from Tversky on this by arguing that for more important and infrequent decisions which require careful and conscious deliberation, a manageable number of alternatives will remain. After the decision makers have reached this manageable number of alternatives i.e., 2 or 3 (Gladwin, 1977), they will then proceed to the Stage 2 process which involves the final selection of the alternative.

Stage 2: Maximisation Subject to Constraints

After passing all alternatives through the Stage-1 constraints (not ordering in importance), the decision maker is left with a small or manageable number of alternatives (2 or 4) to decide about in a more detailed manner in the Stage-2 decision process. Basically, this is where the real decision process taking place. Gladwin (1977) reveals this stage as a hard-core decision process or an algebraic version of maximisation subject to constraints. The process also involves ordering of alternatives on an aspect. The six-step process of Stage-2 is outlined as follows. (See Gladwin 1977, 1980 for a comprehensive discussion of the steps.)

Step 1. Listing of Aspects

If there are 3 or less alternatives to choose from, all aspects which are contained in at least one alternative are considered and listed. For example, a car buyer is left with

two alternatives, car 1 and car 2, after eliminating all the other types of car. All the aspects which influence the car buyer on the choice of the car are listed and considered, such as cost, style, model, colour, comfort and manufacturer reliability.

Step 2. Elimination of Aspects

Aspects can be eliminated in three different ways:

- 1) If the decision maker considers an aspect has little or no subjective worth then that aspect will be eliminated.
- 2) If all the alternatives have equal or equivalent values on an aspect, that aspect will be eliminated.
- 3) If two aspects (α and β) are of equal or equivalent importance, and the order of the alternatives on one aspect is the opposite of the order of the alternatives on the other (e.g., $\alpha_{x1} > \alpha_{x2} > \alpha_{x3}$ and $\beta_{x3} > \beta_{x2} > \beta_{x1}$), then both aspects will be eliminated.

Step 3. Selection of Aspects

Aspects can be selected in two ways:

- 1) Highest utility or subjective worth. Gladwin (1980) suggests that the selection of aspect could be based on the aspect with the highest utility or subjective worth or alternatively the aspect α can be selected by means of a choice function that does not require a rank ordering of aspects.
- 2) Ordering of Alternatives. Gladwin (1980) suggests two ways of ordering alternatives:
 - (a) mutually exclusive, and (b) non-mutually exclusive alternatives.

a) Mutually exclusive alternatives. If the alternatives are mutually exclusive, the decision maker orders the alternatives on the ordering aspect α :

(i) a total order:

$$\alpha_{x1} > \alpha_{x2} > \alpha_{x3}; \quad \text{OR}$$

(ii) a semiorder:

$\alpha_{x1} \gg \delta \alpha_{x2} \gg \delta \alpha_{x3}$, where $\alpha_{x1} \gg \delta \alpha_{x2}$, if and only if $\alpha_{x1} > \alpha_{x2} + \delta$ and δ is a just noticeable difference.

b) Non-mutually exclusive alternatives. If the alternatives (x_1 , x_2 and x_3) are not mutually exclusively, then the decision maker partially orders the alternatives on the ordering aspect α :

(i) $\alpha_{x1} > \alpha_{x2}$ and $\alpha_{x3} > \alpha_{x2}$; OR

(ii) a semiorder: $\alpha_{x1} \gg \delta\alpha_{x2}$ and $\alpha_{x3} \gg \delta\alpha_{x2}$.

Step 4. Constraints

Gladwin (1977, 1980) states that for each of the remaining aspects, the decision maker or environment imposes a minimum requirement or condition that must be satisfied by the selected alternative. Some constraints are formed from aspects imposed by the decision maker, while some may be constraints from limited resources or previous decisions. According to Gladwin (1977, 1980) the decision maker, therefore, is not conscious of formulating constraints from some aspects since they come from farmers' deep knowledge of their farms.

Step 5. Passing through Constraint

The ordered alternatives are passed through the constraints (not necessarily ordered). For the alternative to be accepted it must pass all the constraints. If there is no alternative passing all the constraints, the decision will go to Step 6. Gladwin (1980) concludes that since the alternatives are ordered on an aspect and passed through the constraints, the choice process is therefore an algebraic version of Maximisation Subject to Constraints. She states that this choice process can be represented by a decision tree, table, flowchart, or by a set of decision rules.

Step 6. Alternative Strategies

The ordered alternatives may not be able to pass all the constraints. The decision maker needs to consider an alternative strategy in order for a choice to be made. Gladwin (1977, 1980) suggests few alternative strategies that can be used which include: (1) select another ordering aspect β , (2) retain the ordering aspect α but change the constraint set by decreasing threshold requirement and/or eliminating the constraint, (3) choose the highest ranking alternative on aspect α , and (4) postpone the decision and search for new alternatives.

2.5.4 The decision process as a decision tree

The decision or choice process can be represented by a decision tree (Gladwin, 1989). Gladwin explains that the structure of the decision-tree depends on the number of

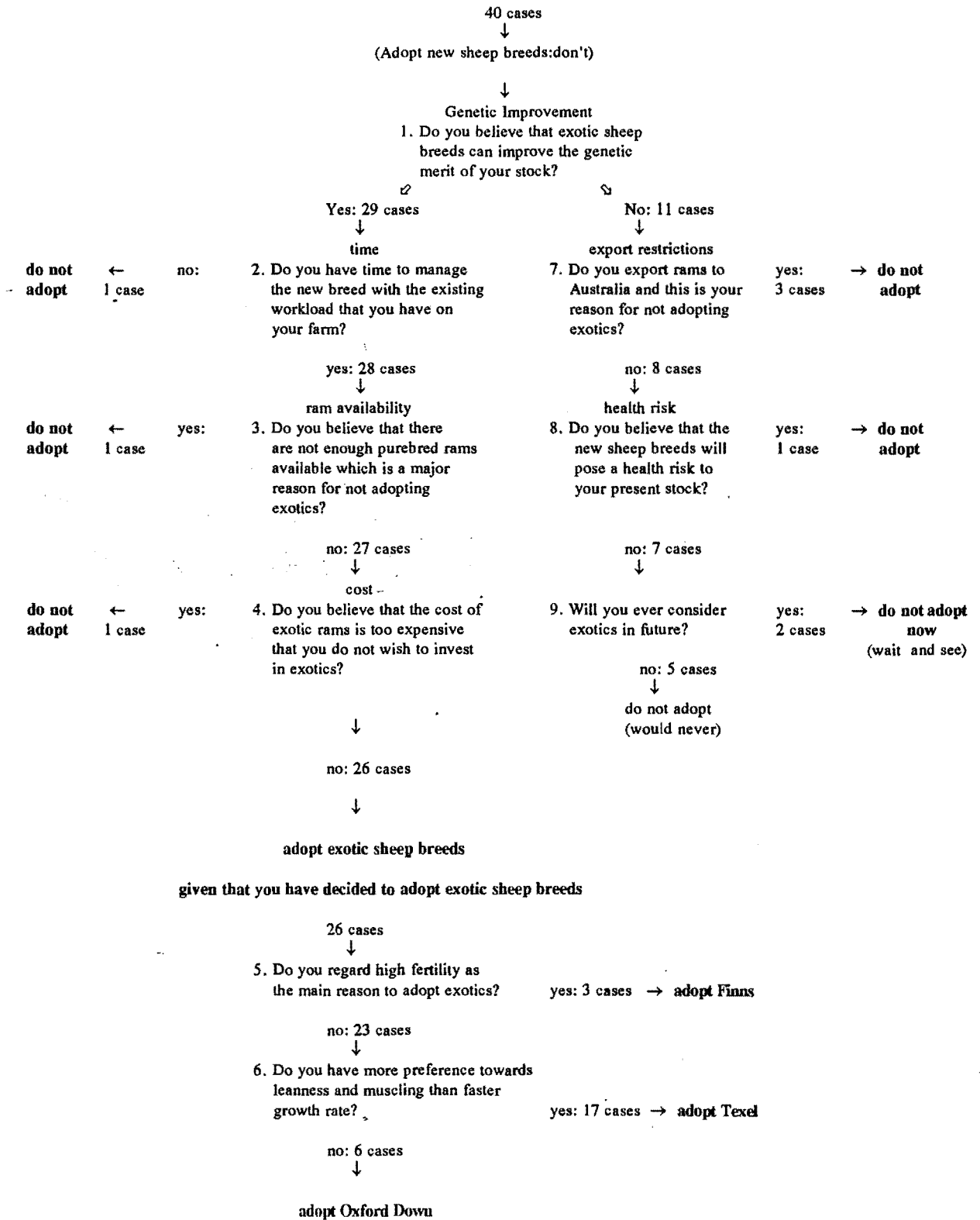
alternatives, aspects and constraints. These aspects are regarded as the decision criteria or constraints which can be used to assess or select the alternative. These criteria or constraints are discrete rather than continuous variables. Gladwin (1989) argues that the decision process is also deterministic rather than probabilistic; that is, the alternative either passes the criteria or constraints or it does not. In other words the probability is zero. A decision tree is, therefore, a sequence of discrete decision criteria, all of which have to be passed along a path to a particular outcome or choice.

2.5.5 Discussion

The ethnographic decision-tree model has been used to model a number of adoption decisions: (1) fertiliser adoption decisions (Gladwin 1976, 1977), (2) farmers' cropping decisions (Barlett, 1977; Gladwin, 1983), (3) fish marketing decision in Ghana (Gladwin, 1975), (4) families' decisions concerning the sexual division of labour (Mukhopadhyay, 1984), (5) choice of cars (Murtaugh and Gladwin, 1980), (6) economic development decisions (Schoepfle, Burton and Morgan, 1984), (7) tree planting decisions (Fairweather, 1992), (8) decisions to adopt the new sheep breeds (Jangu, 1993), and (9) production and marketing decisions of wool (Murray-Prior, 1994).

The underlying strength of this model focuses on two factors (Gladwin, 1989; Jangu, 1993; Murray-Prior, 1994): (1) its eliciting techniques to specify the actual decision criteria, and (2) its capability to be tested. They argue that decision criteria or constraints can be elicited from the decision makers themselves. Jangu (1993) in his study on farmers' adoption of the new sheep breeds used the EDTM not only to identify the adopters but also three groups of non-adopters of the new sheep breeds: (1) "constrained", (2) "wait-and-see", and (3) "would never adopt" based on the decision criteria used in the decisions (Figure 1). Please refer to Jangu (1993) on the detailed procedure of the development of the tree model. Gladwin (1989) argues that the tree models are capable of being tested. This is because they use "more realistic assumptions about individuals' cognitive capabilities" (p.11). In other words, the model has the ability to predict the behaviour of individuals in a group. This is made possible by using the ethnographic approach. This approach allows a group or composite model to be formed from individual models of individual decision processes. They are then tested against the choice from other individuals in the group. In these studies where the model has been tested, the predictability is 85-95 per cent of the choices made by the individuals. One of the

**Figure 1: Farmers' decisions to adopt the new sheep breeds
(Adapted from Jangu, 1993)**



strengths of using the model in decision making is that it can be tested in predicting choices made by another sample of decision makers from the same group (Gladwin, 1989).

Gladwin's two-stage decision processes also complements the adoption-diffusion model. The Stage 1 or a pre-attentive/unconscious process of Gladwin's hierarchical decision process or Tversky's (1972) Elimination by Aspect Theory compliments the first two stages (knowledge and persuasion) of Rogers' (1983) innovation-decision process. According to Gladwin (1980) when a decision-maker is given a large number of alternatives, these alternatives are reduced or eliminated either rapidly or unconsciously based on the particular aspect selected. In other words, when a specific aspect is selected by a decision-maker all the alternatives which do not have the selected aspect will be eliminated. For instance, a farmer may consider a particular lambing percentage as one of her decision criteria to select a breed of sheep. She gathers information about the lambing percentages of various sheep breeds and eliminates rapidly those breeds which do not suit her requirement. Gladwin notes that at this pre-attentive process a decision-maker only reduces the number of alternatives to a manageable level based on certain minimal conditions or a set of criteria or aspects before a final decision is made. The remaining alternatives will be compared thoroughly in Stage 2 of the decision process.

Gladwin's Stage 2 or maximisation subject to constraints corresponds with the last three stages (decision, implementation and confirmation) of Rogers' (1983) innovation-decision process. According to Gladwin, after a decision-maker has gone through the Stage 1 process, she then proceeds to the real decision process which she terms as the conscious or hard-core decision process or maximisation subject to constraints. At this stage, the decision maker has a manageable number of alternatives available to her. In order to choose the alternative, the decision-maker selects one of the aspects to order the alternatives. She then formulates the constraints from the remaining aspects, and passes the ordered alternatives through the constraints. If the highest ranked alternative on the ordering aspect passes through all the constraints, it is considered as acceptable by the decision-maker. This suggests that by passing the alternatives through the constraints the decision maker is very conscious in her decision whether to adopt or reject certain innovations.

The element of relative advantage which is important at the decision stage of the innovation-decision process is also incorporated in the Stage 2 of Gladwin's maximisation subject to

constraints. However, one of the strengths of Gladwin's model is that by subjecting all the alternatives to constraints she is able to pinpoint the factors which influence adoption or rejection of innovations. In other words, Gladwin's method of identifying decision criteria can be used to explain why some farmers are active rejectors and some are passive rejectors. Similarly, by using Gladwin's approach, Jangu (1993) in his study on the adoption of the new sheep breeds was able to identify the adopters and groups of non-adopters based on the decision criteria used in their decisions. Furthermore, the elements of uncertainty, re-invention, reinforcement and dissonance (as reflected in the implementation and confirmation stage of the innovation-decision process) can all be incorporated into the Stage 2 decision process which define the various constraints in the adoption of innovations.

Although the tree model has been described as both a descriptive and predictive model of behaviour of decision makers through the identification of decision criteria, it has also some limitations. One such limitation is that it does not explain psychologically on the selection or choice of aspects or decision criteria. It does not provide comparison among the different groups of decision makers. In other words, it does not provide sufficient explanation for why people might behave in the way suggested by the model neither does it explain the motivation for people's decisions of how the aspects of criteria are chosen. Murray-Prior (1994) developed a method of overcoming this limitation by incorporating personal construct theory into the hierarchical decision model. What he did as he was trying to elicit the choice through the path of a decision tree. He would ask laddering types of questions to the subjects to see if he could elicit constructs to explain why they were going down that decision path. He was dealing with farmers' choices of various production and marketing decisions and that was a less threatening problem than dealing with the issue of non-adoption because non-adopters tend to be suspicious of people asking them why they have not done something. In other words, from their point of view that may be an implication that they are not good or successful farmers. Although the technique appears to be promising by incorporating the personal construct theory into the ethnographic decision tree modelling, the researcher considered it was too threatening to use in dealing with non-adopters. Therefore, a more appropriate technique would be to just see if these four groups did exist and to broadly try to get some ideas of their psychological processes rather than trying to probe why they had made the decisions they have made.

2.6 Summary

There have been some concerns about the low uptake of new technologies by farmers. While most of the studies on farmers' adoption of innovations are focused on earlier and later adopters, less emphasis is given to the non-adopters. Some knowledge about the decision processes of the various groups of non-adopters are important in improving the uptake of new technologies. This Chapter has described some common models of farmers' decision making which are related to adoption: subjective expected utility theory, the adoption-diffusion model and the ethnographic decision tree modelling. The subjective utility theory has limitations and is therefore not considered useful for the research problem. The adoption-diffusion model has also some limitations in terms of providing a plausible explanation of non-adoption behaviour among farmers. The ethnographic decision-tree modelling has also a limitation because it does not provide an explanation on the choice of the decision criteria used by farmers. Although the personal construct theory concept such as laddering has been introduced to the hierarchical decision model, it was considered not appropriate for this particular research problem. Therefore, it was considered to look at another alternative aspect of personal construct theory which can be used to deal with non-adopters. A more detailed review of personal construct theory can be found in the next Chapter.

CHAPTER 3

PERSONAL CONSTRUCT THEORY AND THE REPERTORY GRID TECHNIQUE

3.1 Introduction

The previous Chapter described three models of farmers' decision making: subjective expected utility theory, the adoption-diffusion model and the ethnographic decision tree modelling. The subject expected utility theory was rejected because some researchers argued that it fails to perform as a descriptive and predictive model. The adoption-diffusion model has some limitations because some innovations are not normally accepted by farmers as predicted by the model. Although the ethnographic decision tree modelling was able to categorise farmers into groups based on the decision criteria used, it does not provide psychological explanation on the choice of the aspects used in the decision. Therefore, as a continuation of the decision tree model, this study will put the emphasis on personal construct theory to help understand the cognitive structures of groups of adopters and non-adopters of an innovation.

This chapter will evaluate personal construct theory and how it can be used to explore the mental processes of adopters and different groups of non-adopters of an innovation. The review will include: (1) some basic philosophies behind the theory, and (2) some important aspects of the repertory grid technique. This review will also comment on the elements of the personal construct theory in relation to adoption and non-adoption and also the tree model and the adoption literature. A summary will be presented at the end of this section

3.2 The individual as scientist

George A. Kelly (1955), an American psychologist, developed a comprehensive theory of personal constructs which are presented in the first volume of his magnum opus: "*The Psychology of Personal Constructs: A Theory of Personality*". The theory is concerned with how people construe themselves, other people and their world.

Kelly's attempt to explain this phenomenon is based on his basic notion of the individual as a scientist. Kelly envisaged that people are much like scientists. For example, scientists develop

hypotheses, test these hypotheses, make observations and evaluate the results when carrying out their experiments such as trying out a new production method. These results are subsequently used to make further predictions. Similarly, people formulate hypotheses and test them when making sense of events or to explain their experience. In other words, through this sense-making activity they are able to predict and cope with future events by asking questions and anticipating answers. Kelly claimed that people erect structures of meaning known as personal construct systems where constructs are the channels in which one's mental processes run. They use their theories in the anticipation of life events. What Kelly says is that "...we have our own view of the world (our theory), our own expectations of what will happen in given situations (our hypotheses) and that our behaviour is our continual experiment with life" (Bannister and Fransella, 1986: 8). In other words, Kelly's model of human nature tries to understand the idiosyncratic ways in which people construe and order their world (Solas, 1992a).

Constructive alternativism

Kelly (1955) used "constructive alternativism", widely known as "constructivism", to describe the philosophy underlying his theory. This philosophy suggests that people may use a number of alternative interpretations to understand an event (Neimeyer, 1993; Fransella, 1995). This implies that there are many different ways of making sense of the same reality. There is no one method which is more right or wrong than each other. As Kelly put it (1955:15): "...all of our present interpretations of the universe are subject to revision or replacement" and he proceeds "...there are always some alternative constructions available to choose among in dealing with the world. In other words, they construct many alternative explanations to understand an event. This implies that there are always alternative ways of construing things around us, if only we can imagine them.

Kelly's theory of personal construct seeks to discard the classic trichotomy of psychological thinking which consists of cognition, affection and conation (Warren, 1990; Solas, 1992a). This classic trichotomy or fragmentary approach had earlier dominated the attempt to understand people. Kelly instead presents his theory of constructive alternativism in order to understand how people construe themselves and their world.

Solas (1990) in the review of literature pointed out that Kelly tries to use his theory and technique to challenge the nomothetic emphasis of psychometric research and the method

used in the therapy. According to Kelly, nomothetic research does not define the client's problem correctly and therefore does not help in dealing with the individual client. Kelly then suggested a "credulous approach" (Adams-Webber, 1979; Solas, 1990) which takes into account of client's phenomenological perspective as a concrete source of information. Kelly (1955:322-3) provided a summary of this position in the maxim: "if you want to find out what is wrong in a client's life, ask him - he may tell you."

A comprehensive analysis of this position will not be included in this research but some other authors have used Kelly's ideas and their applications (e.g., Bannister and Mair, 1968; Dunnett, 1988; Winter, 1990; Solas, 1992b)

3.3 Fundamental postulate and corollaries

Kelly's (1955) Personal construct theory, unlike the subjective expected utility theory, is not developed from axioms or assumptions which are used to construct a mathematical model of human behaviour. Instead, he posited the theory as a Euclidean argument with a fundamental postulate elaborated by 11 corollaries which form the corner-stones of the theory. This postulate, together with the 11 corollaries, has much to say about the ways in which people construe events in the environment. In this research it is necessary to describe the central tenets of the theory in relation to decision-making processes of different types of adopters or non-adopters of an innovation because they comprise a broad framework for defining how people think, perceive or construe a certain thing or an innovation.

Fundamental postulate

The fundamental postulate of Kelly's theory is that:

A person's processes are psychologically channelised by the ways in which he anticipates events." (Kelly, 1955:46)

This postulate or assumption has several meanings or implications. One of its implications is related to personality. Personality is the "outward manifestation of a person's beliefs (Earl, 1986a:88) or it is the way how a person goes about "making sense of the world" (Bannister and Fransella, 1986:8). In other words, a person's feeling about a particular environment or behaviour in an environment depends on how he construes the environment. A person is reacting to a particular environment as he sees it. Thus, people who have different personalities and do not normally get on well with each other, do so because they see the world differently from each other.

Kelly argues that people try to make sense of their world by seeing if they can predict how things will turn out. They develop a system of ideas or constructs. This construct reflects the particular way a person has of viewing or construing the important people and events in his/her life (Solas, 1990). Therefore, these constructs serve as their views of the world. According to Kelly, a person's motivation or behaviour is governed by the constructs which are used in structuring their experience. A person's view of the world is influenced by their own experience. In other words, a person's constructs or meanings determine their beliefs, values, actions and ways of thinking rather than some outside motivation or stimulation. Thus, people will produce different reactions under the same environment because each has their own construction system.

Corollaries

This fundamental postulate is then elaborated by means of corollaries or propositions. There are 11 corollaries which are added to the fundamental postulate in order to extend or define its implications. These corollaries are:

- Construction corollary
- Individuality corollary
- Organisation corollary
- Dichotomy corollary
- Choice corollary
- Range corollary
- Experience corollary
- Modulation corollary
- Fragmentation corollary
- Commonality corollary and
- Sociality corollary.

All these corollaries will be described because they can be used to provide explanation in the understanding of the adoption behaviour of farmers.

Construction corollary

The *Construction* corollary states, "A person anticipates events by construing their replications." This proposition does not imply that the same events repeat themselves, but rather people can detect certain recurrent themes in their experience. The main point is that two or more events can be construed in a similar way by two individuals because each has his unique constructions. Kelly (1955) put across his idea that the same act of construction which

establishes some basis of perceived similarity (likeness) also serves to differentiate them from still other events (differences). He suggests that a construct is fundamentally an integrating and differentiating operation whereby at least two events are regarded as similar to one another and, at the same time, different from at least one other event.

In other words, people have their personal constructs in terms of their similarities and contrasts in relation to the other event previously construed. Thus people may end up construing things differently from each other because they have different "reference points or judgmental standards" (Earl, 1986a: 89) - at their discretion. For example, some farmers (the adopters) who have considered the new sheep breeds such as Texel perceived the new breed as less fat and would give them more financial return in future relative to other traditional sheep breeds. However, other farmers (the non-adopters) still believe that their traditional breed would have less fat and have more financial return relative to the new sheep breeds.

Individuality corollary

The *Individuality* corollary says: "Persons differ from each other in their construction of events." Kelly (1970) associates this proposition concerning interpersonal relations between individuals. He explains that this proposition basically has two implications: (1) people tend to impose different constructions on the same events, and (2) it is not likely that any two individuals put their constructs together with regard to the same set of logical relationships. Each person has his own unique system of personal constructs to interpret or make sense of his environment. He thus regulates his own behaviour following these interpretations. Therefore, our personal construct systems are different from each other because each of us has our own experience and capabilities. Thus, we construe or interpret new events differently from each other. As Bannister and Fransella (1986):10 say: "Each of us sees our situation through the goggles of our personal construction system." For example, some farmers may think that exotic sheep breeds would generate a new genetic base to the sheep industry in terms of increasing the lambing percentage. However, other farmers may think differently and consider the exotic breed as a threat in terms of its health hazard to the sheep industry.

Organisation corollary

The *Organisation* corollary says: "Each person characteristically evolves, for his convenience in anticipating events, a construction system embracing ordinal relationships between constructs." Kelly (1955) suggests that there is a degree of linkage between constructs for

organised thought and action. He argues that within the framework of a personal construction system every construct, because of their relationships with each other, implies a set of predictions about each of the events to which it is directed. When an individual interprets an event he construes people or objects in relation to one or more of his constructs. Therefore, by reviewing his personal network of related constructs (theory), he can then get predictions (hypotheses) about the individuals or objects construed. In other words, when an individual has more constructs to assign on a particular event to anticipate it, the meaning will be more clearer and distinct within the framework of his personal construct system.

As Earl (1983) points out, Kelly is arguing that people think in a hierarchical manner or have their own hierarchical system of constructs when coping with complexity and inconsistencies. A construction system of an individual is reflected as a tangled, tree-like structure rather than as a simple ladder of priority relationships. In this way some constructs appear in several subsystems and occupy different levels in them according to the context in which they are used. As Bannister and Fransella (1986) point out this hierarchical arrangement of constructs can also be extended to other areas such as conflict-solving or decision making.

In other words, people rank constructs in entirely different ways. For example, for some people "good versus bad" technology might subsume "traditional versus productive" technology but be subordinated by it for others. In the subsuming case an individual does not perceive the goodness or badness of technology according to whether it is traditional or productive, but based on some other factor. In the subordinate case the test for whether the technology is good or bad is the extent to which it follows the traditional technology (or, for some individuals, productive technology).

Another example to illustrate the idea that construction systems differ in terms of subordinancy and superordinancy of constructs appears in Rogers' (1983) explanation of why the change agent failed to persuade the villagers in Peru to drink clean boiled water. In this example, the change agent sees boiling as precondition for good health whereas the villagers see bad health as precondition for consuming boiled water.

Dichotomy corollary

Kelly's *Dichotomy* corollary says: "A person's construction system is composed of a finite series of dichotomous constructs." As Adams-Webber (1979) point out, based on this

proposition, Kelly is suggesting that each of these constructs basically consists of a single bipolar distinction, e.g., friendly-alloof. In other words, the construct is said to be meaningful if it provides the basis of perceived similarities (or likenesses) and differences (contrasts) among the events. One end of the pole of the construct denotes the justification of perceived similarity between two events, and the opposite end of the pole represents the basis of their contrast with one other event. Therefore, an individual's construct can be understood fully by encompassing both its poles because the difference or contrast is required as well the similarity to define its meaning.

As pointed out by Adams-Webber (1979), Kelly is explaining that this dichotomous nature of personal construct is an essential or important dimension of all thinking produced by individuals. Lets assume that a set of three elements comprises of A, B and C. In Kelly's ideas, A and B are perceived as similar to one another but different from C. For example, Mary and Joan may be seen as "friendly" and Josephine as "alloof". As Kelly (1970), cited in Adam-Webber (1979:5-6), explains:

"A construct is the basic contrast between two groups. When it is imposed it serves both to distinguish between its elements and to group them. Thus the construct refers to the nature of the distinction one attempts to make between events, not to the array in which events appear to stand when he gets through applying the distinction between each of them and all the other."

Kelly is also suggesting that people have finite or limited numbers of constructs when forming theories of how to categorise a particular construct (Earl, 1983). They form theories differently from each other resulting in some being blind to things that others see. For example, an individual who is not interested or inexperienced in cars may assess them as simply "fast versus slow" but not "Datsun versus other brands". Earl gives an illustration of the bipolar constructs which shows his choice matrix concerning his constructs in the decision to buy a house. The choice matrix is as follows:

Brick versus weatherboard
 Tiled versus tin roof
 House versus apartment
 Three versus two bedrooms
 Separate laundry versus laundry in bathroom
 Built-in versus need to buy wardrobes
 Detached versus semi-detached
 Wood/coal versus oil heating
 Mountain versus water views

Earl points out that the number of constructs an individual can manage to construe a particular event depend on his intelligence, educational background, upbringing, past interests and other.

These dichotomous constructs of personal construct theory seems to support Gladwin's (1989) ethnographic decision tree-modelling which makes use of a decision tree model to represent the main criteria decision-makers use in their decisions whether to adopt or not to adopt certain innovation(Murray-Prior, 1994). Gladwin reflects the decision criteria in the form of a decision tree which is "a sequence of discrete decision criteria, all of which have to be passed along a path to a particular outcome or choice" (1989:14). Gladwin explains that the path to the outcome is also dichotomous and is expressed as an "if-then" decision rule based on yes or no outcome. Thus the decision process as described by Gladwin is termed as "deterministic rather than probabilistic".

Choice corollary

The Choice corollary says: "Persons choose for themselves that alternative in a dichotomised construct through which they anticipate the greater possibility for the elaboration of their system." This proposition provides an explanation of how people make their elaborative choices of alternatives. Adams-Webber (1979) points out that Kelly views individuals as always experimenting with their own behaviour. These experiments are looked upon as hypotheses between constructs within the individuals' personal systems. Kelly argues that these hypotheses which people make involve choices of alternatives between using the contrasting poles of one or more of their personal constructs. A particular alternative is chosen if it would enable a person's ability to anticipate future events or allow him to cope with the world, or at least, to make the world as more predictable and comprehensible. Kelly suggests two types of choices: (1) extensive, and (2) definitive. An extensive choice by an individual involves the choice of that alternative which provides a basis for extending the range of convenience of his system into new areas of experience. A definitive choice involves the choice of that alternative which would pull a person's construction together into a more consistent pattern.

In short, what Kelly has suggested in connection with the choice of alternatives, is that, an individual appraises the outcome of his experiment or trial in terms of its implications throughout his network of hierarchically related constructs. For an inquiring person to be able

to ask a particular question of the world he will construe certain environmental features to be relevant. In Rogers' language, he suggests that farmers' choice whether to adopt or reject a particular innovation depends on how they perceive the various characteristics or attributes of the innovation which include: the relative advantage, compatibility, trialability, observability and complexity. These attributes of innovation later influence the choice or predict the rate of adoption of innovations. As Rogers (1983:16) explains:

"...innovations that are perceived by receivers as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations. These are not the only qualities that affect adoption rates, but past research indicates that they are the most important characteristics of innovations in explaining the rate of adoption."

Range corollary

The Range corollary says: "A construct is convenient for the anticipation of a finite range of events only." This proposition reveals that each construct has its own particular range of convenience, focus of convenience, as well as context. Adams-Webber (1979) points out that a range of convenience of a construct comprises all those things to which a person would find its application useful. A construct's focus of convenience comprises those particular things to which a person finds its application maximally useful. These are the elements upon which the construct is likely to have been formed originally. The context of construct comprises those elements among which a person ordinarily discriminates by means of the construct. It is somewhat more restricted than the range of convenience, since it refers to the circumstances in which the construct emerges for practical use, and not necessarily to all the circumstances in which a person might eventually use the construct. It is somewhat more extensive than the focus of convenience, since the construct may often appear in circumstances where its application is not optimal. For example, a farm machine can be construed in terms of its "applicability" on the farm. By contrast, it might not be useful to construe a machine as "friendly".

Experience corollary

The Experience corollary says: "A person's construction system varies as he successively construes the replication of events." In this proposition, Kelly is arguing that new structure emerges within a person's personal construct system to accommodate events which are ambiguous within the context of current structure. Kelly assumes that as events unfold and

people find that their predictions turn out for better or worse, they revise construct systems to include some aspects of the new evidence. Kelly argues that experience refers to the constructions and revisions of constructions placed upon events. It does not refer to the repeated confrontation with events which are always viewed in an exactly similar way. If people do not change their constructions as a result of the outcomes of their predictions, they will not get any new experience. Their experience will, therefore, be considered as the same. When they are later aware of a few irregularities between what they anticipated and the outcome, they put themselves in a position where they may change some aspects of themselves so as to adapt themselves to the new evidence. Thus, people change their construct systems in relation to the accuracy of their anticipations. In changing their construction systems, people are changing themselves and they may experience the change as more a painful chaos than a logical exercise.

People normally revise their theories in the light of their experience as an attempt to get more accurate representations of the nature of events. As described by Earl (1983), this revision process is termed as learning. Earl describes learning as consisting of three main forms: (1) altering of assessments, (2) altering the relationships between constructs, and (3) addition of new constructs to the person's system. A person may change his/her assessment of a particular event in respect of some construct axes. In the light of experience a person may also change the order of the constructs. He/she can also add new constructs to his/her system when evaluating or appraising a situation.

An illustration of the experience corollary is cited in diffusion theory in terms of how farmers perceive the characteristic of compatibility in a decision whether to adopt or reject the innovation (Rogers, 1983). An innovation is perceived as compatible when it is consistent with the existing values, past experiences, and needs of potential adopters. If a farmer's experience has shown that the innovation has not given any benefits to the farmers they would not consider the innovation. As Rogers says:

"Compatibility of an innovation with a preceding idea can either speed up or retard its rate of adoption. Old ideas are the main tools with which new ideas are assessed. One cannot deal with an innovation except on the basis of the familiar and the old fashioned..." (p.224).

Modulation corollary

The Modulation corollary says: "The variation in a person's construction system is limited by the permeability of the constructs within whose range of convenience the variants lie." In this proposition, Kelly (1955) is trying to introduce the ideas of permeable and impermeable constructs to explain the limitations of change occurring within the construct system of an individual. As defined by Bannister and Mair (1968), a permeable construct is "one which is open to the inclusion of new events", and an impermeable construct is "one which cannot allow new elements or events to be subsumed within its range of convenience". By a permeable construct Kelly (1955) suggests that an individual "will admit to its range of convenience new elements which are not yet construed within its framework" (p.79). If a person's superordinate constructs are impermeable, they are not likely to be able to subsume new constructs, and therefore he shows little construing in response to the events with which he is confronted.

An illustration how permeable and impermeable constructs might apply can also be found in diffusion theory in terms of describing the earlier and later adopters of an innovation. The earlier adopters or innovators can be regarded to have permeable constructs because they are considered as venturesome, cosmopolite in their outlook, rational and very receptive to change or acceptance of new ideas (Rogers, 1983). As Rogers says: "...the innovator plays an important role in the diffusion process: that of launching the new idea in the social system by importing the innovation from outside of the system's boundaries. Thus, the innovator plays a gatekeeping role in the flow of new ideas into a social system" (p.248). Conversely, the later adopters or the late majority and the laggards groups can be regarded as having impermeable constructs because they are considered to have unfavourable attitudes or be resistant, to change. They are always sceptical about the new ideas and very localite in their outlook. As Rogers states: "The late majority and laggards do not have such favourable attitude toward science. They will not adopt a new idea until they feel that most uncertainty about the innovations' performance has been removed; these later adopters place greatest credibility in the subjective experiences of their peers with the innovation conveyed to them through interpersonal networks" (p.263).

Fragmentation corollary

The Fragmentation corollary says: "A person may successively employ a variety of construction subsystems which are inferentially incompatible with each other." In this

corollary, Kelly (1955) is suggesting that a person's successive constructions of events are not necessarily derivable from one another. In other words, a person's construction system is a hierarchy and also a series of subsystems with varying ranges of convenience. The corollary implies that people are not consistent in their constructions or actions and thoughts. The way people behave today cannot necessarily be inferred from the way they behaved yesterday. An illustration of this point is concerning a situation where a person chooses to drive his car instead of taking a flight even though statistics may indicate that there are more accidents occur on land than in the air. This example may seem trivial but as Earl (1983) explains: "Either the person has some blind spots and contradictions that she is unaware of her construction system, or there is no real incompatibility and it is just that some constructs are superordinate to others."

Another example is taken from Jangu (1983) concerning the adoption of the new sheep breeds from the perceptions of both the adopters and non-adopters. The adopters consider the genetic factor as the main motivating factor to adopt the new breeds. Some non-adopters also believe in the genetic factor but later do not adopt because of certain constraints such as cost and time constraints. This shows that certain constructs are inferentially incompatible with one another. What is acceptable to one may not be compatible to another. Therefore, people may have constructs which are superordinate to others.

Commonality corollary

The Commonality corollary states that: "To the extent that one person employs a construction of experience which is similar to that employed by another, their processes are psychologically similar to those of the other person." In this corollary, Kelly is saying that making inferences about the psychological processes of other individuals will be easier when they are similar to our own in structure and content. As Bannister and Mair (1968:23) explain:

"Kelly indicates here that two similar people need not have experienced the same events, or even similar event, nor need the ways in which they have tested out their constructions of these events have been the same or similar. What has to be similar, in order for their processes to be psychologically akin, is their constructions of experience."

Therefore, people do sometimes share a similar construction system and they may behave in similar ways because they construe things in similar ways. They are similar with respect to

events which have the same meaning for them. They can act alike even if they are exposed to different stimuli. This is because of their similarity of construction of events. In other words, farmers who have similar construction of events or are perceived to have common interest, ideas and objectives are likely to share ideas and experiences with each other. Farmers may also listen to the advice of the extension officers if they construe things similarly to them.

Perhaps this corollary is more related to agricultural extension activities in terms of extension officers' contact with their farmers. For example, Woog (1978) in his study on the evaluation of the role of extension in the pig industry using the personal construct theory has shown that extension officers are likely to be successful in terms of influencing their clients to follow their advice if they share similar constructs with their clients. Woog also suggested that farmers who have the similar background and shared experiences are considered as relevant sources of advice. As cited in Woog (1978), this commonality of construction would result in more effective communication between supervisor and employees (Triandis, 1959a and 1959b) and between therapist and patients (Landfield and Nawas, 1964).

Kelly's construct commonality is also related to Rogers' (1983) concept of homophily in communication. Rogers indicates that people are said to be homophilous when they have similar characteristics such as education, social background and experience. He suggests that more effective communication occurs when the source and the receiver are homophilous. In other words, a group of people who are homophilous are able to learn effectively from each other because they are considered to have the same "wavelength". The main difference between these two concepts is that while Rogers focuses on attributes such as education, Kelly focuses on the construct/thinking or perceptions of the individuals.

Sociality corollary

The *Sociality* corollary says: "To the extent that one person construes the construction processes of another, they may play a role in a social process involving the other person." In this corollary, Kelly is giving special attention on the role of an individual in a social process. He defines role as a course of activity which is played out in the light of one's construction of one or more other persons' construct systems. As Adams-Webber (1979) point out, the corollary implies that a person's social development involves the gradual acquisition of increasing skill in making inferences about the personal construct systems of other people in a social situation. In other words, any interaction between individuals involves understanding

others' perspectives in order to function effectively in a social process. We do not have to have similar construction systems or to be similar people in order to be able to interact with each other. What is more relevant is that our construct systems should give a meaningful picture to one another. In other words, an individual can accurately infer the personal axes of reference of another individual as a basis for effective communication and understanding. Thus, if we are able to understand other people we are then able to construe their construction. As such, we are playing a role in a social process with them.

The sociality corollary is also related to how Rogers (1983) explains the differences in perceptions between the early and later adopters of innovations. Rogers suggests that faster rates of innovation adoption are achieved when the villagers are more interconnected because there are more network interaction among themselves and that they can be reached by interpersonal networks. Rogers explains: "...the later adopters are surrounded by peers who have already adopted the innovation. These peers may act as a psychological or vicarious trial for the later adopters, and hence, the actual trial of a new idea is of less significance for them" (p.231), and he concludes, "...social systems whose members are more closely linked by communication networks have a stronger diffusion effect and a faster rate of adoption of innovation" (p.235-236). Kaine and Lees (1994) also give similar views but express the importance of homogenous groups for the effective transfer of technology within the network. They say: "...the key feature of successful technology transfer within the network model of information creation and exchange is the identification of homogenous groups of farmers based on their concordance of interests in an innovation or package of innovation" (p.54).

Another example of this corollary can be found in Rogers' description of earlier and later adopters in terms of their social participation and empathy. Rogers suggests that earlier adopters have more social participation than later adopters. In terms of the ability to project him or herself into the role of another person outside the local system, earlier adopters have greater empathy than later adopters. This suggests that earlier adopters are able to think imaginatively and to communicate effectively into other systems.

The above sub-sections have described some basic concepts of personal construct theory: the fundamental postulate and corollaries. From this discussion, personal construct theory seems to have some potential in providing some information required for the problem of

understanding non-adoption. The next sub-section will describe how personal construct theory can be operationalised to do this.

3.4 Eliciting construct systems

In order to use personal construct theory to understand the behaviour of individuals, the constructs that reflect that particular behaviour need to be elicited. There are many different ways of eliciting constructs ranging from an informal conversation approach to a more formal computerised techniques (a comprehensive description of these techniques can be found in Bannister and Mair, 1968; Fransella and Bannister, 1977; and Dunnett, 1988). Dunnett (1988) categorises the formal techniques of eliciting constructs into two main groups: (1) techniques based on individual constructs and (2) techniques using systems of constructs. These techniques are briefly introduced here but a detailed discussion will be on the repertory grid technique because it is more appropriate in this research.

3.4.1 Techniques using individual constructs

The techniques based on individual constructs fall into three groups: (1) Laddering (Hinkle, 1965), (2) Pyramiding (Landfield, 1971), and (3) ABC Model (Tschudi, 1977). They are described as follows.

Laddering

Laddering is one of the techniques of constructs elicitation based on individual constructs. This technique is first proposed by Hinkle (1965) for eliciting superordinate constructs. Superordinate constructs are types of constructs which are of higher order of abstraction than those elicited from triads or dyads of elements. This technique (see Fransella and Bannister, 1977) starts by first eliciting constructs in the normal manner. A few constructs may have been elicited by a triadic procedure. The subject is asked to look more closely at the original construct. S/he is then asked which end of the construct is preferable and why this is so. This process of constructs' elicitation by laddering is summarised by Hinkle (1965:32-33) in this way: "Now on this construct you preferred this side to that side. What I want to understand now is why you would prefer to be here rather than there ... What are the advantages of this side in contrast to the advantages of that side as you see it?" (Hinkle, 1965:32-33).

In this technique, the answer given is another construct superordinate to the first and which also has a preferred side. The question "why" is again asked on the preferred side of this new construct. Again, the question "why" is asked of each new construct until each time the subject is not able or not willing to provide more answers. An example of a laddering technique of construct elicitation is given by Easterby-Smith (1981). In a grid based on people the construct produced can be extrovert versus introvert. The subject says that he would prefer to be "extrovert". The interview between the subject and the researcher can be as follows:

Researcher: "Why would you prefer to be extrovert?"

Subject: "Because people respect "extroverts"; introverts are "disregarded"."

Researcher: "Why is it important to be respected?"

Subject: "Because this indicates that you are a valuable person; people who are "disregarded" are worthless ..."

Easterby-Smith (1981) argues that during this process a series of new constructs are produced from any of the first constructs. These constructs tend to be increasingly important for the subject generating them. Therefore, the "why" question produces constructs of greater generality (superordinate constructs) and "what" or "how" questions produce constructs at a lower level of generality or more specific constructs (subordinate constructs).

By this technique, the meaning of a construct is explored by discovering the more general or abstract connections. Dunnett (1988) suggests that by this approach, a researcher is able (1) to understand the subject's construct which does not make sense to him, and (2) to discover why change is hard for a particular individual.

Pyramiding

Pyramiding technique is another technique of construct elicitation which is based on individual construct. Conceptually it involves exploring a person's construct in the opposite direction to that of laddering. That is, constructs are explored from a relatively superordinate (abstract) construct to more concrete subordinate ones. The details of pyramiding procedure are found in Landfield (1971:134-152.) The main difference between laddering and pyramiding is that the former involves "why" question, while the latter consists of "what" or "how" questions. Thus a pyramid develops (Dunnett, 1988: 10) in this way:

makes good relationships

vs.

has difficulty making relationships

↔

more approachable vs. less inclined to share feelings

↔

easy going vs. up-tight

ABC Model

The third type of technique of construct elicitation which is based on an individual construct is called ABC Model. This is proposed by Tschudi (1977). According to Tschudi, a simple form of a construct network consists of three constructs which can be labelled as ABC. The aim of this technique is to investigate the problems or implicative dilemmas (Dunnett, 1988) associated with moving from one pole of a construct to the contrast or desirable pole. The technique involves exploring the construction of the advantages and disadvantages of each pole. The objective is to understand why a change in behaviour does not necessarily occur.

For example, a person sees himself as "weedy" but wishes to become "strong". However, there is no change observed. To explain this situation Dunnett presents it in this way (see Dunnett, 1988:10):

A1	being weedy	A2	being strong
B1	often picked on doesn't get girls often feels unwell	B2	able to stand up for myself get a girl-friend be looked up to
C2	looked after by another not expected to fight battles	C1	have to look after myself have to leave home

In the above model, A is the construct along which change is desired. A1 is an emergent pole and A2 its contrast or desired end. B1 and C1 are the disadvantages of each pole. B2 and C2

are the advantages. This explains why the change in behaviour or movement has been very slow.

The major aim of this research is to identify the broad differences in constructs between groups which might lead to them viewing the adoption of an innovation differently. Because of this the focus might be on exploring a system of constructs and not necessarily on examining one construct and its relationship to other constructs. The ideal situation would be to elicit systems of constructs and then to explore the relationships between these by identifying superordinate and subordinate constructs. However, this is very time-consuming and it was considered the subjects might not be willing to be probed too much given the sensitive nature of the research. Therefore, given the research focus and practical limitations it was decided to use the repertory grid technique rather than other techniques which can be used to elicit and explore one construct such as laddering, pyramiding and ABC model.

3.4.2 Techniques using systems of constructs: Repertory grid technique

The other formal systems of eliciting constructs are techniques based on systems of constructs (Dunnett, 1988). According to Dunnett, these systems consist of three groups: (1) self-characterisation, (2) enactment, and (3) repertory grid. Self-characterisation and enactment techniques are most relevant to clinical psychology and, therefore, will not be discussed. The detailed discussion will be on the repertory grid technique because it is considered as most widely used in agricultural research and the most appropriate way of achieving this research objective of eliciting the systems of constructs of adopters and various groups of non-adopters of an innovation.

Repertory grid technique

Kelly (1955) developed a rigorous methodology which is called a repertory grid technique in order to discover individuals' internal representations or constructs. The technique allows the researchers to detect and measure the personal constructs of an individual. It gives an insight into what and how people think. As pointed out by Easterby-Smith (1981), it is a technique that can be used to quantify the subjective data from which the judgements and decisions of individuals are obtained. The following discussion describes several issues related to the repertory grid technique: definition, the nature of elements and constructs, some of its applications, strengths and weaknesses.

Definition

The repertory grid methodology has contributed significantly in the development of personal construct theory. The definitions of a Repertory grid technique, therefore, has a direct relationship on this theory. Adams-Webber (1979) defines a Repertory grid as "a method of quantifying and statistically analysing relationships between the categories used by a subject in performing a complex sorting task." In a similar form, Bannister and Mair (1968:136) gives the definition of a repertory grid as "any form of sorting task which allows for the assessment of relationships between constructs and which yields these primary data in matrix form." Adams-Webber points out that this definition is different from the traditional sorting tasks because individuals are replaced by the usual objects and the associations between categories are evaluated rather than the accuracy of the sorting.

Another definition of a repertory grid is that given by Stratten and Hayes (1993) in their Second Edition, *A Student's Dictionary of Psychology*. They define a repertory grid as: "A technique developed by George Kelly, for utilising a person's personal constructs to examine the significant people in his world, and so identify actual or potential sources of psychological discomfort or stress. The repertory grid is an idiographic technique, which enables a therapist to see the patient's world as they see it, a valuable first step in most forms of therapy. The repertory grid is also used more generally in research to indicate how people perceive and understand their worlds (p.165)."

A repertory grid technique, therefore, permits researchers to discover or elicit the unique pattern of relationships among several constructs of an individual. In other words, the repertory grid technique allows the researchers to explore personal construction systems of individuals. It attempts to stand in other peoples' shoes, to see their world as they see it so as to understand their situation.

There are two important units in personal construct theory: elements and constructs. The repertory grid technique is a method developed by Kelly (1955) used to elicit or explore these constructs. They are described as follows.

Elements

An element is one of the two important components of the repertory grid. The following describes (1) the definition, (2) the rules for selecting, (3) the strategies for selecting, and (4) the generation of the elements.

Stewart and Stewart (1981) describe elements as people, objects, events and activities. As described by Solas (1990), elements are any things which a person wishes to compare such as people, situations and events. They are chosen to represent the area in which construing is to be investigated. They determine the focus of the grid. As described by Smith (1986) and Smith and Gibson (1988) the elements are the objects of an individual's thoughts such as people, objects and also include any abstract qualities.

Rules for selecting elements

There are several factors to be considered when choosing the type of element to be used in a grid (Fransella and Bannister, 1977; Stewart and Stewart, 1981). There are described as follows:

Elements should be discrete. The elements should be as discrete as possible. They have to be specific and precise. If the elements are not precise, the constructs will not be clear and the constructs produced will also not be clear. The choice of various types of car such as Mazda, Honda, Datsun etc. are examples of discrete elements.

Elements should be homogenous. They must be precise and drawn from the same category so that the constructs elicited and used in the grid are applicable to all elements. In other words, classes of elements should not be mixed together. For example, people should not be mixed with things and things should not be mixed with activities. Some examples of acceptable categories are: "people who have strong influence on my job performance"; "my subordinates", etc. It is not acceptable to mix categories in a set of elements. because the constructs that are generated from elements in one category are not applicable to those in another category. For instance, the construct honest-dishonest can be applied to most people. However it will be difficult to describe "attending meetings" in terms of honest versus dishonest. In Kellian term, "all elements must be within the range of convenience of the constructs to be used." This is because constructs are discriminations we make between people, thing or events and that each of the construct applies only to a limited number of

people, things or events. The range of convenience of specific constructs cannot always be accurately assessed by the researcher. Therefore, the respondent must be given the chance to say when a construct is not applicable to an element or they cannot construe a particular element.

Elements should not be sub-sets of other elements. In other words, it is not advisable to choose smaller elements which have the characteristics of bigger elements.

Elements must also be representative of the area to be investigated. As explained in Easterby-Smith (1981), a grid about "significant people in my life" which did not include spouse or parents could be rather suspect. Likewise it is necessary to include good and bad dimensions. This can be done by including contrasting pairs of elements: "a person you like versus a person you dislike"; "a machine which is workable versus a machine which is not workable". Easterby-Smith however pointed out three problems related to this contrasting approach. Firstly, it can influence the nature of constructs elicited towards the dimension chosen for contrasting the elements. Secondly, people may find it difficult to name someone whom they do not like. Thirdly, if the same grid is to be completed by a group of people, it is important to make sure that all the people are able to relate directly to the elements specified. Kelly (1955:230), however, gives a summary of the importance of representativeness when choosing the elements in this way: "If the test is to indicate how the subject develops his role in the light of his understanding of other people, it is necessary that the other people appearing as elements in the test be sufficiently representative of all the people with whom the subject must relate his self-construed role." While trying to ensure that the elements are sufficiently representative, Kelly also developed the use of the role title list or role descriptions.

Elements should not be evaluative. Elements which are too general or implicit should not be chosen. Similarly, those elements which contain evaluative attributes should not be selected. These implicit or evaluative elements do not have personal relevance to the subjects.

Strategies for generating elements

There are many ways available to the researcher in order to generate elements. However, as noted by Stewart and Stewart (1981), the researcher must ensure that the subject is able to

think of a specific person to fit the description. Four methods of generating elements are summarised below (e.g., Stewart and Stewart, 1981; Easterby-Smith, 1981; Beail, 1985):

Supply elements to the subjects: One of the ways of generating elements is to supply the elements to the subject. The investigator can provide a list of names of places, persons, objects or products to the subject. The elements do not necessarily have to be limited to people.

Provide role or situation descriptions: Elements can also be generated by providing role or situation descriptions. For example, an investigator can provide a number of role descriptions of any person such as a teacher s/he likes. The researcher can also provide a list of questions to the subjects. The answers will be the elements.

Define a pool or area of interest: The other method of generating elements is to define a pool or area of interest. An investigator can ask the subject to specify the name of persons, places or objects to fit certain general descriptions.

Elicit elements through discussion: Once the pool or area of interest has been defined, elements can also be generated through joint-discussion between the researcher and the subject. Through their discussion the subjects can generate a list of specific elements.

Stewart and Stewart (1981) noted that all these strategies can be mixed when choosing the elements. They suggested that by allowing subjects to generate the elements and asking questions to them provided a better procedure because they could provide free interview-bias. They also suggested that it is best to start preparing questions (element-eliciting questions come in pairs) followed by free-ranging discussion which allow the subjects to generate a list of elements. A strategy of providing the elements by the researcher can be followed later.

Number of elements in a grid

Easterby-Smith (1981) provides some suggestions as to the number of elements in a grid related to industrial and organisational applications. For industrial uses the number of elements can be very low. If a computer is used to analyse the grid then the number of elements should be more than six otherwise the analysis will be distorted. Kelly (1955) suggested that most of the grids used by clinical psychologists have 15-25 elements.

Easterby-Smith however noted that in organisational uses this requirement is seldom followed.

Construct

A construct is another component of a grid. Kelly (1955:105) defines a construct as "a way in which some things are construed as being alike and yet different from other." It is a way a person distinguishes similarity or the way in which a person understands two things as being alike and different from the third. As described by Dunnett (1988), a construct is a discrimination used by individuals to understand life events when they try to make sense of their experiences. The way a person sets up his/her hypothesis is by discriminating between things. For example, when a person anticipates something s/he considers something to have a particular attribute (X) which distinguishes it from other things which have an attribute (Y). The basis of this hypothesis is therefore the construct of X versus Y. Kelly also suggests that our cognitive system consists of bipolar constructs which imply that individuals affirm and negate. They have an emergent pole and a contrast pole such as illness-health and honest-dishonest.

It is also noted that a number of different terms are used to describe a construct. These include describing constructs as the building blocks of mental models (Howard, 1994; Latta and Swigger, 1992), the internal, mediating cognitive processes (Diamond and Thompson, 1985), the internal representation or model of the environment which is unique to each individual (Underwood and Salmon, 1980; Woog, 1978) or a personally organised system of interpretation (Beail, 1985). Constructs are also described as the dimensions which a person uses to compare the elements (Solas, 1992a) and act as "goggles or transparent templates through which the world is viewed" (Solas, 1992b:378). Similarly, Smith (1986) and Smith and Gibson (1988) define constructs as the qualities possessed by the elements which are then used to differentiate among the elements of our thoughts. According to them these constructs are the "mental spectacles" or lens through which people see and view their world and analogous to directions on a map. For example, some qualities may be physical such as durability, brilliance or size; constructs can include some kind of evaluation such as goodness and usefulness; and also can be some characteristics of individuals such as kindness or warmth.

Assumptions underlying constructs

Before describing some procedures concerning elicitation of constructs, it is necessary to state the various assumptions related to constructs. Kelly specifies six assumptions that underlie his first Role Construct Repertory Test (Rep Test) which are relevant to grid modifications and construct elicitation. Fransella and Bannister (1977) gave the summary of these assumptions as follows:

Permeable constructs. The constructs elicited must be permeable. This suggests that an individual is able to apply the constructs to people and interpersonal situations other than the three elements from which the construct is elicited. As Kelly (1955:229) says: "We hope that the subject reveals, in taking the test, those channels through which new experiences, as well as old, may run."

Pre-existing constructs. Pre-existing constructs should be elicited. While the subject develops a new construct during the process of elicitation, it is assumed that this does not occur and that there is "some lingering degree of permanence in the constructs".

Communicable. The verbal labels attached to the constructs must be communicable. The investigator has a correct idea as to what the subject is getting at. In other words, the investigator must know how the respondent might attach meaning to the constructs. It is therefore useful for the investigator to clarify the meaning of these constructs with the subject.

Understanding of other people. The constructs elicited must represent the subjects' understanding of the way other people look at or perceive things. A social interaction between the subject and other people enables the former to meaningfully describe how others see the world and themselves. It also allows the subject to describe how the perceptions and beliefs have impact on their own construct system.

Non-dissociation. The subject must not dissociate herself or himself from the elements or constructs elicited. In other words, s/he must be able to see herself or himself somewhere along the construct dimensions.

Bipolar constructs. The constructs elicited from the subject must be explicitly bipolar. In other words, the subject states both what a person or thing is. For example, a person can be described as friendly (positive pole) and unfriendly (negative pole).

Types of constructs

There are three main types of construct based on how they are used in relation to the elements (Easterby-Smith, 1981; Bannister and Fransella, 1986; Winter, 1990): (1) pre-emptive, (2) constellatory, and (3) propositional. These are described as follows:

Pre-emptive construct. A pre-emptive construct is a type of construct which is generated by the subject in a pre-emptive manner. As defined by Bannister and Fransella (1986), a pre-emptive construct is “one which pre-empts its elements for membership in its own realm exclusively” (p.18). Winter (1990:13) defines it in this way: “A pre-emptive construct is one which, when applied to an event, does not allow the application of any other construct to that event.” For example, a farmer may have his own farm objective or target to be attained within a certain period of time through the use of a certain farm technology or practice. If he is not able to achieve his objective he might not use that particular farm practice any more. This type of construct classification, however, has its own limitation because it restricts the subject to construe objectively (Bannister and Fransella, 1986). It denies the right of the subjects to review, re-interpret and see their environment from a wider perspective.

Constellatory construct. A constellatory construct is a type of construct which can be produced by the subject in a constellatory manner. As quoted in Bannister and Fransella (1986), a constellatory construct is “one which fixes the other realm membership of its elements” (p.19). Winter (1990: 13) defines it in this way: “A constellatory construct does allow an event to which it is itself applied to be viewed in terms of other constructs but, as in the use of stereotypes, it specifies the way in which these constructs are applied to the event.” According to Winter, a person is exhibiting a constellatory type of construing if he views himself as failing in a task at work but also construes himself as stupid, incompetent, worthless, unlovable, and as characterised by a host of other undesirable attributes. In other words, a person would try to rationalise or to give his strong justification for his action. Bannister and Fransella views that this type of construct is commonly associated with subject who has a stereotyped or typological way of thinking.

Propositional construct. As the name implies, Bannister and Fransella defines a propositional construct as the one which is generated by the subject in a propositional manner. These are constructs which do not produce any implication concerning the other realm membership of its elements. This is regarded as an "as if" type of construct. Winter (1990:13) defines it in this way: "A propositional construct, on the other hand, does not determine what other constructs may be applied to an event to which it is applied." For example, when an individual wants to buy a car he would list some of the propositions related to the types of car available in the market.

According to Kelly (1955), these three types of constructs are closely related to his own model of decision making which he refers to as the Circumspection-Preemption-Control Cycle (CPC cycle) (Winter, 1990). The circumspection phase occurs when an individual considers a number of options. (Gladwin's stage 1 decision process) The preemption phase occurs when an individual preempts their choices to two. The control phase occurs when the person takes control by making the final choice between two options. (The preemption and control phases are similar to Gladwin's stage 2 process).

Corresponding, consensus, conflicting and contrasting constructs. Following Kelly's ideas, Shaw and Gaines (1988) also suggested four types of constructs which he terms as: (1) corresponding constructs which refer to the use of different constructs but similar ways of thinking, (2) consensus constructs which refer to the use of the same constructs and similar ways of thinking, (3) conflicting constructs which refer to the same constructs but different ways of thinking, and (4) contrasting constructs which refer to different constructs and different ways of thinking.

Research using personal construct theory and repertory grid technique

Kelly's (1955) personal construct theory have been applied in various fields, such as in clinical psychology, psychotherapy, marketing, education, tourism and agriculture. These studies have shown the potential of this theory to explore people's construct which they use to perceive the events in their environment.

Kelly's personal construct theory and repertory grid technique have been used in the field of clinical psychology and psychotherapy for many years. For example, Ryle (1976) has used the grid technique in a clinical setting and has produced meaningful results. Since then its

application has been extended and adapted to other fields of enquires. Stewart and Stewart (1981) list some of its applications in the industry such as market research, quality control, questionnaire design, investigation of motivation and managerial effectiveness, training evaluation and counselling.

Kelly's repertory grid technique has also been used in education such as for investigating teaching effectiveness (e.g., Solas, 1990; Corporaal, 1991; Fairweather and Peebles, 1994). Solas (1990), for example, has successfully applied the repertory grid technique to elicit and evaluate the constructs used for teaching effectiveness. Solas showed that the technique was a "powerful heuristic tool" for this purpose. Fairweather and Peebles (1994) used the computer version of repertory grid technique, the RepGrid software programme compatible with Apple Macintosh, to assess the teaching performance of two types of students as indicated by school principals and teachers in Christchurch. A total of 30 subjects were interviewed for the study. By using the technique, Fairweather and Peebles, were able to produce some meaningful results giving a detailed account of principals' and teachers' perceptions or constructs of the two types of students.

Others also use personal construct theory and repertory grid technique in tourism studies to elicit people's constructs or perceptions of seaside resorts (Riley and Palmer, 1976), to investigate how people view their environment (Stringer, 1976), and to examine travellers' images of areas (Embacher and Buttle, 1989; Mansfeld and Ginosar, 1993). In other words, by using personal construct theory and repertory grid these researchers are able to study how individuals or tourists evaluate and appraise images in their environment and these are important for future development of tourism.

Studies using personal construct theory with or without the use of repertory grid technique have also been undertaken by a number of researchers in agriculture (Bock, 1976; Townsend, 1976; Woog, 1978; Ilbery, 1978; Munroe and Fisher, 1982; Ilbery and Hornby, 1983; Briggs, 1985; Whybrow, 1988; Rusten and Gold, 1991; Murray-Prior, 1994). Bock (1976), for example, successfully applied the technique to analyse farmers' perception or constructs they used to evaluate different sources of market information in decision making. In other words, by using such technique Bock was able to provide some insights into farmers' viewpoints regarding the use of various sources of information and hence farmers' behaviour. Other researchers also used the RepGrid to analyse the important attributes of information sources in formulating price expectations used by farmers to make decisions (Munroe and Fisher,

1982; Whybrow, 1988). Townsend (1976) successfully used the repertory grid technique to investigate why colonisation of new land in Colombia, South America failed to achieve agrarian reform. A total of 84 rainforest farmers and 10 extension officers were interviewed and completed the grids. The image of Colombian planners or extension officers is that rainforest farmers (colonists) do not have the skills and that they do not wish to learn the new skills. However, by using the repertory grid technique, Townsend was able to show that these images or visions of extension officers are found to be incorrect. In other words, the failure of colonisation to achieve a prosperous family-farm structure was not because the rainforest farmers were irrational and ignorant but because the planners failed to understand the cognitive systems of the rainforest farmers.

Woog (1978) in his study on the role of extension in the Australian pig industry, used personal construct theory and repertory grid technique: (1) to elicit from the farmers the constructs they used to evaluate extension officers and (2) to investigate the degree of commonality in the construct systems between the extension officers and the farmers who are either extension users or non-extension users. Twenty extension officers and 52 pig producers were interviewed. Using the RepGrid, Woog was able to identify farmers' expectations of the extension officers in terms of their attitudes and roles they have to perform in the pig industry. For example, farmers expected extension officers to be expert in a specific field, to be thoroughly knowledgeable about their clients' situations and to be able to disseminate information which was immediately useful in solving the practical problems of their clients. The study gave a better insight into some of the problems of extension. Extension officers were not aware of: (1) the relevance of their advice or information to their clients within their conceptual construct framework, (2) their varied roles as expected by their clients, and (3) the difficulties experienced by their clients in communicating with them. From the study, Woog had demonstrated that RepGrid was a useful tool to explore the nature and the capacity of the farmers' construct systems and that an understanding of these construct systems were important to enhance the effectiveness of extension and hence to facilitate the uptake of new technologies or advice by farmers.

Ilbery and Hornby (1983) used the repertory grid procedures in an exploratory survey of 35 farmers in mid-Warwickshire to examine the importance of socio-personal factors in agricultural decision-making. They used six different types of farms as elements and those different factors perceived to be important in farming operations as constructs. The 35

farmers were divided into four groups based on certain characteristics such as age, education, farm size and farm types. Results of this exploratory survey using the repertory grid technique clearly demonstrate the diverging perceptions or constructs of different groups of farmers although they are in a similar physical conditions. Ilbery and Hornby have demonstrated that the repertory grid technique allows one to gain an insight into the complexities of the decision-making process. They concluded that the choice of certain enterprises is a highly individualistic process and that the farmers' attitudes vary according to the type of farm practice.

Briggs (1985) used personal construct theory and repertory grid technique in his exploratory study identifying the main decision factors or constructs underlying farmers' choice of crops in Central Sudan. A total of 85 farmers were interviewed. The subjects were asked to grade each of the constructs elicited in terms of their most important crops. By using the repertory grid technique, Briggs was able to demonstrate that: (1) non-economic factors such as farmers' experience and perception of the crop yield superseded economic factors in farmers' decisions to choose the most important crops, (2) personal contact through extension agent was relatively unimportant in the transfer of new technologies, (3) the differences in decision factors or constructs among farmers show that farmers do not exist as homogenous groups as perceived by extension agents or rural planners, and (4) farmers can be identified into sub-groups based on the types of decision factors or constructs used. This study clearly demonstrates the potential use of the repertory grid technique in providing a more useful insight into farmers' decision making and hence agricultural planning in Africa. However, Briggs has suggested that more studies be conducted in different physical and economic environments before the findings be recommended to other areas.

Lately, Murray-Prior (1994) in his study on the production and marketing decisions of woolproducers in the New England area incorporated Gladwin's (1977) hierarchical decision model and Kelly's (1955) personal construct theory but without the use of repertory grid technique. A total of almost 100 farmers were selected randomly and interviewed. Two types of decisions were modelled in the study: (1) major strategic decisions (production decisions), and (2) major annual decisions (marketing decisions). The hierarchical decision model was used to provide the decision criteria or aspects in the decision models. Farmers' construct systems were elaborated using the laddering and pyramiding techniques of personal construct theory. In other words, by using personal construct theory Murray-Prior was able to explain

human behaviour and learning in the selection of the aspects used in the decisions. The results of this study showed that wooproducers in the New England area used simplifying rules and strategies in their production and marketing decisions. According to Murray-Prior, for short-term decisions, the price change may either lead producers to consider changing the enterprise mix or not to change at all. However, for long-term decisions, the wool producers ignored some information about changes in the prices of the enterprises because from their experience of trying to predict prices and change the enterprises did not likely to lead to greater profit.

In general, most of the above studies make use of the repertory grid technique to elicit constructs related to a particular problem. In other words, the repertory grid technique was used to determine the cognitive structures or constructs people have in connection with a particular event or object. The technique was also used to understand whether those constructs elicited influence people's behaviour. Various types of analytical procedures applied to the grid matrix to infer the significance of the constructs in determining behaviour. Therefore, it is noted that the method seems to have a great potential for understanding the constructs of non-adopters but has not often been used in this way.

Strengths, weaknesses and limitations of personal construct theory

Kelly's theory and the repertory grid technique have been accepted world wide in various fields of research. It is considered as an objective and flexible research technique. The repertory grid technique has provided an important tool in many fields of inquiry such as market and consumer behaviour, education, agriculture and tourism. Despite its strengths and many advantages, the use of repertory grid has also some weaknesses.

The technique allows the researchers to elicit constructs from the subjects. It has flexibility and objectivity without imposing ideas upon the subjects (e.g., Woog, 1978; Hallsworth, 1988; Embacher and Buttle, 1989; Rusten and Gold, 1991; Fairweather and Peebles, 1994). In other words, the technique can be used to minimise interviewer interference (e.g., Bannister and Mair, 1968; Fransella and Bannister, 1977) and to produce data without observer bias (Stewart and Stewart, 1981; Ormrod, 1993). The Grid is also suitable for retrieving subjects' cognitions in their own terminology (Corporaal, 1991). Solas (1990) in his study of students' personal impressions of teaching effectiveness described the Grid as a powerful "heuristic tool" for investigating teaching effectiveness in social work education.

According to Solas the flexibility and efficiency provided by the grid method suggests that it is applicable to various issues related to teaching and learning.

The Grid method can be used to measure content and structure of cognitive systems of the subjects (Woog, 1978; Dun, Pavlak and Roberts, 1987; Brook and Brook, 1989; Corporaal, 1991). In other words, it allows the researchers to see the world as the subjects see it and allows them the freedom to produce their own dimensions or perceptions of the environment. In agricultural research, repertory grid technique "provides insight into what people think, but more importantly, it gives an insight into how people think" (Woog, 1978:10).

People are limited in their information processing capabilities and this implies that the manner in which they make their decisions would also be different. However, Kelly observed that individuals use only a few constructs while making their decisions. These constructs used are related to their anticipations of the future. As quoted in Murray-Prior (1994:129), Loasby (1986:45) says:

Kelly emphasises the significance of bounded rationality (though not under that name) both for the professional scientist and for the amateur scientist whom he wishes to study. Because the universe is presumed to be an integrated whole, any perception of it is inevitably partial and inaccurate; we can interpret it only with the aid of models of our own creation. These models cannot be derived from the phenomena by some natural principle of selection and adaptation, since an integrated universe embodies no such principles; they are human inventions. In a very important sense, scientific knowledge is not discovered, but created ..."

As cited in Murray-Prior (1994), this argument is supported by the studies of MacCrimmon and Wehrung (1986). Their findings revealed that business executives tend to concentrate on a few aspects of the decisions although information was available on more aspects.

Earl (1983) argues that from the perspective of personal construct theory people's behaviour can be explained by their capability to anticipate events. In his proposition to integrate economist's and psychologist's ideas to develop an "economic theory" of motivation and perception, Earl (1986b) suggests that an individual's decision-making capacities are limited and the future cannot be known before its time.

Despite the strengths and usefulness of the repertory grid, the method is also subject to criticisms. There are some instances where the weaknesses of the method have been identified.

Solas (1992a) pointed out that some of the constructs developed in the grid are considered as too general and overgeneralised. It can be quite difficult to fit elements to constructs. Earl (1983) raised the issue of whether personal construct theory is unscientific because people can rationalise their own behaviour based on their own construction systems. Therefore, all types of behaviour in relation to individual constructs can be rationalised.

The other criticism is the problem of eliciting the constructs. It is not possible to elicit all the constructs. Murray-Prior (1994) listed some of the reasons for difficulty in eliciting the constructs. The first reason was termed as physiological which was recognised by Kelly (1955):

"A person's behaviour may be based upon many interlocking equivalent-difference patterns which are never communicated in symbolic speech. Many of these preverbal or nonverbal governing constructs are embraced in the realm of physiology."

Elicitation of constructs in order to produce two contrasting poles can be a problem (Easterby-Smith, 1981). A classical approach to eliciting constructs is using a triadic method. The intention is to produce two contrasting poles for the construct, even though it is sometimes suggested that the poles should be opposites. Easterby-Smith pointed out three problems arising from this method. Firstly, the problem with requesting "opposites" is that it tends to give logical opposites rather than opposites in meaning. Following the example provided by Easterby-Smith, the logical opposite of 'ambitious' is 'not ambitious'. However, an individual may think of the real opposite of 'ambitious' as being 'does not trample on colleagues'. Secondly, the selection of triads could also influence the final grid. For example, if the elements are not given equal chances of appearing in triads some elements will dominate the type of constructs being produced. This will eventually cause distortion in the overall grid. Thirdly, the subjects may find it difficult to think of new constructs. The elements in successive triads, therefore, should be changed rapidly i.e., do not repeat two elements in successive triads.

The other possible reasons for difficulty in constructs elicitation include: individuals could have problem in defining priorities especially when the situations are not clear; and people may be unwilling to admit the construct they are using. This is because they might conflict with higher level images they like to present of themselves (Earl, 1983).

Kelly (1955) was aware of these problems. However, he considered these problems not because of the research method or theory but more because of researchers' understanding in terms of their explanation of the research to the subjects.

Repertory grid is an in-depth and qualitative research method and consumes a great deal of researchers' time in order to elicit constructs (e.g., Fairweather and Peebles, 1994; Murray-Prior, 1994). The sample sizes are, therefore, limited. Thus the repertory grid technique is only appropriate for small in-depth studies.

3.5 Conclusion

In this chapter, the basic central ideas about Kelly's theory of personality, *Personal Construct Theory*, and the repertory grid technique for eliciting constructs have been outlined. These include the fundamental postulate, corollaries and some aspects and applications of the repertory grid technique. The central idea about the theory is that people are viewed as if they are scientists in a general sense. They make sense out of their experience and anticipate events. They develop hypotheses or constructs, test these hypotheses and make observations and evaluation of the results. The ultimate aim of individuals is to predict and control events. The review of the literature on personal construct theory and the repertory grid technique shows that they can be used to understand individuals' decision behaviour. This provides an appropriate way of achieving the objective of understanding or exploring the cognitive structures of adopters and various groups of non-adopters of an innovation.

The application of personal construct theory and the repertory grid technique to achieve the objectives of this research are addressed in the remainder of the thesis.

CHAPTER 4

METHOD

4.1 Introduction

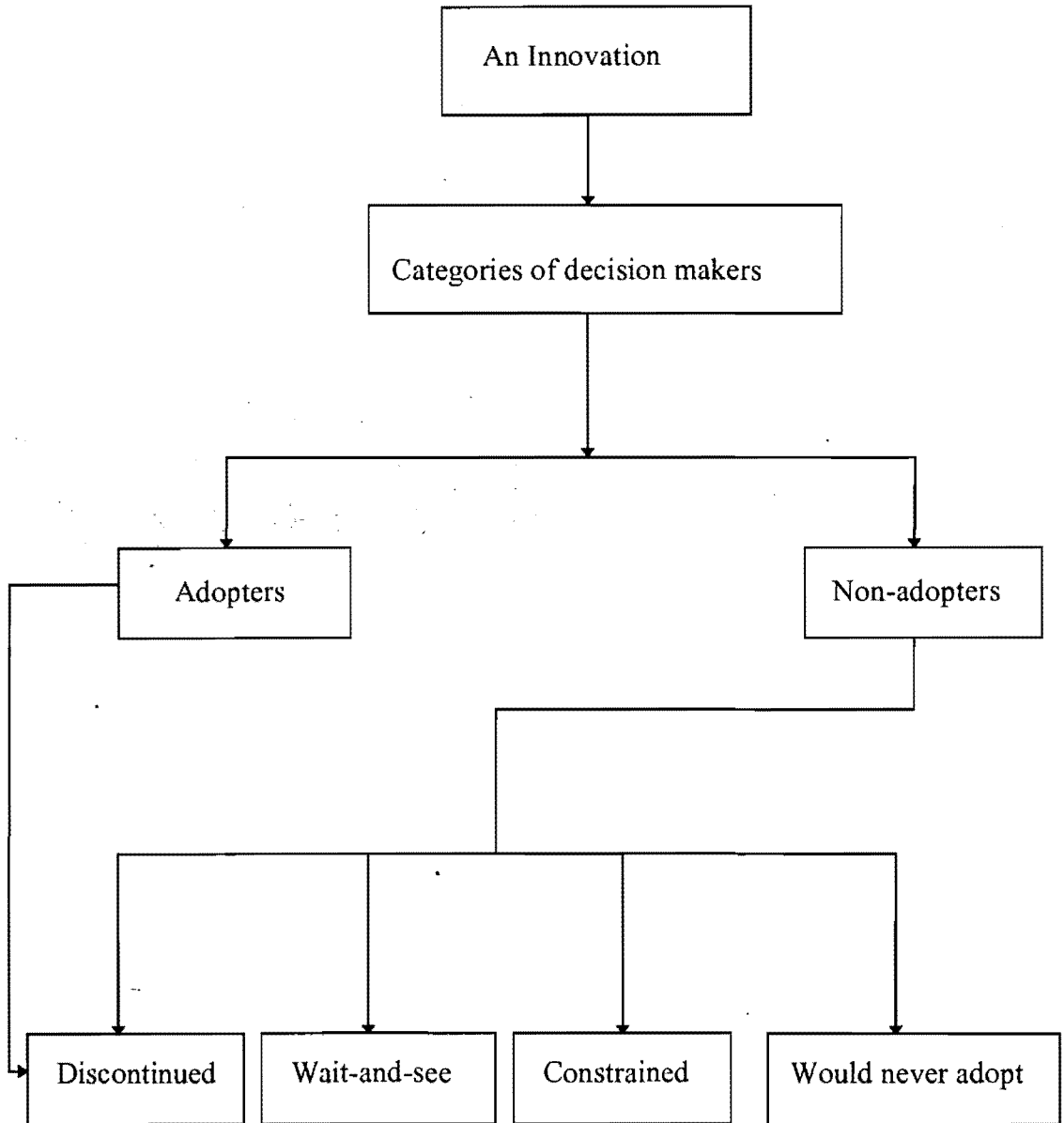
As discussed in Chapters 2 and 3, there was literature available on adoption and various groups of adopters but little was available on non-adoption or non-adopters. There were different groups of non-adopters and it was proposed that there might be similarities and differences in their mental constructs or cognitive structures. It was concluded that personal construct theory and its repertory grid technique could be helpful in studying these constructs.

This chapter outlines the following: (1) a conceptual model of categorising decision makers; (2) the study area and industry; (3) some innovations in dairying; (4) sampling procedure; (5) background information on subjects interviewed, and (6) the repertory grid technique. A summary will be presented at the end of the chapter.

4.2 A conceptual model of categorising adopters and non-adopters

Ethnographic decision tree modelling can be used to classify farmers into adopters and four classes of non-adopters (see the conceptual model in Figure 2). In an empirical study, Jangu (1993) identified three groups of non-adopters and he identified this empirically in another adoption context thereby verifying that the groups in Figure 2 actually exist even if in another industry. It seems reasonable to assume on the basis of ethnographic decision tree modelling's example that these groups of non-adopters could conceptually exist in all cases dealing with adoption. But in addition there is a further group that Jangu (1993) did not deal with and that is the "Discontinued" group and obviously there is this group of individuals who had adopted a particular innovation but decided to discontinue. Therefore, ethnographic decision tree modelling has conceptually been used to identify different classes of non-adopters and these classes have been verified empirically in another context.

The four classes of non-adopters identified in this research are: discontinued, wait-and-see, constrained and would never adopt. The "discontinued" non-adopters are those who

Figure 2: A Conceptual Model

have adopted the innovation but have decided to discontinue because of some reasons. The “wait-and-see” can be regarded as “fence seaters” who are aware of the innovation but have not made the decision to adopt because of some reasons. The “constrained” ones have decided not to adopt because of some constraints. The “would never adopt” non-adopters are those who have stated they would very unlikely to adopt because of certain reasons.

Although research has identified these different groups of decision makers, we know nothing about their mental processes. For effective transfer of technology there is a need to explore the mental processes or cognitive structures of these decision makers.

Earlier research has focussed on various groups of adopters: innovators, early adopters, early majority, late majority and laggards. The non-adopters have been seen as similar to later adopters or laggards. The discontinuers of innovations have also been seen in this way.

However, this may not be the case because non-adopters may have decided not to adopt because of reasons which they consider as valid or rational. For example, the “constrained” non-adopters, may have some similar personal characteristics with that of the adopters, but may have decided not to adopt because of certain constraints which they consider as valid and important. Similarly, the “wait-and-see” non-adopters may have yet decided to adopt because they would prefer to have their minds open about the innovations. They may not necessarily have the characteristics of later adopters or laggards.

These different groups of non-adopters may have different mental processes or cognitive structures in their decisions not to adopt because of the way that they have categorised themselves. Similarly, the individuals within a group may have similar mental constructs because they seem to behave in the same way. Knowing about these different groups of non-adopters and any similarities and differences in their mental constructs would be very useful for effective extension or transfer of technology to farmers.

This research tries to explore the cognitive structures of adopters and four groups of non-adopters of an innovation. The main objectives are to see whether there is any: (1)

heterogeneity between the groups that follow different decision paths, and (2) homogeneity within the group that follow the same decision path.

4.3 The study area and Industry¹

4.3.1 The study area

For reasons of cost and time the study was conducted in Canterbury Region including those areas in Kaikoura. Canterbury is located on the central east coast of South Island. It covers an area of 3.92 million hectares or 14.5 per cent of New Zealand's total land area of 26.9 million hectares. The population is 466,000 or 51 per cent of the total South Island total population. It has the largest plain in New Zealand and also covers the volcanic hills of Banks Peninsula. One of the most important climatic features of the plains is that it has a low rainfall and hot summers which allows mixed farming of sheep and crops. Flood and spray irrigation play a significant role in boosting agricultural production in lower-rainfall areas. Canterbury contributes about 16 per cent of New Zealand's livestock and over 57 per cent of its arable crops. Soils of the Canterbury plains are derived from silty, sandy or stony accumulations of alluvium, windblown loess, coastal dune sandy and boulder banks and peat. The mineral particles are derived principally from greywacke.

There are three main systems of farming in Canterbury: livestock, cropping and horticulture. Livestock farming mainly comprises of sheep, beef cattle, dairy, poultry, pigs, deer and goats. The total sheep numbers in 1995 were 8.97 million of which 6.2 million were breeding ewes. Total beef numbers in 1995 were 461,000 of which 30 per cent were breeding cows. Dairy cow numbers in June 1995 were 165,000 compared to 120,387 in 1991. The recent upturn in the dairy industry has led to the increase in the number of dairy cattle. Hens and pullets were numbered at 379,250 or 13 per cent of the total produced in the country. With the recent upturn in the Deer industry the deer population is 268,000 or 22 per cent of the total produced in the country. There is

¹ The information on the description of the study area was extracted from the Annual Review of New Zealand and Canterbury Agriculture, 1997 and the Livestock Improvement, Dairy Statistics 1995/96.

limited demand for goat meat or cashmere and mohair. There is only a few farms having goats of economic importance.

The main cash crops grown are wheat, barley, peas, ryegrass and white clover seeds. Flat terrain, moderate rainfall, and low summer humidity make Canterbury an important grain-growing region in the country.

A wide range of horticultural crops are grown for both export and the local consumer market. Crops include apples, pears, stone fruits, berries, vegetables and a large number of flower varieties.

4.3.2 Dairy industry in Canterbury

The researcher has chosen to study the dairy industry in Canterbury. One of the reasons is that there has been an upturn in national activity in dairy in recent years and a lot of dairy conversions have occurred. There are also a lot of innovations available for adoption by dairy farmers. The Livestock Improvement Corporation, New Zealand, has also provided some good contacts in the dairy industry. For these reasons, it was therefore a good industry to use for this study.

Canterbury can be divided in four areas: North Canterbury, Central Canterbury, Mid-Canterbury and South Canterbury (Gaul and Hughes, 1996). According to Gaul and Hughes, there are a full range of land uses in each of these areas which include sheep, cropping and mixed-cropping. This provides alternative feed resources which are important to the Canterbury farming system. There are also large areas of hill country which provide good grazing for farmers.

The regional distribution of dairy farms has remained fairly constant over the last three seasons in New Zealand. In the South Island region, the farms have, on average, larger properties with larger herds than those in the North Island. In Canterbury, the average herd size is 331 cows. (The New Zealand average is 199 cows.) The total number of cows is 153,820 or 5.2 per cent of the total number in the country or 31.3 per cent of the total number in South Island. The average stocking rate is 2.8 cows per hectare and

farms have an average effective area of 122 hectares. The average milkfat production per cow is 154 kg milkfat or 268 kg milk solids (MS).

4.4 Innovations in Dairying

4.4.1 Innovations

There are a number of innovations which can be adopted in dairying. These innovations are associated with animal breeding and pasture management in order to increase production. Some of these innovations include: herd testing, artificial insemination, heifer synchronisation, metabolisable energy testing, moisture probe testing, feed budgeting and inducing cows to calve (please refer to Table 1 for the list of these innovations). Some dairy farmers in Canterbury have adopted some of these innovations while others have not. Some of these innovations are described as follows.

Herd testing. Herd testing is one of those practices used for herd improvement in dairying. This testing of each cow for its production (milk quantity, milkfat and protein) is offered to farmers by the Livestock Improvement Corporation (LIC). A technician from the LIC will take the sample (or supply the equipment to dairy farmers to get the sample by themselves) and test the sample from each cow for volume, fat and protein contents and also the somatic cell content. The information on these tests will then be supplied back to farmers. Other information, such as the production index and the breeding index, will also be given to farmers. The number of farmers who do herd testing in New Zealand has been increasing steadily, from 21% of total herds in the 1955/56 season to 85.6% in 1994/95 season. In South Island, the percentage of total herds using herd testing services is 83% in the 1995/96 season. Herd testing allows dairy farmers to breed for higher production by culling those low producers cows.

Artificial insemination. Artificial insemination (AI) is also referred to artificial breeding (AB). The main reason for using AI is to have a more rapid improvement in genetic merit of the herd which is made possible by using highly selected progeny tested bulls (Holmes, 1987). In New Zealand, there has been an increase in the proportion of cows mated using AB from 45% in 1974/75 season to about 82% in the 1995/96 season. In South Island, a total of 371,210 cows (or 15.4 per cent of the total number in the

country) were inseminated and 48,194 yearlings to artificial insemination (or 27.7 per cent of the total number in the country) during the 1995/96 season.

Table 1: A List of type of Innovations in Dairy Farming

No	Types of Innovations	Have you adopted this innovation?				
		Adopted (period use)	Not adopted			
			constraint	discontinued	wait and see	would never adopt
1	Leasing of dairy cows					
2	Baleage					
3	Metabolisable Energy (ME) Testing					
4	Dairy grazing					
5	Dairy heifer grazing					
6	Borderdyke irrigation					
7	Pivot irrigation					
8	Travelling irrigator					
9	Moisture probe testing					
10	Use of nitrogen fertiliser					
11	Soil testing					
12	Herbage testing					
13	Foliar fertiliser					
14	Feed budgeting					
15	Artificial insemination					
16	Heifer synchronisation					
17	Embryonic transfer					
18	Herd testing					
19	Herringbone cowshed					
20	Rotary turnstyle cowshed					
21	Inducing cows to calve					

Heifer synchronisation. As defined by Jelly (1991), heifer synchronisation (synchronisation of oestrus also referred to synchrony mating of heifers) is used as a management tool to try to get them calve as early as possible. In other words, it condenses the calving spread and moves the calving forward. It aids the use of artificial

insemination in heifers, hence, effectively improves the rate of genetic gain in the herd. It is promoted by the Livestock Improvement Corporation.

There are several methods used in synchronising the cycles of the heifers. However, the most common is the use of the CIDR (controlled internal drug release) devices and then inseminating the heifers at the same time². The CIDR is a plastic intravaginal device with the ability to release progesterone at a controlled rate. Progesterone is the normal hormone produced by the corpus luteum in the ovary which stops the animal coming into oestrus. Another type of hormone is prostaglandin which destroys the corpus luteum in the ovary and stops the production of progesterone. The schedule of events of synchronising dairy heifers are as follows: (1) identify the cycling animals and tail paint all yearlings being considered for treatment, (2) insert CIDR and CIDIROL capsule and apply tailpaint, (3) inject yearlings with CIDR devices with half dose of prostaglandin, (4) remove CIDR devices after 12 days, and (5) inseminate 50-52 hours after CIDR removal or to detected oestrus.

In South Island, yearlings to AB has been increasing rapidly for the past eight years, from 4,144 in the 1987/88 season to 48,194 in the 1995/96 season. A high percentage is using heifer synchronisation (Gaul, 1997).

Metabolisable energy testing (ME). Metabolisable Energy is the proportion of energy absorbed from the feed by the digestive tract and retained for metabolic purposes. The units of ME are megajoules (MJ). All feeds can be ranked on their metabolisable energy content as a proportion of feed dry matter (M/D value, expressed as MJME/kg DM) to indicate their value to ruminants. The M/D value of a feed may be called the “ME Concentration” of that feed. Metabolisable energy is a good measure of the nutritive value of feed.

Moisture probe testing. This is an instrument used to test the moisture level in the soil. The reasons for using the probes are: to determine when to irrigate the paddocks; to economise the use of water and also to improve pasture quality. Many dairy farmers have also used these probes where irrigation systems are available.

² EAZI-BREED, CIDR and Livestock Improvement, 1996.

Feed budgeting. Feed budgeting is an integral part of a pasture management system. The main reason for using feed budgeting is to determine how much feed is available and how much is required. It helps to determine how much supplements such as hay or silage are required. Some farmers use formal calculations to determine the amount of dry matter per hectare on their farms while others use their own field experience based on their eye appraisal.

Inducing cows to calve. Inducing cows to calve, also called induction, is a method of inducing premature calving of cows through injection of certain hormone (Holmes, 1987). The main purpose is to calve later calving cows earlier and thereby concentrating the calving spread. This is one way of getting a benefit of extra milk production from the cows. While there are many farmers using this method others consider the method as a very “inhumane” way of “killing” animals and hence prefer not to use it on their farms.

4.4.2 Selection of Elements

The preceding sub-section describes some of the innovations which can be adopted in dairying. The researcher has decided to use innovations as elements with the main element being heifer synchronisation. The initial approach was to examine a number of innovations (several grids elicitation) instead of one innovation (a single grid elicitation) for a particular subject. However, when the researcher actually did an exploratory test of this approach in the field, he found that it took far too long to complete. It was not feasible from the point of view of time for the subject. Therefore, it was decided to use the innovations as the elements and one innovation, heifer synchronisation, as the main element, and also look at other innovations in the context of how the subjects would relate these to heifer synchronisation.

As described in sub-section 4.4.1, heifer synchronisation was one of those important innovations in dairying. The main reason for its selection rather than some other innovations was because some farmers have different views about its use. Although the technology has been on the farm for more than fifteen years or so, there were still some farmers who have not used it. There were also some who have used it but decided to discontinue. The researcher was not only interested in the adoption of heifer

synchronisation but also other innovations, particularly how they were related to heifer synchronisation.

However, not all innovations will be selected by a particular subject. In this study, the researcher ensured that a particular subject would be faced with combinations of adopted and non-adopted innovations.

4.5 Sampling procedure

This research used a qualitative approach through in-depth examination of a small non-random sampling of some dairy farmers in Canterbury who were adopters and non-adopters of heifer synchronisation. This section covers the following topics: (1) justification for the use of a qualitative approach and a non-random sampling, (2) selection of samples, and (3) sample size and representation.

4.5.1 Justification for the use of a qualitative approach and a non-random sampling

This aim of this research is to provide an in-depth examination of non-adopters of an innovation. There is very little information known about non-adopters and it is suspected that there might be four groups of non-adopters who were different in their mental constructs. Because it is not known who the non-adopters are of a particular innovation or innovations, it is not possible to identify a population and randomly select from them. Babbie (1989) argues that when topics defy simple quantification and need to be understood in natural setting, then a qualitative research approach is more appropriate. He also suggests that its use as exploratory approach when the subject area is relatively new and unstudied, as in this case.

An additional advantage of a qualitative research in this study is that it allows for non-random sampling. Because the population is difficult to identify, drawing a random sample is not possible. Therefore, a method which allows an alternative sampling method is an advantage. On the aspect of sampling technique, Babbie (1989) points out that controlled probability sampling is seldom used in qualitative research. He suggests three sampling methods that can be used in qualitative research: quota sampling, snowball

sampling and deviant case sampling. In this particular case, the researcher used snowball sampling. There was a need for the researcher to identify one subject initially who would in turn be able to introduce another subject to participate in the research.

4.5.2 Selection of samples

The names of farmers considered for the research were obtained from the Livestock Improvement Corporation, the Department of Farm and Horticultural Management and from the farmers themselves. Five groups of farmers were used: adopters and four classes of non-adopters. The four groups of non-adopters were: discontinued, wait-and-see, constrained, and would never adopt. Because the researcher was interested in studying the adoption of heifer synchronisation, one of the ways of identifying the subjects for these four categories of non-adopters was by phoning them and asking them what was the main reason for not adopting heifer synchronisation. These subjects were given the four possible groups (classes) of non-adopters and were asked which particular class was relevant to them. The same procedure was applied to all subjects until the researcher was able to get five subjects from each of the four classes of non-adopters. It was observed that it was easy to get more subjects from the adopters but difficult for the non-adopters.

4.5.3 Sample size and representation

A total of 25 dairy farmers consisting of five subjects (cases) from each of the five groups of decision makers were interviewed. One of the reasons for only having five subjects because it was hard to get more non-adopters from each group. Because of the small sample size used there is a need to elaborate on this issue from a qualitative research perspective.

Ragin (1994) indicated that a qualitative approach of social research is interested in commonalities or some common patterns by in-depth investigation of a small number of cases. The aim was to reveal the important characteristics of a case (subject) and give insight into fundamental connections among these characteristics. Ragin also pointed out two components of analytic frames to clarify and characterise social phenomena: (1) framing by case - establishes an important category or set of phenomena, and (2) framing

by aspect - indicates how the cases within a category vary. Ragin's methods of making analytic comparison in qualitative data analysis were also shared by Neuman (1997). Neuman suggested two methods of making analytic comparison: (1) method of agreement - focuses attention on what is common across cases or looks for one or more common causes to explain the common outcomes in all cases, and (2) method of difference - differs in outcomes and causal features or characteristics.

One other issue on the sampling size is related to representativeness and generalisability of the findings. According to Sarantakos (1993), in qualitative research, representativeness was not relevant and not important except for generalisability. On the issue of representativeness he argued that sampling in qualitative research was not based on the theory of probability because of the small sample size. However, he said the sampling procedures used in the research were connected to theoretical sampling and was directed towards essential and typical cases. In other words, even though researchers regard generalisations as significant in qualitative research they relate them to typical cases and not to principles of quantitative research.

4.6 Background information of subjects interviewed

A total of 25 dairy farmers or cases were selected for the interviews comprising of one group of adopters and four groups of non-adopters. These four groups of non-adopters were: discontinued, wait-and-see, constrained and would never adopt. Five subjects (cases) were interviewed from each group. Table 2 shows the summary of the background information of the subjects concerning the age, educational attainment, farm size, number of milking cows and the average milk production per cow.

The dairy farmers interviewed were aged between 26 and 70 years. The adopters were aged between 38 and 56 years. The non-adopters were between 26 and 70 years. The average age for each group was as follows: adopters (45 years), discontinued (47.6 years), wait-and-see (33.8 years), constrained (45.8 years) and would never adopt (51 years). There was one subject above 60 years from the "constrained" group and two subjects above 60 years from the "would never adopt" group. Generally, there were more older farmers in the "would never adopt" group and slightly younger farmers in the "wait-and-see" group.

Table 2: Summary of background information of subjects

Category of Adopters and Non-adopters	Subject no.	Age (yrs)	Education	Farm size (ha)	No. of milking cows	Av. milk production (kg ms per cow)	Category of dairy farmers
Adopters	3	48	Dip.FM	82	200	350	Seasonal and owner operator
	5	38	F.5	200	350	340	Seasonal, town milk supply and owner operator
	6	56	Dip.FM	200	400	322	Seasonal and owner operator
	8	42	F.5	64	250	412	Seasonal and owner operator
	9	41	F.5	154	300	360	Seasonal and sharemilker
	Average	45		140	300	356.8	
Discontinued	1	50	F.4	68	210	340	Seasonal and owner operator
	2	46	F.5	132	250	350	Owner and townmilk supply
	4	47	F.5	105	240	350	Seasonal and winter contract
	11	54	F.5	160	300	400	Seasonal and owner operator
	12	46	F.4	400	450	450	Seasonal and owner operator
	Average	47.6		173	290	378	
Wait-and-See	10	26	Dip.FM	154	300	333	Seasonal and owner operator
	13	28	F.4	80	200	330	Seasonal and sharemilker
	17	40	F.5	270	130	269	Seasonal and owner operator
	19	43	Civil engineer	106	185	330	Seasonal and owner operator
	22	32	F.5	170	395	290	Sharemilker and seasonal
	Average	33.8		148	242	309.8	
Constrained	15	32	F.5	96	293	360	Seasonal, winter contract and sharemilker
	16	54	F.5	92	240	335	Seasonal and owner operator
	18	39	F.5	145	230	300	Seasonal and owner operator
	21	66	F.1	120	200	313	Seasonal and owner operator
	25	38	F.6	75	200	500	Town milk supply, winter contract and owner operator
	Average	45.8		106	232.6	361.6	
Would never adopt	7	37	B.Ag.Sc.	200	580	360	Seasonal and sharemilker
	14	40	F.5	170	200	406	Town milk supply and owner operator
	20	70	F.1	50	130	330	Seasonal and owner operator
	23	61	F.5	80	187	360	Seasonal and owner operator
	24	47	F.5	60	150	400	Seasonal and sharemilker
	Average	51		112	249.4	371.2	

The level of educational attainment of the individuals from all the five groups did show certain differences with at least two subjects from each group having fifth form education. There were two subjects who had completed their diploma in agriculture from the adopters' group, one diploma in agriculture (wait-and-see group) and one degree in agriculture (would never adopt) from the non-adopters' group.

The farm size from the adopters ranged between 82 and 200 hectares and that of the non-adopters was from 60 to 400 hectares. The average farm size for each group is as follows: adopters (140 ha), discontinued (173 ha), wait-and-see (148 ha), constrained (106 ha) and would never adopt (112 ha). Generally, the constrained and the would never adopt have smaller farm size.

The number of milking cows is related to the farm size. The adopters have between 200 to 400 dairy cows; and the non-adopters have between 130 to 580 cows. The average number of milking cows for the five groups is as follows: adopters (300), discontinued (290), wait-and-see (242), constrained (233), and would never adopt (249).

The milk production per cow does not vary greatly between the adopters and the non-adopters. The average production of milksolid (kg ms per cow) is as follows: adopters (356.8 kg), discontinued (378 kg), wait-and-see (309.8 kg), constrained (361.6 kg) and would never adopt (371.2 kg).

The adopters and non-adopters of heifer synchronisation come from six categories of dairy farmers: seasonal/owner operator, seasonal/sharemilker, seasonal/winter contract, seasonal/town milk, seasonal/winter contract/sharemilker, and town milk/winter contract/owner operator. Generally the adopters are the seasonal/owner operator. The non-adopters are from the seasonal/owner operator and included the town milk suppliers.

4.7 Repertory grid technique

4.7.1 RepGrid programme

This study used the computer version of the Repertory Grid technique called the RepGrid software programme. Figure A2.1 (see Appendix 2) shows the functionality of

RepGrid: (1) eliciting constructs, (2) FOCUS, (3) PrinCom and (4) Socio. (Please refer to Manual RepGrid 1990 for more details about RepGrid.)

Eliciting Constructs

The most common technique used for eliciting constructs is the minimal context form or triad method. The elements are presented in a group of three. This number represents the least number of elements in order to produce both a similarity and a difference. The subject is asked to respond to a question: "In what way two elements are alike and thereby different from the third?" The way in which the two elements are similar is the emergent pole of the construct. The other pole is called the contrast or implicit pole of the construct.

Repertory Grid Analysis

Repertory grids encode information about a person's way of looking at the world. This information is used for some purposes since it can help to remember the basis for decisions and actions. It can also be analysed in a number of ways to give the underlying structures or construct systems in a person's world view and its relationship to those of others. There are many forms of analysis that are widely used for different purposes. RepGrid gives all the commonly used techniques for the analysis of the constructs: (1) FOCUS, (2) PrinCom and (3) Socio.

The FOCUS algorithm is a distance-based hierarchical cluster analysis method that sorts the constructs into a linear order. In other words, the constructs closest together in the space are also closest together in the order. The program FOCUS gives a hierarchical clustering of an expert's construct system that preserves the data elicited from the individual so that the sources of the analysis are evident and can be discussed. The FOCUS sub-programme provided the FOCUS analysis which was used to understand the association between the elements and constructs. It provided explanation for all the types of construct dimensions elicited. It also helped to understand the association between the constructs and the elements. The elements used were rated on each of the constructs elicited.

The results of the FOCUS analysis were displayed in an array called the *focused grid*. This focused grid displayed all the elements identified including heifer synchronisation. It

showed the subjects' constructs which they used to construe heifer synchronisation. The elements were shown on the Element Tree consisting of the adopted innovations (marked clear) and the non-adopted innovations (marked in bold and italic) and formed the vertical list on the right hand side of the focused grid. The numbers immediately above the list of elements were the matching percentage. The constructs elicited were shown on the Construct Tree and formed the horizontal axis at the top of the focused grid again with numbers showing the rating values of the elements on each of the constructs.

The subjects were asked to give their own construction or interpretation of the focused grid including the elements clustered together. Special attention was given to heifer synchronisation in terms of how the subjects construed the technique in relation to their farming systems.

The PrinCom sub-programme is a distance-based cluster analysis using the standard principal component analysis techniques. The PrinCom program gives a non-hierarchical cluster analysis based on the principal components that can be used to gauge the main dimensions along which a person is making distinctions. The PrinCom algorithm spatially clustered the elements and constructs in a repertory grid and showed them in a graphical form. The axis that appeared as a dotted line on the horizontal was called the first principal component and that on the vertical was the second principal component. The results from this analysis were displayed in the PrinCom output including: (1) constructs correlations, and (2) the percentage of variance for each component. The principal components analysis explained the principal or main components and reported the correlations between the constructs and elements. In other words, by comparing the repertory grids for a specified innovation (element) the researcher was able to see if there were any common patterns in the constructs that correspond to a particular group of farmers.

The Socio sub-programme provided the Socio analysis which was used to identify similarities and differences in the personal construct systems of individuals within each group of decision makers. It offers the researcher to explore several grids at once and look for instances of shared thinking. This research, however, did not include the indepth

study of the socio part of the RepGrid analysis. (For more detailed information about the RepGrid, please refer to the RepGrid Manual 1990).

4.7.2 Interview procedure

The list of names of subjects were obtained from the Livestock Improvement Corporation, the Department of Farm and Horticultural Management and from other farmers. An introductory letter from the Head of Farm and Horticultural Management Department and a letter confirming the date and time of the interview from the researcher were sent to these subjects a few weeks before the interview. There were eight farmers (all non-adopters) who refused to participate in the research. Some of the reasons mentioned for not willing to participate were: (1) busy with their farm works, (2) other appointments, and (3) not interested.

The first stage of the interviewing was done in July/August, 1996 and the final interview was conducted in September, 1996 and February, 1997.

One day before the interview the subjects were given a reminder through phone calls to confirm the appointment. This was very important because the research coincided with the calving season (a very busy time for the farmers) and confirmation was necessary so as not to cause any inconvenience not only to the researcher but also to the subject.

Before the interview commenced, the researcher thanked the subjects for their time and their willingness and kindness to participate in the research. The subjects were briefly told of the purpose of the research. They were also asked whether they agreed for the interview to be tape recorded. Two forms were used to record the background information of the subjects and their farming systems. The researcher also took notice of the presence of the subjects' spouses or relatives. They could be operating the family farm in partnership with each other. Their presence in the interview was, therefore, relevant particularly at the construct elicitation stage.

The interview commenced by first asking the subjects to describe their background information of their farms and their farm objectives. They were then shown a list of elements. Because the researcher was interested in focussing on heifer synchronisation,

the subjects were asked to indicate which particular category the innovation of heifer synchronisation be classified as (see Table 1 and Figure 2). If the subject has adopted the innovation, that innovation would be placed in the “adopted” category. The innovation would be placed in the “constrained” category if the subject did not adopt because of certain constraints. If the subject has earlier adopted the innovation but later decided to reject it, then the innovation would be placed in the “discontinued” group. If the subject did not adopt the innovation because s/he would still want to evaluate but still has an open mind about the innovation then it would be placed in the “wait-and-see” category.

Similarly, if the subject indicated that s/he would never adopt the technique for any reasons such as personal reasons or farm circumstances then the innovation would be classified in the “would never adopt” category. In other words, it was very unlikely that the subject would adopt the innovation. The same procedure applies to other types of innovations. The subjects were also asked to indicate some of the main reasons why certain innovation was placed in a particular category.

Once the subject has classified all the elements into the various groups the researcher then proceeded with the grid interview of eliciting the constructs using the computer version of the repertory grid technique of the RepGrid software programme.

4.7.3 Elicitation of constructs

The next part of the interview involved eliciting the constructs from the subjects. The subjects were introduced to the basic idea of a triadic comparison of construct elicitation and also the idea of the term “construct”.

To begin eliciting the constructs using the RepGrid software programme, the researcher clicked the “New Grid” button (Figure A2.3) and the “Triad” button (Figure A2.2) and a random selection of the three elements (innovations) appeared on the computer screen. Because the researcher was interested on how the subject construed heifer synchronisation, he would make sure that this innovation appeared in the triad. In other words, the main purpose was to explore the cognitive structures or constructs of the subject with respect to heifer synchronisation compared to other innovations. The subject was then asked to respond to the question which appeared at the top of the screen:

“In what way are two of the elements (innovations) alike and different from the third element?”

The subject was asked to pick and click on the innovation which was different from the two innovations. The next screen displayed a new construct which had two poles and had to be specified by the subject: (1) similarity between the two elements (the emergent pole) and (2) difference in this one (implicit pole). Essentially, the reason for the similarity and difference given by the subject provided the two poles of the construct (bipolar constructs). In other words, the distinction of why two innovations were similar and different from the third innovation was a construct. Once the subject had agreed to both labels of the construct, he was then asked to give an explanation as to why such a construct was selected. This explanation was tape recorded.

Using this construct, the subject was then asked to rate all the elements which appeared on the left side of the rating scale. (The rating scale was numbered from 1 to 9.). This was done by dragging the elements to the rating scale. Those elements which were not applicable to the construct were either not dragged to the rating scale or dragged but positioned at the centre of the scale. At this rating stage, the discussion was also recorded because the subject was also giving his reason(s) or explanation when giving the rating values to the elements.

During the triadic comparison the researcher was also given the opportunity to detect additional constructs by the subject. The researcher would then ask the subject to clarify the constructs(s). If the subject agreed that it was another construct the researcher would click the “Add” button to establish another construct and the same rating procedure would be done.

The subject would be asked to click the “Triad” button for several times to elicit more constructs until he had no other new construct produced. In other words, the subject had identified all the constructs he used to construe heifer synchronisation.

4.7.4 Repertory Grid Analysis

The final part of the interview involved presenting the subject the results of the FOCUS analysis. Because of the time factor the PrinCom and the Socio analyses were done by the researcher after the interview. However the general procedure of operating these two analyses will be described in this sub-section.

FOCUS analysis

The subject was first introduced to the FOCUS programme and told how his/her involvement in the analysis was important in terms of interpreting the correlation between the elements and between the constructs.

To proceed with the analysis, the researcher clicked the "FOCUS" button to display the focused grid. The subject was asked to give his interpretation and explanation with regard to the correlation between the elements or between the constructs that showed high matching percentage or correlation. This part of the interview was also tape recorded because the researcher was interested to explore the subject's attitudes not only to heifer synchronisation but also to other types of elements in the grid. The final part of the FOCUS analysis was done by the researcher after the interview. The researcher selected the "Text" button to produce the element and construct matching score values.

PrinCom analysis

The PrinCom algorithm spatially clustered the elements and constructs in a repertory grid and showed them in a graphical form. The principal components analysis described the principal or main components and also the correlations between the constructs and elements. The axis which appeared as a dotted line on the horizontal was called the first principal component and that on the vertical was the second principal component. A common theme was identified which was used to describe each of the components. In other words, using the PrinCom analysis, the research was attempting to establish some common patterns or similarities among the cases within the same group and also differences across the cases between the groups.

To begin with the PrinCom analysis, the researcher clicked the "PrinCom" option (see Figures A2.3 and A2.4) to display the PrinCom dialogue window. This served three

purposes: (1) to obtain the percentage of variance for the components, (2) to display the principal components, and (3) to identify the common theme for each of the components. The results of the Princom analysis of the grid were displayed in a graphical form showing the first and second principal components.

First, to obtain the percentage of variance for the components, the researcher unmarked the check box, *graph*, and then marked the check box, *text*, and *components* to obtain the percentage of variance attributable to these components. In this research the cut-off point used for the component was 25 per cent. In other words, those components which had the percentage of variance of 25 per cent or below would be excluded in the analysis. By using 70 per cent of this variance explained the analysis includes the main components because it was expected that it would be among these that it would be possible to identify similarities or differences between adopters and non-adopters.

Second, to display the principal components, the researcher marked the check box, *graph*, and specified the two axes, *horizontal* and *vertical* before clicking the "OK" button. The results of the PrinCom analysis of the grid were shown in a graphical form showing the first and second principal components. At the positive end of the first component, the researcher identified the construct labels and the elements which scored highly on this component. Similarly, at the negative end of the first component the researcher also identified the construct labels and the elements which scored highly on the component. The same procedure was applied to the second principal component if its percentage of variance was more than the cut-off point of 25 per cent.

Socio analysis

In this research, the Socio analysis was only used to examine similarities in the personal construct systems of individuals within. The results of the analysis were shown in a graphical output.

To begin with the analysis, the researcher clicked the "socio" option (see Appendix 2 Figures A2.3 and A2.5). The researcher marked the check box, *graph*, and the check button, *construct links*. A matching level of 70 per cent was used. By clicking the "OK" button the results were expressed in a graphical form represented by a socionet showing the construct links between the grids of individuals.

4.8 Summary

A conceptual model can be used to depict some categories of decision makers: the adopters and four groups of non-adopters. It is proposed that those individuals within a group have similar mental constructs and that between the groups are different. The objectives of this research were to explore and understand these mental constructs. Some innovations in dairying were chosen as elements but the main element used was heifer synchronisation. A computer version of the repertory grid technique, the RepGrid software programme, was used to elicit and analyse the mental constructs of the decision makers.

The next Chapter presents the detailed results of this research.

CHAPTER 5

RESULTS

5.1 Introduction

This chapter presents the summary of the RepGrid analysis of the grid interviews of twenty five dairy farmers using the RepGrid software programme. These farmers represented the two main groups of decision makers (adopters and non-adopters) in connection with their decisions to adopt or not to adopt the heifer synchronisation programme. Five subjects have adopted the programme and were still using it during the time of the interview. There were four groups of non-adopters: (1) "discontinued", (2) "wait-and-see", (3) "constrained" and (4) "would never adopt". Five subjects were also interviewed from each of the four groups of non-adopters.

This chapter, firstly, presents the summary of the RepGrid analysis of the adopters' constructs. Each subjects' constructs are presented, a comparison is then made between the subjects, and this comparison is supported by the results of a socio analysis which identifies the extent to which constructs are shared within the group. This procedure is then repeated for each of the groups of non-adopters. Finally, a summary of all results is given for each group. This includes a summary of constructs, a summary of the results of the focused grids, and a summary of the results of the principal components analysis. Detailed results and analysis for each subject are presented in Appendix 1.

5.2 Adopters' Constructs

A total of five dairy farmers who have adopted and are still using the heifer synchronisation technique were interviewed. This section presents a summary of the results of analyses of the repertory grids of these adopters.

5.2.1 Subject 3's Constructs

The RepGrid analysis has revealed three important constructs which are used by subject 3 to construe heifer synchronisation. These important constructs are: profitability, genetic gain, and workload. Subject 3 has revealed that dairy farming from his point of view or

experience involves a lot of time, hard work and pressure. For example, mating management of heifers involves a lot time and labour. However, he has identified a new innovation, heifer synchronisation, which can help overcome this pressure. He has indicated that it would help increase farm efficiency and hence farm profitability if this heavy workload or pressure can be reduced and time and labour can be saved.

5.2.2 Subject 5's Constructs

Subject 5 uses four construct dimensions to construe heifer synchronisation: genetic gain, profitability, convenience and workload. He believes that the heifer synchronisation programme, together with artificial insemination and herd testing, help increase the rate of genetic gain in the herd, which in turns increases farm profitability. He also describes the usefulness of using heifer synchronisation as reducing his workload, saving labour and time, and hence making the farm work more convenient.

5.2.3 Subject 6's Constructs

Subject 6 has displayed many important factors associated with heifer synchronisation which he believes are relevant to his decision to adopt and continue using the programme. These important factors are: ease of mating management, genetic gain, profitability, reduces workload and easy to use. Subject 6 believes that heifer synchronisation helps to increase the genetic gain in the herd, ease the mating management, and hence profitability. His experience using the programme also demonstrates that it is easy to use. It saves much time and labour and thus reduces farm workload. Consequently, it makes his farm operation more convenient, effective and profitable.

5.2.4 Subject 8's Constructs

Subject 8 has revealed four main factors or benefits in terms of his construing heifer synchronisation: genetic gain, reduces workload, ease of use, and profitability. He believes that heifer synchronisation would be able to give him a maximum use of high genetic quality with which to breed his herd replacements and that this is directly related to profitability. Subject 8 has also raised the importance of labour and time consumption

regarding the use of heifer synchronisation. He also indicates that the programme is easy to use. These four important factors regarding heifer synchronisation are not only what he believes to be true but also what he experiences to be practical in his farming system.

In other words, the use of heifer synchronisation makes his dairy farming operation more efficient, productive and profitable.

5.2.5 Subject 9's Constructs

Subject 9 has revealed three main construct dimensions in his construing of heifer synchronisation: genetic gain, profitability and ease of mating management. He believes that heifer synchronisation would be able to increase the genetic quality in the herd by making use of his own heifers. This would also allow him to improve his selection potential of replacement heifers, and hence profitability.

The subject also shows that heifer synchronisation allows him to manage the mating of his heifers more easily because they all calve at the same time. It also saves a lot of his time and labour. In other words, the subject has revealed the importance of time and labour saving and ease of management in relation to making the dairy operation much more efficient and profitable.

5.2.6 Summary of Adopters' Constructs

The five adopters of heifer synchronisation produced six constructs to construe the programme or in their decisions to adopt the programme (see Table 3). These constructs were: genetic gain, ease of mating management, profitability, reduces workload, convenience and easy to use. However, the three shared constructs used were: genetic gain, mating management and profitability. All the subjects mentioned that one of the long-term benefits of using the programme is its ability to increase the rate of genetic gain in the herd. They argued that the higher the genetic capability of the animals, the more profit they would give in relation to milk production. The programme would give them a greater nucleus from which to select their heifer calves, or more heifers to select from their breeding stock. The programme also allowed them to manipulate the calving pattern of their heifers so that most of them calved earlier and at the same time. They said some

Table 3: Summary of Adopters' Constructs

Subject no.	Construct dimension	Subject's perspectives on heifer synchronisation	Theme (derived from first principal component)
3	<ul style="list-style-type: none"> • Genetic • Profitability • Workload 	<ul style="list-style-type: none"> • Genetic gain • More profitable • Reduces workload (ease of mating management, save time, labour and effort) 	Genetic gain for profits
5	<ul style="list-style-type: none"> • Genetic • Workload • Convenience • Profitability 	<ul style="list-style-type: none"> • Genetic gain • Reduces workload (less cost & less hassle) • More convenient (ease of mating management) • More profitable (more milk and heifers for breeding stock) 	Genetic gain for profits
6	<ul style="list-style-type: none"> • Mating management • Genetic • Profitability • Workload • Ease of use 	<ul style="list-style-type: none"> • Ease of mating management • Genetic gain • More profitable • Reduces workload (save time) • Easy to use 	Genetic gain for profits
8	<ul style="list-style-type: none"> • Genetic • Workload • Ease of use • Profitability 	<ul style="list-style-type: none"> • Genetic gain • Reduces workload, ease of mating management (save time/labour & effort) • Easy to use • More profitable (genetic gain & calving management) 	Reducing workload for profits
9	<ul style="list-style-type: none"> • Genetic • Profitability • Mating management 	<ul style="list-style-type: none"> • Genetic gain • More profitable (genetic) • Ease of mating management (concentrate calving & save time) 	Genetic gain for profits
<p>Shared constructs: Genetic gain, ease of mating management and more profitable Others mentioned: Reduces workload, convenient and easy to use</p>			

of their heifers were grazing off-farm and at a distance away from the main property. They considered it was much more convenient and profitable to have their heifers calve earlier and at the same time. This means that they were able to do the work once, which reduced their workload and work pressure on their farms. Some of the subjects also mentioned that it was easy to use.

5.2.7 Socio Analysis of Adopters' Constructs

Figure 3 is the socionet displaying the graphical output of all the construct links between the five grids of adopters at 70 per cent matching level. At this matching level, all the five grids are connected to each other. The arrows indicate that at least 50% of the constructs match or correspond within the grids named at the end of the arrows. All the five grids are linked by four double headed arrows. As described in 5.2.6, the three shared constructs used by these subjects are: genetic gain, profitability and ease of mating management. This connection of the grids by the double headed arrows shows that these subjects used some shared constructs in their decisions to adopt heifer synchronisation. In other words, they have some common thoughts about the programme, and hence behaved in a similar way. The results from the socio analysis, therefore, support the findings of the observation made about the adopters.

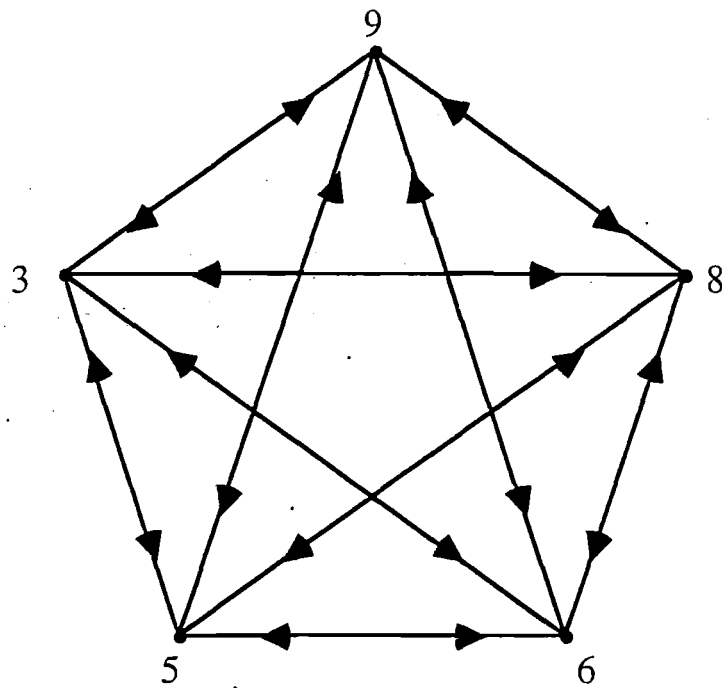


Figure 3: Socionet of adopters ✓
(Construct links at least 50% over 70.00)

5.3 “Discontinued” Constructs

This section presents a summary of the results of analyses of the repertory grids of the “Discontinued” non-adopters.

5.3.1 Subject 1’s Constructs

Subject 1 uses four construct dimensions to construe heifer synchronisation: farm objectives, cost, results and genetic improvement. The subject was not happy using the programme. The cost was high; the results were poor; there was no genetic improvement and he was not able to achieve his objectives. Hence, he decided to discontinue using the synchrony programme.

5.3.2 Subject 2

Subject 2 has displayed three construct dimensions in his construing of heifer synchronisation: financial constraint, high cost and no financial benefits. He has indicated that he has not enough capital to allow him to continue using the programme because he has used the money to buy an additional property for the family. He was not happy with the results because he did not achieve his objective.

5.3.3 Subject 4

Subject 4 has revealed three main construct dimensions in his construing of heifer synchronisation: cost, convenience and results. The subject has decided to discontinue using heifer synchronisation because it involves high cost, causes inconvenience, and shows poor results.

5.3.4 Subject 11’s Constructs

Subject 11 has shown five construct dimensions to construe heifer synchronisation: breeding, cost, objectives, results and convenience. Although he believes that heifer synchronisation is related to animal breeding in terms of the genetic improvement, he decided to discontinue using the programme. He was not happy because of the high cost

involved, the poor results and inconvenience and hence its ineffectiveness in achieving farming objectives.

5.3.5 Subject 12's Constructs

Subject 12 has displayed four construct dimensions in his construing of heifer synchronisation: animal breeding, financial returns, labour efficiency and cost. Although the subject believes that heifer synchronisation is associated with genetic improvement and calving management he decided to discontinue using the programme. He was not happy with the poor results he obtained. The cost was high and hence the financial return was poor.

5.3.6 Summary of "Discontinued" constructs

The five "discontinued" non-adopters produced five constructs in their construing of heifer synchronisation (Table 4). These constructs were: genetic improvement, high cost, poor results, not convenient and not able to achieve farm objectives. All the five non-adopters indicated that their original perception of heifer synchronisation was related to genetic improvement and ease of mating management in the herd.

However, because of some reasons they had decided to discontinue using the programme. There were two shared constructs used by all of them in their decisions to discontinue: poor results and high cost. All the subjects had indicated that, based on their experience, these two constructs were directly related to each other. They said that the exercise was expensive because the results they obtained were considered very poor, or the conception rate that they obtained was as low as 46 per cent. They had expressed their concern about these costs: (1) the purchase of drugs, CIDRs and the payment of the veterinary fees, (2) the transportation costs as these heifers were grazed off the farm, and (3) the payment of the additional labour needed to assist in the programme. The subjects argued that these costs were not justified because the conception rate they were getting was very poor.

The other constructs mentioned were the inconvenience of using the programme and its inability to enable them to achieve their farming objectives. Two subjects, subjects 4 and

Table 4: Summary of “discontinued” constructs

Subject no	Construct dimension	Subject’s perspective on heifer synchronisation	Theme (derived from first principal component)
1	<ul style="list-style-type: none"> • Achieving farm objectives • Cost • Results • Genetic - Income 	<ul style="list-style-type: none"> • Genetic improvement and mating management • Not achieving farm objectives (not intensive calving) • Expensive (heifers not in calf sold out) • Poor results (low conception and long spread calving pattern) • Not able to achieve genetic improvement (heifer did not conceive to AI/loss of genetic heifers) 	Effectiveness and achievement
2	<ul style="list-style-type: none"> • Financial constraint - Profit • Cost • Results 	<ul style="list-style-type: none"> • Genetic improvement and mating management • Financial constraint • High cost (low conception rate) • Poor results (spread calving pattern) 	profits and benefits
4	<ul style="list-style-type: none"> • Cost • Convenience • Results 	<ul style="list-style-type: none"> • Genetic and mating management • High cost (low conception rate) • Not convenient (distance/labour) • Poor results (long calving pattern) 	Convenience, effectiveness and achievement
11	<ul style="list-style-type: none"> • Animal breeding • Cost • Objectives • Results • Convenience 	<ul style="list-style-type: none"> • Genetic improvement and calving management • Costly (time & labour) • Not able to achieve objectives • Poor results (low conception rate) • Not convenient (distance, time & labour) 	Effectiveness and convenience in achieving farm objectives
12	<ul style="list-style-type: none"> • Animal breeding - Pasture production • Financial returns • Animal breeding - Labour efficiency • Cost 	<ul style="list-style-type: none"> • Animal production (genetic improvement) • Poor returns (less replacement heifer calves) • Animal production (calving management of heifers) • High cost (poor results) 	Achievement from good returns
<p>Shared constructs: High cost and poor results Other constructs mentioned: Not convenient and not able to achieve objective</p>			

11, indicated that heifer synchronisation was not convenient to use. Their heifers were grazed at some distance from the main property, and they had had to make a few trips to the grazing area to administer the programme. Subjects 11 and 12 had expressed their deep concern about their experience because they were not able to achieve their objectives of increasing the conception rate in the herd, and hence an increase in farm income. Their original perception was that by using such programme they would be able to increase their income. However, the results or the conception rate they obtained through such a programme was well below their expectation.

In summary, the “discontinued” non-adopters were unhappy with their bad experience of using heifer synchronisation. They construed that it was not effective in terms of achieving their farm objectives.

5.3.7 Socio analysis of Discontinued constructs

Figure 4 is the socionet which displays the graphical output of all the construct links between the five grids of “discontinued” non-adopters at 70 per cent matching level. At this matching level all these five grids are connected by a double headed arrow. There are two possible explanations for this based on the types of constructs they used to construe the programme. Firstly, as described in 5.3.6, all the five non-adopters believed that heifer synchronisation was related to genetic improvement and ease of calving management in the herd. However, they had decided to discontinue using the programme. Secondly, there were two shared constructs which were used by the five subjects in their decisions to discontinue using such a programme: poor results and high cost. This double headed arrow shows that these subjects have used these same constructs in their view of heifer synchronisation. This shows that the individuals in this group shared similar ideas or thoughts about heifer synchronisation and hence behaved in a similar way. These results from the socio analysis, therefore, support the findings of the observation made about the “discontinued” non-adopters.

5.4 “Wait-and-See” constructs

This section presents a summary of the results of analyses of the repertory grids of the “Wait-and-See” non-adopters.

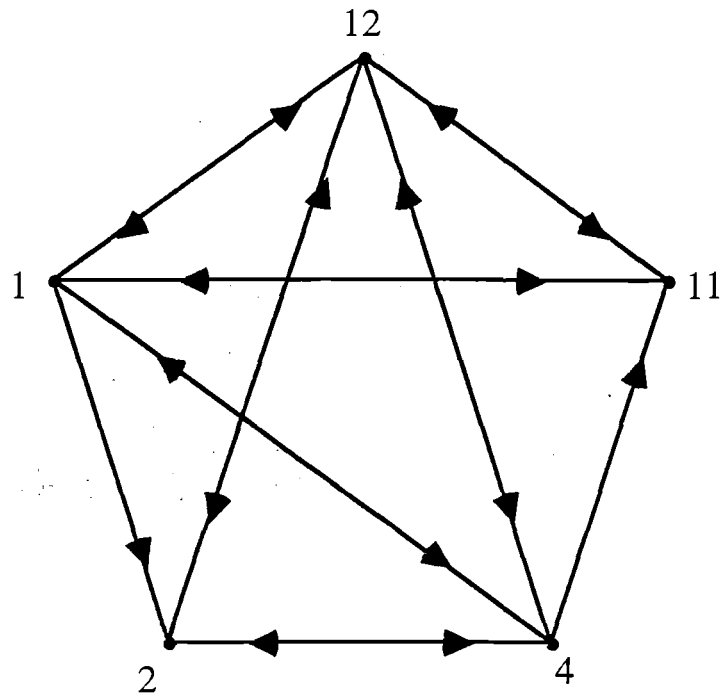


Figure 4: Socionet of "discontinued" non-adopters
(Constructs link at least 50% over 70.00)

5.4.1 Subject 10

Subject 10 has shown five construct dimensions in his construing of heifer synchronisation: reproductive trait, cost, results, experience and calving management. The subject is aware of the functions and uses of heifer synchronisation. However, he still has some concern about other factors associated with it: high cost, poor results and inexperience. He feels that the cost is still high; the results are not satisfactory and that he needs to have some practical experience in handling the programme.

5.4.2 Subject 13's Constructs

Subject 13 has used four main construct dimensions to construe heifer synchronisation: genetic gain, labour, calving management and cost. The subject is aware of the importance and uses of heifer synchronisation. However, because of his concern over its cost, time and labour needed he decided to have a "wait and see" attitude towards it.

5.4.3 Subject 17's Constructs

Subject 17 has shown four construct dimensions in his construing of heifer synchronisation: usefulness, genetics, time and cost. Although the subject was aware that heifer synchronisation was related to genetic improvement, he would prefer to have a "wait-and-see" attitude towards it because he was still concerned about its usefulness, cost and the time available to do the exercise.

5.4.4 Subject 19's Constructs

Subject 19 has displayed three construct dimensions to construe heifer synchronisation: familiarity, importance and the cost. Subject 19 is aware of the importance of heifer synchronisation. However, because he was not familiar with the programme he considers it is less important to him. It is more expensive to use too.

5.4.5 Subject 22's Constructs

Subject 22 has shown three construct dimensions used to construe heifer synchronisation: necessity, cost and breeding. The subject is aware that heifer synchronisation is connected to breeding and genetic improvement in the herd. He says because he considers that the need is not there, and that he has another cheaper option available, there is no need to use heifer synchronisation. However, the subject still has a "wait-and-see" attitude towards the programme.

5.4.6 Summary of "Wait-and-See" constructs

Although the five "wait-and-see" non-adopters were aware that heifer synchronisation was related to genetic improvement and ease of mating management, they did not consider that these two constructs were important. Some other constructs were more important (see Table 5 for the summary of the constructs). There were two shared constructs mentioned: high cost and poor results. Other constructs mentioned by some other individuals were: lack of experience, hassle, not familiar and no necessity. The subjects were concerned about the costs of drugs, CIDRs, payment of veterinary fees and transportation costs. They were also concerned about the poor performance of the programme. Some individuals also indicated that they had a lack of experience in handling the programme. Others mentioned that it would create a lot of hassle because their heifers were off the main property.

5.4.7 Socio analysis

Figure 5 are the socionets which display the graphical output of all the construct links between the five grids of the "wait-and-see" non-adopters at 70 per cent matching levels. The socio analysis indicated that all the five grids of individuals were connected by double headed arrows. The results showed that these individuals have some shared constructs or common thoughts about heifer synchronisation and hence showed similarity in their behaviour. The results, therefore, support the findings of the observation made about the "wait-and-see" non-adopters.

Table 5: Summary of “Wait-and-See” constructs

Subject no.	Construct dimension	Subject’s perspective on heifer synchronisation	Theme (derived from first principal component)
10	<ul style="list-style-type: none"> • Reproductive trait • Cost • Results • Experience • Calving management 	<ul style="list-style-type: none"> • Genetic improvement and calving management • High cost (materials and low conception rate) • Poor results (low conception rate) • Lack of experience • Manipulate cows at calving (mating management of heifers) 	High cost and ineffective
13	<ul style="list-style-type: none"> • Pasture management - genetic gain • Time and labour • Calving management • Cost 	<ul style="list-style-type: none"> • Genetic gain (poor results) • More time and labour (hassle) • Calving management (calve earlier) • High cost (transportation and unexpected poor results) 	Genetic gain but expensive
17	<ul style="list-style-type: none"> • Usefulness • Genetic • Time • Cost 	<ul style="list-style-type: none"> • Not useful at present (hassle) • Genetic improvement and ease of mating • Shortage of time • Expensive (if not in calf or poor results) 	Usefulness of time
19	<ul style="list-style-type: none"> • Familiarity • Importance • Cost 	<ul style="list-style-type: none"> • Genetic and ease of mating • Not familiar (not in detailed). Heard negative things about synchronisation • Least important (facilities, labour & hassle) • Expensive (drugs, poor results or low conception) 	Familiarity, cost effectiveness and importance
22	<ul style="list-style-type: none"> • Necessity • Cost • Animal feed - breeding 	<ul style="list-style-type: none"> • No necessity because those heifers already mated sent to graziers • High cost (drugs & if results poor) • Genetic and calving management • Not ready yet because cheaper option available 	Expensive and unnecessary
<p>Shared constructs: High cost and poor results Others mentioned: Lack of experience, hassle, not familiar and no necessity</p>			

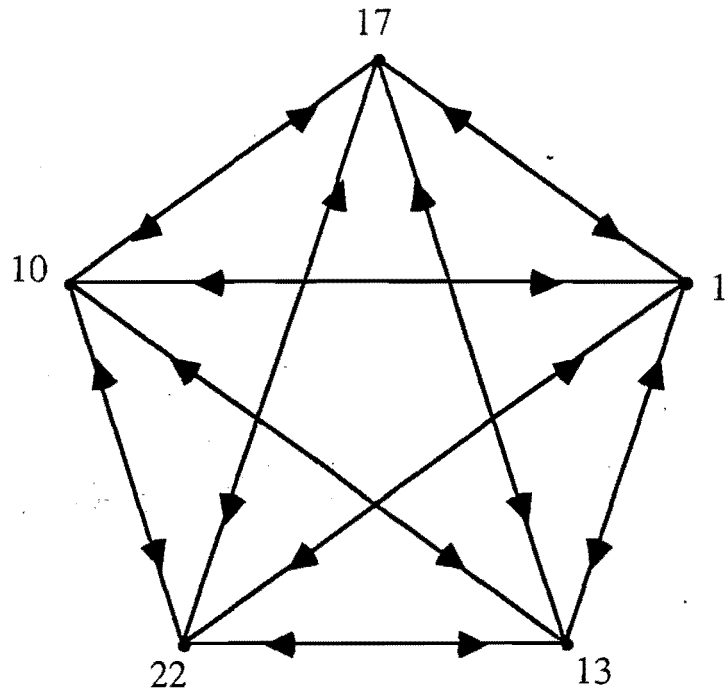


Figure 5: Socionet of "wait-and-see" non-adopters
(Construct links at least 50% over 70.00)

5.5 “Constrained” constructs

This section gives a summary of the analyses of the repertory grids of the ‘Constrained’ non-adopters.

5.5.1 Subject 15’s Constructs

Subject 15 has revealed four constructs in his construing of heifer synchronisation: genetics, time-consuming, lack of facilities and poor results. Subject 15 is aware of the significance and uses of heifer synchronisation. However, because of the constraints of time, facilities and his deep concern about the poor success rate, the subject did not consider adopting heifer synchronisation was desirable.

5.5.2 Subject 16’s Constructs

Subject 16 has shown five construct dimensions in his construing of heifer synchronisation: breeding, calving management, success rate, cost and distance. Subject 16 is fully aware on the use of heifer synchronisation. However, because of some constraints, he has decided not to adopt. These important constraints include high cost, poor results, and shortage of time and labour.

5.5.3 Subject 18’s Constructs

Subject 18 has revealed five constructs in his construing of heifer synchronisation: no direct gain, no interest, no benefit, genetic gain and poor results. Although the subject is aware of the benefits of the programme with regard to increasing in the rate of genetic gain and calving improvement, he has not adopted such a programme because of some constraints. At present he is more concerned about improving his pasture and soil fertility compared to genetic improvement or calving management of his heifers. He is happy with the existing procedure and the results of his animal breeding programme. He has no interest in using heifer synchronisation at the moment, because he considered there is no direct gain for him. He is concerned about the existing constraints: poor success rate, lack of time and money. He said his priority was to improve his soil and pasture quality on his farm

5.5.4 Subject 21's Constructs

Subject 21 has revealed four construct dimensions he used to construe the innovations which also include heifer synchronisation: breeding, feed, convenience and cost. However, he used three major constraints in his decision not to consider heifer synchronisation. These constraints are: (1) shortage of feed, (2) inconvenience of use, and (3) high cost.

5.5.5 Subject 25's Constructs

Subject 25 has revealed four construct dimensions to construe heifer synchronisation: labour, breeding, cost and facilities. The subject was aware of the uses of heifer synchronisation. However, he chose not to adopt because of the constraints of labour and good facilities needed for the programme.

5.5.6 Summary of "Constrained" constructs

Even though the five "constrained" non-adopters were aware that heifer synchronisation was related to genetic improvement and ease of mating management, they did not consider these two factors as important. They did not adopt because of some constraints: labour intensive/time consuming, high cost, poor results, and lack of facilities (see Table 6 for the summary of the constructs used).

There were two shared constructs used in their decisions not to adopt: high cost and labour intensive/time consuming. First, the programme was labour intensive or time-consuming. Two subjects (subjects 18 and 21) used different terms to construe heifer synchronisation but refer to the same meaning associated with labour. For example, subject 21 indicated that heifer synchronisation was not convenient for him because it would create a lot of pressure and hassle for him. His heifers were grazing off the farm and a lot of procedures and preparations were used. Subject 18 described heifer synchronisation as no direct gain to him because it needed a lot of time, money and effort. In other words, all of them were indicating labour and time as their major constraints in their decision not to adopt such a programme.

Table 6: Summary of “Constrained” constructs

Subject no.	Construct dimensions	Subject’s perspective on heifer synchronisation	Theme (derived from first principal component)
15	<ul style="list-style-type: none"> • Genetic • Time • Facilities • Results 	<ul style="list-style-type: none"> • Genetic improvement and calving management • Time consuming and low conception rate • Not able to provide facilities (cattle yard) • Poor success rate (poor results and high cost) 	Time and facilities for farming success
16	<ul style="list-style-type: none"> • Feed requirement • Calving management • Success rate • Cost • Distance 	<ul style="list-style-type: none"> • Calving and genetic improvement • Calving management • Variable success rate (unreliable results) • Expensive (drug, time/labour and if results poor) • More labour and time (distance from grazier’s area) 	Cost and certainty of results
18	<ul style="list-style-type: none"> • Gain • Interest • Benefit • Genetic gain • Results 	<ul style="list-style-type: none"> • Genetic gain and calving management • No direct gain (time, effort and money for other important innovations) • No interest (less priority) • Less beneficial (quite happy with existing innovations) • Poor success rate 	Cost, gain and benefits
21	<ul style="list-style-type: none"> • Breeding - Feeding programme • Feed • Convenience • Cost 	<ul style="list-style-type: none"> • Genetic and calving • Feed constraint • Not convenient/high cost (time, labour and hassle) • Costly (drugs & poor results) 	Costs and convenience relevant to pasture management and animal breeding
25	<ul style="list-style-type: none"> • Labour • Animal breeding - Leasing of cows • Cost • Facilities 	<ul style="list-style-type: none"> • Labour intensive (handling and hassle) • Genetic and calving • Expensive (drugs and labour) • Cannot afford facilities (yards) 	Cost and facilities
<p>Shared constructs: High cost and labour intensive/time consuming Others mentioned: Poor results (unreliable) and lack of facilities</p>			

Second, the programme was expensive to use. All the five subjects indicated that heifer synchronisation was expensive to use because the conception rate was considered as low. The subjects argued that if the conception rate was low, they would not be able to recover all the initial costs used in the programme.

Other constructs mentioned by some other individuals were: poor results and lack of facilities. The poor success rate produced by the programme was also an important construct used not to adopt the programme. Three subjects (15, 16 and 18) indicated that the programme has a variable success rate or very poor. They learned from various sources of information that the conception produced from the programme was very low and no better than those from natural mating by the bulls. This was also an important constraint in the decision not to adopt such a programme.

The other important construct mentioned is the problem of providing adequate facilities for the programme. Three subjects (15, 21 and 25) described the provision of good yard facilities and sufficient feed were also major constraints related to the adoption of heifer synchronisation. They argued that because the programme involved handling of a large number of animals at one time, that would mean that good yard facilities or sufficient feed has to be made available. They said that they could not afford all these facilities.

Another subject was also concerned about the programme because there was no direct financial gain obtained. He would prefer to put his money, time and energy to do other farm work which he considered would give a direct financial benefit such as improving the soil fertility and pasture.

In summary, the "constrained" non-adopters have identified several constructs or constraints which they construed as the main reasons for not adopting heifer synchronisation. These constructs were related to cost, poor results and lack of facilities.

5.5.7 Socio analysis

Figure 6 is the socionet showing the construct links between the five grids of “constrained” non-adopters at 70 per cent matching level. At this matching level all these five grids of “constrained” non-adopters were connected by a double headed arrow. As described in 5.5.6, the five “constrained” non-adopters were all aware that heifer synchronisation was related to genetic gain and ease of mating management but had decided not to adopt. They used two shared constructs in their decisions not to adopt: high cost and labour intensive/time consuming. Other constructs mentioned were: poor results and lack of facilities. This explains why the grids are connected by a double headed arrow. These individuals have expressed some common thoughts about heifer synchronisation and behaved in a similar way. The results, therefore, support the findings of the observation made about the “constrained” non-adopters.

5.6 “Would Never Adopt” constructs

This section presents a summary of the analyses of the repertory grids of the “Would Never Adopt” non-adopters.

5.6.1 Subject 7’s Constructs

Subject 7 has revealed three constructs used to construe heifer synchronisation: high cost, poor result and complexity. The subject considers that heifer synchronisation is not important to him because of high cost, poor results and complexity of use on his farm. He prefers to have a technology which is simple to use, more cost effective, and producing good results.

5.6.2 Subject 14’s Constructs

Subject 14 has revealed four constructs he used to construe heifer synchronisation: mating management, breeding, relevance and advantage. Subject 14 has shown that innovations which are not relevant and not applicable will not be introduced on his farm.

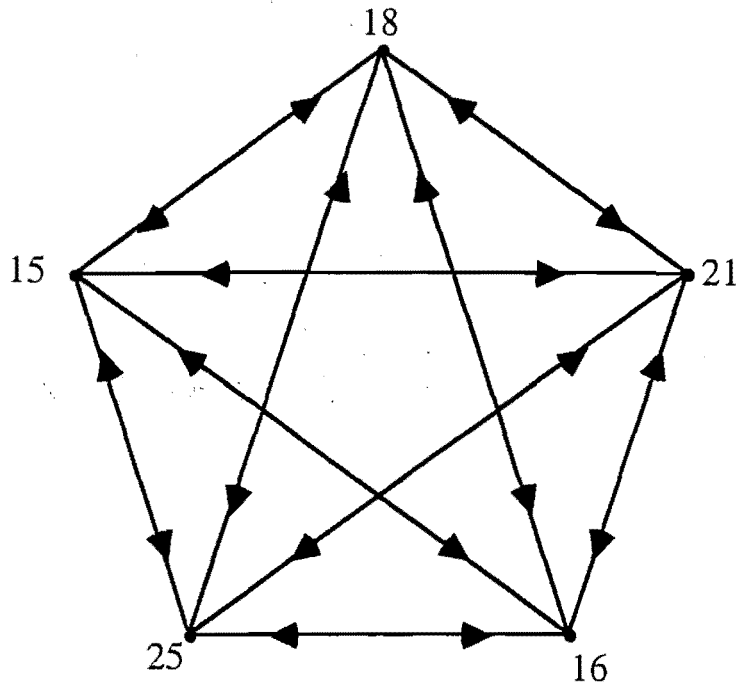


Figure 6: Socionet of "constrained" non-adopters
(Construct links at least 50% over 70.00)

5.6.3 Subject 20's Constructs

Subject 20 has revealed three important constructs used to construe heifer synchronisation: no need, no benefit and not useful. The subjects says there is no need of heifer synchronisation on his farm. It is not useful and hence of no benefit to him. He feels very contented with his present working style on the farm and considers there is no need for change.

5.6.4 Subject 23's Constructs

Subject 23 has revealed three construct dimensions he used to construe heifer synchronisation: not important, not relevant and hassle. The subject considers that heifer synchronisation is not important and irrelevant on his farm. It would cause a lot of hassle or increase work pressure and hence not beneficial to him. Because of farm circumstances he considers he would never adopt heifer synchronisation on his farm.

5.6.5 Subject 24's Constructs

Subject 24 has revealed three construct dimensions used to construe the heifer synchronisation: no need, risky and labour intensive. The subject has indicated that there is no need for heifer synchronisation on his farm. The risk of feed shortage for the animals is very high and it demands a lot of labour. He considers he would never adopt such an innovation on his farm.

5.6.6 Summary of "Would Never Adopt" Constructs

The five "Would Never Adopt"-non-adopters were aware that heifer synchronisation was related to genetic gain and ease of mating management. However, they did not consider these two factors were important to them. Some of the constructs mentioned in their decisions not to adopt were: not relevant/no need, complicated, hassle, costly, risky and poor results. (Please refer to Table 7 for the summary of the constructs used.)

One shared construct which was used by all the subjects in their decisions not to adopt the programme was: not relevant or no need. The subjects indicated that the programme

Table 7: Summary of “Would Never Adopt” constructs

Subject no.	Construct dimensions	Subject's perspective on heifer synchronisation	Theme (derived from first principal component)
7	<ul style="list-style-type: none"> • Cost • Results • Ease of use 	<ul style="list-style-type: none"> • Genetic gain and calving management • Costly (drugs & no justification for small number heifer calves) • Poor results (low conception and no benefit) • Complicated (time, facilities & less effective) 	Cost effectiveness and simplicity
14	<ul style="list-style-type: none"> • Pasture management - mating of heifer • Pasture management - breeding programme • Relevancy • Advantage 	<ul style="list-style-type: none"> • Ease of mating of heifers • Genetic and calving management • Not relevant (town supply farmer) • No advantage (not applicable because town supply farmer) • Existing system is equally good 	Relevance and applicability
20	<ul style="list-style-type: none"> • Need • Benefit • Usefulness 	<ul style="list-style-type: none"> • Genetic gain & calving management • No need for change (heifers get in calf earlier than synchronisation). Synchronisation is no better than the existing method used. • No benefit (extra work/labour and more pressure). • Not useful (Preferred own style of working on farm. Preferred to work slowly and quietly). 	Utility and benefits
23	<ul style="list-style-type: none"> • Importance • Relevancy • Hassle 	<ul style="list-style-type: none"> • Genetic gain & calving management • Less important (not keeping large number of replacement calves) • Not relevant (more pressure on grazing) • More hassle (pressure, labour and preferred to work in slow pace and in stages) 	Relevance and simplicity
24	<ul style="list-style-type: none"> • Need • Risk • Labour 	<ul style="list-style-type: none"> • Genetic gain & calving management • No need (distance, time & pressure on feed supply) • High risk of feed shortage • Labour intensive (work pressure) 	Need and relevancy
<p>Shared constructs: Not relevant/no need Others mentioned: Complicated, hassle, costly, risky and poor results</p>			

was not relevant or they considered there was no need for the programme because it did not fit into their farming systems. Some mentioned that the programme was only relevant to seasonal suppliers of milk and not applicable to town milk suppliers. Others indicated that there was no need for heifer synchronisation on their farms because they preferred not to change their existing style of working quietly and slowly with less pressure. They said they were happy with their existing farm performance. They considered heifer synchronisation was not applicable and no better than their existing system of putting bulls over their heifers.

Four subjects (subjects 7, 20, 23 and 24) used four different constructs respectively: costly, no benefit, more hassle and labour intensive. They were all referring to the aspect of cost. They had indicated that heifer synchronisation was labour intensive or created a lot of hassle which they considered very expensive.

Two subjects (subjects 7 and 24) indicated that heifer synchronisation would need good facilities such as yard and grazing (feed). Subject 24 indicated that heifer synchronisation would create a high risk of feed shortage due to calving a large number of animals at one time.

In summary, because of their farm circumstances, the subjects indicated that heifer synchronisation was not applicable or not needed on their farm.

5.6.7 Socio analysis of “Would Never Adopt” Constructs

Figure 7 is the socionet showing the construct links between the five grids of “would never adopt” non-adopters at 70 per cent matching level. At this matching level all these five grids of “would never adopt” non-adopters were connected by a double headed arrow. This shows that these individuals have some common ideas or thoughts about heifer synchronisation and hence behaved in a similar manner. The results from the socio analysis, therefore, corroborate with the findings of the observation made about the “would never adopt” non-adopters.

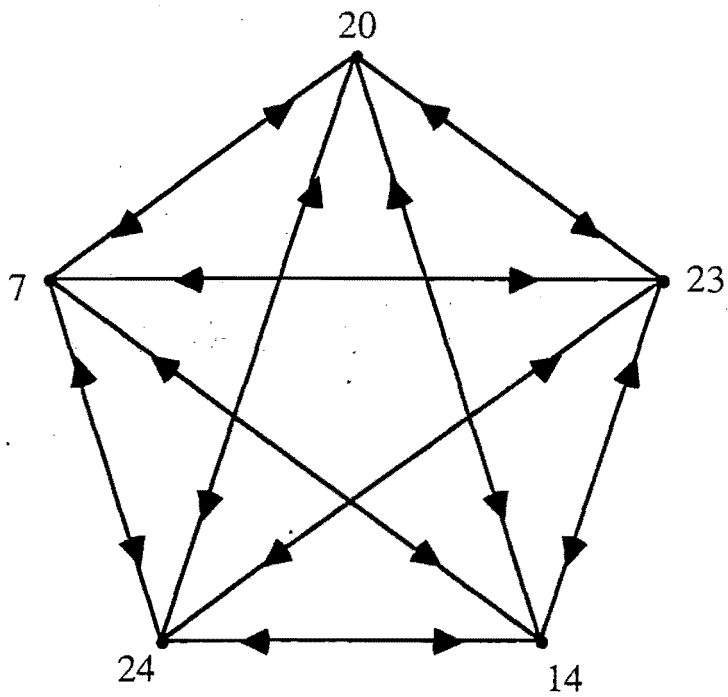


Figure 7: Socionet of "would never adopt" non-adopters
(Construct links at least 50% over 70.00)

5.7 Summary of all Results for each Group of Decision Makers

Adopters

1. The adopters produced six constructs to construe heifer synchronisation in their decisions to adopt: genetic gain, ease of mating management, profitability, reduces workload, convenience and easy to use. There were three shared constructs used by the adopters: (1) genetic gain, (2) ease of mating management and (3) profitability. They said that there were both long- and short-term benefits in using the programme. The long-term benefit was its ability to increase the rate of genetic gain in the herd and hence milk production and farm profitability. The short-term benefit was that it provided ease of mating management through synchrony mating of the heifers and artificial insemination so that a high percentage of them would calve earlier (concentrated calving pattern) instead of having them calve right through the calving season. The subjects indicated that because their heifers were grazed off-farm the programme gave them a lot of convenience and hence reduced their workload on the farm. They also said that it was easy to use without much technicalities involved.

2. The focused grids of the adopters showed that, generally, heifer synchronisation was linked to artificial insemination and herd testing. According to the subjects these innovations were all related to animal breeding or improving the genetic quality in their herd. Other important cluster of elements includes: use of nitrogen fertiliser, feed budgeting, travelling irrigator and moisture probe testing. The adopters indicated that these innovations were clustered because they were all important and related to pasture or feed management.

3. The adopters of heifer synchronisation have adopted more innovations displayed to them. Some of these innovations were: heifer synchronisation, artificial insemination, herd testing, use of nitrogen fertiliser, travelling irrigator, and dairy heifer grazing.

4. The adopters have not adopted a few of the innovations displayed to them. Some of these innovations were: embryonic transfer, moisture probe testing, and rotary cowshed.

5. Using the PrinCom analysis, the common theme generated from these constructs is “genetic gain for profits” and that heifer synchronisation loads heavily on the first principal component. In other words, the synchrony programme is important to all the subjects because it contributes to achieving their objectives of increasing profitability through genetic gain and ease of mating management in the herd. The results from the socio analysis showed that all the five adopters’ grids were connected by double headed arrows. This shows that they have some shared constructs in their decision to adopt heifer synchronisation. In other words, they have some common thoughts and behaved in a similar manner.

“Discontinued” non-adopters

1. The “discontinued” non-adopters produced five constructs to construe heifer synchronisation: genetic gain, high cost, poor results, not convenient and not able to achieve farm objectives. They had received the information about heifer synchronisation as related to genetic gain, ease of mating management and hence profitability before they made their decisions to adopt. However, after experiencing it for a few years, they had decided to reject the programme and this research has identified two shared constructs used by the subjects in their decisions to reject the programme: (1) poor results and (2) high cost. The subjects claimed that based on their experiences the results obtained from synchronisation were considered as poor. Firstly, the conception rate was very low, as low as 40 per cent. Secondly, the programme still produced a spread calving pattern instead of a concentrated pattern. Because the results obtained were poor, the subjects then indicated that the costs involved in the programme were also high.

Some subjects also indicated that because their heifers were grazed off-farm the programme was not convenient to use. They had to travel some distance from their farms which caused a lot of inconvenience. They regarded this as labour-intensive and time-consuming. The subjects also saw that the programme did not help them achieve genetic improvement in the herd because they claimed that their heifers did not conceive to artificial insemination. They said that they had lost their genetically superior heifers because the heifers which were not in calf had to be sold.

2. The focused grid showed that, generally, the non-adopted innovations were located together as one group. Heifer synchronisation was generally linked to embryonic transfer which was not adopted. According to the subjects, they were linked because both were related to genetic improvement, but were not adopted because of the high costs involved.

However, the adopted innovations seemed to show a better linkage between them. For example, soil testing, feed budgeting and use of nitrogen fertiliser were generally linked to each other. The subjects indicated that these innovations were related because they were important to pasture or feed management. Other classes of adopted innovations which were linked were artificial insemination and herd testing. The subjects mentioned that they were related because both were connected to animal breeding or improving the genetic gain in the herd.

3. "Discontinued" non-adopters did not adopt a larger number of innovations displayed to them. Some of the innovations which are not currently adopted include: heifer synchronisation, embryonic transfer, and moisture probe testing.

4. The group has adopted only a few of the innovations displayed to them. Some of these innovations were: artificial insemination, herd testing, use of nitrogen fertiliser, travelling irrigator, soil testing and dairy heifer grazing. However, there were other individuals in the group which have also not adopted these innovations.

5. Using the PrinCom analysis the common theme generated from these constructs is related to "achievement" and that heifer synchronisation loads heavily on the first principal component. In other words, although the subjects had earlier been informed that the main objectives of using heifer synchronisation were related to genetic gain and ease of mating management, they had decided to reject because they could not achieve these objectives. The socio analysis indicated that all these five grids of non-adopters were connected to each other. This shows that the individuals in this group have shared common ideas and thoughts about the innovation and hence behaved similarly to each other.

“Wait-and-See” Non-adopters

1. The “wait-and-see” non-adopters have thought about heifer synchronisation. However, they had decided not to adopt by showing a “wait-and-see” attitude towards the programme for several reasons. The research has identified seven constructs produced by the group to construe heifer synchronisation: genetic improvement, high cost, poor results, lack of experience, hassle, not familiar and no necessity.

All the subjects were aware that heifer synchronisation was related to genetic gain and ease of mating management of heifers. The short-term benefit of having a synchrony mating of these heifers was to condense their calving patterns so that they would calve as early as possible. However, despite these potential benefits the subjects had decided not to adopt but preferred to have a “wait-and-see” attitude towards it. The subjects used two shared constructs in their decisions not to adopt: high cost and poor results. The subjects had expressed their deep concern about the high costs involved in the programme. These costs include: the purchase of drugs and CIDRs, the payment of veterinary fees and transportation costs. The subjects were also concerned about the poor results obtained from the programme which could also escalate the costs. In other words, they are very concerned that the capital or money invested in adopting heifer synchronisation would not result in any benefits to them.

Some subjects also indicated that they had lack of practical experience or were not familiar with the details of the programme and had also heard about some negative aspects of the programme because young heifers were artificially manipulated. Their heifers were away from their main farms and they considered the programme would involve a lot of labour and time and hence would create a lot of hassle. However, despite all these factors associated with heifer synchronisation this group of non-adopters has preferred to have a “wait-and-see” attitude towards the programme.

2. The focused grids of this group showed that the non-adopted innovations were generally located in one group and the adopted in the other group. Some classes of the adopted innovations were related to each other. For example, herd testing and artificial insemination were generally linked to each other but not to heifer synchronisation. Others include use of nitrogen fertiliser and feed budgeting.

3. The “wait-and-see” non-adopters have adopted about half of the innovations displayed to them. Some of these adopted innovations were: herd testing, artificial insemination, inducing cows to calve and use of nitrogen fertiliser.
4. The group has also not adopted about half of the innovations displayed to them. These innovations include: embryonic transfer, moisture probe testing and leasing of dairy cows.
5. Using the PrinCom analysis, the common theme that would best describe their behaviour is related to “cost” and that heifer synchronisation loads heavily on the first principal component. They are concerned about the perceived high costs involved in the programme. The costs were expected to be higher if the results were poor. Some of the subjects had indicated their lack of familiarity and experience with the programme. The socionet also shows that all these five grids were closely linked to each other and hence behaved in a similar manner.

“Constrained” Non-adopters

1. The “constrained” non-adopters have thought about heifer synchronisation. However, because of certain constraints they had decided not to adopt. The research has identified five constructs used by these non-adopters to construe the programme: genetic improvement, high cost, labour intensive/time consuming, poor results and lack of facilities. The individuals were all aware of the potential benefits from the programme: genetic improvement and ease of calving management. However, because of some constraints which they considered as important, they decided not to adopt. The subjects used two shared constructs which constrained them in their decisions not to adopt: high cost and labour intensive/time consuming. They considered the drugs, CIDRs and payment of veterinary fees were expensive. They had also indicated that the results from the programme were unreliable and this would cause the costs to increase too. The subjects also indicated that most of their heifers were grazing off-farm away from their main farms. Because of the distance involved, they considered mating of these heifers using the synchrony programme would be very labour intensive and time consuming and hence created a lot of hassle. Some others also indicated that they could not afford to

provide facilities, such as yard and pasture which also constrained them from using the programme.

2. Their focused grids also showed that the non-adopted innovations were located in one group and the adopted ones in the other group. Some classes of the adopted innovations were related to each other. For example, herd testing and artificial insemination were generally closely linked to each other because both were related to genetic improvement in the herd but were not connected to heifer synchronisation. Other classes of innovations which were linked were: use of nitrogen fertiliser, feed budgeting, moisture probe testing and ME testing. They were related to feed management.

3. The group has adopted about half of the innovations displayed to them. Some of these innovations were: herd testing, artificial insemination, use of nitrogen fertiliser, feed budgeting, and dairy heifer grazing. Herd testing and artificial insemination were generally linked to each other. Similarly, use of nitrogen fertiliser and others were also linked to each other.

4. The group has also not adopted about half of the innovations displayed to them. Some of these innovations were: leasing of dairy cows, embryonic transfer, borderdyke irrigation and the rotary turnstyle cowshed. Some of them were closely linked to each other, such as embryonic transfer and heifer synchronisation.

5 Using the PrinCom analysis the common theme produced from their constructs is related to "cost" and that heifer synchronisation loads heavily on the first principal component. In other words, the subjects were constrained by the cost involved in implementing the programme. These costs were varied: purchase of drugs and CIDRs, payment of veterinary fees, cost of facilities, such as yards and pasture, and the time and labour required to implement the programme. The uncertainty of the results was also perceived as costly by the subjects. The socio analysis also indicated that all the five grids were closely linked to each other. This shows that the individuals in this group have some common ideas and thoughts about the innovation and hence behaved similarly to each other.

“Would Never Adopt” Non-adopters

1. The “would never adopt” has produced seven constructs to construe heifer synchronisation: genetic gain, no need, hassle, costly, complicated, risky and poor results. This group was aware of the information that heifer synchronisation was related to increasing the rate of genetic gain, and synchrony mating of heifers to earlier calving. However, despite this awareness of these potential benefits, the group had decided not to adopt or were unlikely to adopt such a programme for several reasons.

The group has used one shared construct in their decisions not to adopt or being unlikely to adopt such a programme: not relevant. Other similar terms used were: no need, no advantage, not useful and less important in their farming systems. The subjects in this group of non-adopters, unlike those in the other groups of non-adopters, did not show a clear indication that they had evaluated the cost and results of heifer synchronisation except for one subject. In this case, subject 7 seemed to indicate that he had evaluated the costs and benefits thoroughly before making the decision not to adopt. For example, he used three constructs in his decisions not to adopt: costly, poor results and complicated. Although he was aware that the programme was related to genetic gain and mating/calving management he had decided not to adopt because of the perceived high costs, poor results and complexities associated with the programme. He said that there was no justification to use the programme because he did not keep a large number of replacement calves; he considered the small number of heifer calves produced did not justify the expense of using such a programme. He iterated that with these constructs it would be very unlikely that he would adopt heifer synchronisation in future.

The other four subjects did not seem to show clearly that they had evaluated the costs and benefits of using the programme. They seemed to be very defensive or blunt in their decisions not to adopt. One subject mentioned that such programme was not relevant or not applicable because he was a town milk farmer and has been allocated certain quota to supply milk throughout the year. Others considered there was no need for change because the present performance of their heifers was considered better than or equal to those in the programme. Some have indicated that the programme could create a lot of hassle and high risk. It could create a lot of hassle because of the distance, time and labour involved. They would prefer not to change their existing work style which has less

pressure, quiet, simple and a slow pace. Others considered the programme has a high risk of feed shortage because of the large number of animals involved.

2. The non-adopted innovations were generally located in one group and those adopted ones were in another group. One class of non-adopted innovations which were generally linked were heifer synchronisation and embryonic transfer but were not linked to herd testing and artificial insemination. According to the subjects, heifer synchronisation and embryonic transfer were related to genetic improvement but were not adopted because they were not needed on their farms. The adopted innovations seemed to indicate a better matching between them. For example, use of nitrogen fertiliser, dairy heifer grazing and artificial insemination were closely linked to each other. They were related to animal feeding and breeding.

3. The group has adopted less than half of the innovations displayed to them. Some of these innovations were: inducing cows to calve, use of nitrogen fertiliser, dairy heifer grazing, artificial insemination, and herd testing.

4. The group has not adopted more than half of the innovations displayed to them. Some of those non-adopted innovations were: embryonic transfer, leasing of dairy cows, moisture probe testing, rotary cowshed and ME testing.

5. Using the PrinCom analysis the common theme produced is related to “relevancy” of the innovation to their farming systems and that heifer synchronisation loads heavily on the first principal component. They do not consider that there is a need for heifer synchronisation because it is not relevant to their values and farm circumstances. Some had indicated that they preferred to work with an innovation which is simple, creating less pressure and less hassle. The socionet also shows that all the five grids were closely linked to each other which indicates that they perceived and behaved in a similar way to each other.

5.8 Conclusion

The chapter has presented the summary of all results for each group of decision makers: the adopters and four groups of non-adopters. The adopters and non-adopters were all

aware that heifer synchronisation was related to genetic improvement and ease of mating management. While the adopters perceived these two factors as benefits in their decisions to adopt, the non-adopters perceived them as not important. The non-adopters have also stated their own constructs for not adopting, which were different from the adopters. Furthermore, although the four groups of non-adopters sometimes showed similar constructs each has other distinctive constructs which made them behave differently from each other.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

6.1 Introduction

There has been very little research on non-adopters of innovations. The aim of this research was to focus on non-adopters to see how they differ from each other and from the adopters. More specifically, the main purpose of this study was to explore the cognitive structures of the adopters and non-adopters of an innovation to see whether there was any: (1) homogeneity within the groups that follow the same decision path and (2) heterogeneity between the groups that follow different decision paths. The practical implications of understanding the cognitive structures of adopters and non-adopters is that such knowledge could assist in understanding the uptake of new technologies by farmers. This issue has rarely been addressed in farm management research.

A literature review of farmers' decision making models was presented in Chapters 2 and 3. The subjective expected utility theory was rejected. Some researchers argue that it fails to perform as a descriptive and a predictive model; it does not reflect the actual decisions made by the individuals because of their limited information processing abilities. The classical adoption-diffusion model has also some limitations because new technologies are not normally accepted by farmers as predicted by the model. However, it provides many propositions which provide some interesting insights. Although the ethnographic decision tree modelling was able to categorise farmers into adopters and various groups of non-adopters based on the decision criteria used, it does not provide psychological explanation on the choice of the aspects used in the decisions.

Kelly's personal construct theory, as discussed in Chapter 3, was used to address some of the limitations of these models while utilising some of their concepts. This theory was used to explore the cognitive structures or mental constructs of the adopters and the four groups of non-adopters of the heifer synchronisation technique among dairy farmers. Dairy farmers interviewed were from Canterbury and Kaikoura areas in South Island, New Zealand. A RepGrid software programme compatible with Apple Macintosh computer was used to collect and analyse the data. A summary of the research results for each of the five groups was given at the end of Chapter 5.

This chapter will cover six sections: (1) a comparison of the research results for the different groups, (2) a discussion of these findings with reference to the existing literature, (3) research implications, (4) some limitations of the research, (5) some suggestions for future research, and (6) conclusions. This study shows that the adopters and non-adopters have used different construct systems in their decisions to adopt or not to adopt the innovation. Furthermore, among the four groups of non-adopters there are also differences in their construct systems.

6.2 Comparison of the findings among the five different groups

This section provides a comparison of the research results for the five different groups of decision makers. The section is divided into three sub-sections. The first sub-section will compare the adopters to all the non-adopters. The second sub-section will compare the four different groups of non-adopters: (1) discontinued, (2) wait-and-see, (3) constrained, and (4) would never adopt. The third will include some other findings generated from the research. A summary of these comparisons will be presented at the end of the section.

6.2.1 Comparison between adopters and non-adopters

The adopters are compared to the non-adopters based on the following factors: (1) personal constructs, (2) focused grid (3) number of innovations adopted, and (4) themes generated from the PrinCom analysis (see Table 8).

Personal constructs

Generally, the adopters and the non-adopters have used different constructs to construe heifer synchronisation. However, one similarity between them was related to their awareness of information about heifer synchronisation. Both the adopters and the non-adopters were all aware that heifer synchronisation was related to genetic improvement and ease of mating management in the herd. In other words, they were all aware that heifer synchronisation could help improve the rate of genetic gain and also synchronise mating of their heifers so that most of these heifers could calve earlier and at the same time.

Table8: Summary of Comparison between Adopters and Non-adopters

Attributes	Similarities	Differences
Personal constructs	Adopters and non-adopters were both aware that heifer synchronisation was related to genetic gain and ease of mating management.	<p>Adopters considered genetic gain, ease of mating management and profitability were important. Non-adopters did not rate the innovation highly on these constructs They construed it as high costs and poor results.</p> <p>Adopters considered heifer synchronisation helped reduce workload and more convenient to use because their heifers were grazed off-farm. Non-adopters construed it as not convenient and hassle although they also had their heifers grazed off-farm.</p> <p>Adopters considered it as easy to use but some non-adopters construed it as complicated.</p>
Focused grid	Focused grids of adopters and non-adopters showed that innovations which were both used by them, such as use of nitrogen fertiliser, feed budgeting and travelling irrigator for pasture management, were closely linked or clustered to each other.	Focused grid of adopters showed heifer synchronisation was generally linked to artificial insemination and herd testing and hence genetic gain. However, focused grid of non-adopters showed that heifer synchronisation was linked to embryonic transfer instead of artificial insemination.
Themes		There were differences in themes generated among the five groups. The adopters emphasised genetic gain for profits. The “discontinued” non-adopters were on achievement. The “wait-and-see” non-adopters emphasised high costs associated with the programme. The “constrained” ones were on costs as the major constraints. The “would never adopt” emphasised relevancy and practicality of the innovation.

The main difference was that they used different constructs in their decisions to adopt or not adopt heifer synchronisation. The adopters used three common constructs in their decisions to adopt heifer synchronisation: genetic gain, ease of mating management and profitability. These subjects maintained that the long-term benefit of using the technique was its ability to increase the rate of genetic gain. It also helped synchronise the mating of heifers through artificial insemination so that most of the heifers would calve earlier. These two functions helped increase farm profitability. The other constructs used by some of the adopters to construe the technique were: reduces workload, convenient and easy to use. The adopters mentioned that their heifers were grazed off-farm and a distance away from the main property. Hence, using this technique, they said, helped reduce their workload because it saved a lot of their time and labour and hence was more convenient for them. They also mentioned that it was less technical compared to embryonic transfer and easy to operate.

However, the non-adopters of heifer synchronisation did not consider the constructs listed by the adopters above as important to them although they were aware that it was related to genetic gain and ease of mating management. In other words, they did not consider that genetic gain, ease of mating management, profitability, reduces workload, convenient and easy to use as important to them. Instead, they used different constructs in their decisions not to adopt: high cost, poor results, not convenient, hassle, risky, complicated etc. Some of these constructs seemed to be at the opposite end of the poles of the constructs used by the adopters.

The non-adopters mentioned that the technique was expensive to use because it would include the purchase of drugs, CIDRs, transportation and payment of veterinary fees. The results were considered as poor with a low conception rate.

The non-adopters of heifer synchronisation grazed off-farm and a distance away from their main farms but they considered this arrangement was not convenient and in fact created a lot of hassle, was labour-intensive and time-consuming. Thus it was not convenient to the non-adopters. Furthermore, some non-adopters, argued that it was complicated to use because it would involve more organisation in terms of making arrangements with the veterinary technicians. Some of them claimed that the technicians were some distance from their areas. Some non-adopters also indicated that there was no

need for the technique because it was not relevant to their farming systems. One of the reasons mentioned was that some farmers were satisfied with the existing farm performance and that they were happy with their existing working style with less pressure on them.

Focused grid

The adopters' focused grids showed that heifer synchronisation was generally linked to herd testing and artificial insemination. The adopters explained that they were linked because they were related to genetic improvement in the herd. However, in the non-adopters' focused grids, heifer synchronisation was not normally linked to herd testing and artificial insemination but instead linked to embryonic transfer. They explained that heifer synchronisation and embryonic transfer were linked because both were related to genetic gain but were not adopted because of high costs and also were not relevant in their farming systems. This finding shows that not all farmers considered there was a need for heifer synchronisation to improve genetic gain in their herd. Some other factors were also considered.

However, from the focused grids of both the adopters and non-adopters it was observed that there was certain similarity in how the innovations which had been adopted by the adopters and non-adopters were linked to each other. For example, use of nitrogen fertiliser, feed budgeting, and travelling irrigator were generally adopted by both the adopters and non-adopters and they normally formed a cluster. The subjects explained that these innovations were linked to each other because they were all important to pasture or feed management. This shows that some farmers have their own priorities on their farms. They use those farm practices which suit their own farm circumstances.

It was also observed that there were certain innovations which the adopters have not adopted but have been adopted by the non-adopters. Similarly, there were certain innovations which the non-adopters have not adopted but have been adopted by the adopters. For example, subject 16 (adopter) has not adopted inducing cows to calve because he was concerned about the pressure from environmental groups and the fact that he was a town milk farmer. However, subject 44 (would never adopt) has adopted inducing cows to calve because this was one of his sources of income. He has not adopted the moisture probe testing because he considered it was not applicable since

there was no irrigation system on his farm. This result also shows that what is relevant to one might not be relevant to another.

Number of innovations adopted

It was observed that the number of innovations adopted by the adopters seemed to be more than that of the non-adopters. However, the main innovations which were related to animal breeding such as herd testing and artificial insemination and that of feed management such as use of nitrogen fertiliser and feed budgeting were adopted by all the groups of adopters and non-adopters.

Themes generated from PrinCom analysis

Using the PrinCom analysis, each of the adopters and the four groups of non-adopters have generated their own common theme arising from their constructs, and that heifer synchronisation generally loads heavily on their first principal components. The common themes generated are: (1) genetic gain for profits for the adopters, (2) achievement for the “discontinued”, (3) cost for the “wait and see”, (4) costs as constraints in the “constrained”, and (5) relevancy for the “would never adopt”. The adopters considered that heifer synchronisation would be able to generate more income through synchronised mating of heifers and genetic improvement in the herd. The “discontinued” non-adopters were not happy with the innovation because they could not achieve their objectives of having a condensed calving pattern of their heifers and genetic improvement in the herd. The “wait-and-see” non-adopters were generally more concerned about the costs involved and were still keeping their minds open on the innovation. The “constrained” non-adopters were prevented from using the innovation because of certain constraints such as the costs. The “would never adopt” non-adopters indicated that there was no need of such an innovation because it was not relevant and practical in their systems. In other words, each of these five groups of decision makers seem to generate some form of commonality within the group.

6.2.2 Comparison between groups of non-adopters

The previous sub-section compared the adopters and the non-adopters. This sub-section compares the four groups of non-adopters in terms of the following factors: (1) personal constructs, (2) evaluation of cost and returns, and (3) farm circumstances and working

style (see Table 9). The results show that the four groups of non-adopters have different construct systems in their decisions to reject or not to adopt heifer synchronisation. The groups may have some similar constructs but there were other distinctive constructs which made them behaved differently from each other.

Personal constructs

Generally, the four groups of non-adopters used different constructs in their decisions not to adopt heifer synchronisation. However, sometimes they used similar constructs in their decisions but acted in a different way from the other groups. One similarity among these four groups of non-adopters was that they were all aware that heifer synchronisation was related to genetic gain and ease of mating management but these were not important to them. They also did not construe that heifer synchronisation was related to reducing workload, convenience and easy to use as construed by the adopters. Instead, some had construed that the innovation was labour intensive, time-consuming and complicated.

Among the four groups of non-adopters there were some differences in their construing of heifer synchronisation although some constructs were similar. However despite this the behaviour of each group was different to other groups. The “discontinued” non-adopters were different from the other three groups (wait-and-see, constrained and would never adopt) in terms of their experience with the innovation. The former had tried or experienced the innovation but later decided to reject it. The “discontinued” group shared two constructs in their decisions to reject the innovation: poor results and high cost. Their experience was that the results were poor because of the low conception rate, higher loss of genetic heifers and a spread out calving pattern instead of the concentrated calving pattern. Because the results were very poor they claimed that the costs involved were therefore very high. Other constructs mentioned by some of the “discontinued” group were: not convenient and not able to achieve objectives. The “wait-and-see” non-adopters also shared two constructs similar to the discontinued group in their decisions not to adopt the technique: poor results and high cost. They had expressed their deep concerns about the costs of drugs, and transportation, and also unexpected poor results or uncertainty of the results. Other constructs mentioned by some of this group which were different to the discontinued group were: lack of experience, hassle, not familiar and no necessity. This group of non-adopters had

Table 9: Summary of Comparison between Groups of Non-adopters

Attributes	Similarities	Differences
Personal constructs	<p>All groups of non-adopters were aware that heifer synchronisation was related to genetic gain and ease of mating management but these were not important to them.</p> <p>They did not construe heifer synchronisation as related to reducing workload, convenience and easy to use.</p>	<p>“Discontinued” non-adopters: Had used but decided not to continue. Two shared constructs used were: poor results and high cost. Other constructs mentioned were: not convenient and not able to achieve objectives.</p> <p>“Wait-and-see” non-adopters: Two shared constructs used were: poor results and high cost. Other constructs mentioned were: lack of experience, hassle, not familiar and no necessity. But still keep minds open.</p> <p>“Constrained” non-adopters: Two shared constructs used were: high cost and labour intensive (time-consuming). Other constructs mentioned were: poor results and lack of facilities.</p> <p>“Would never adopt” non-adopters: One shared construct used was: not relevant. Other constructs mentioned were: hassle, costly, complicated, risky and poor results.</p>
Evaluation of cost and results		<p>The “discontinued”, “wait-and-see” and “constrained” groups seemed to show their evaluation of cost and results associated with the use of heifer synchronisation. The “would never adopt” non-adopters did not mention much on these constructs.</p>
Farm circumstances and working style		<p>The “discontinued”, “wait-and-see” and “constrained” non-adopters gave more emphasis on cost and results. The “would never adopt” stated that they preferred to maintain their existing working style which was not mentioned by the other three groups of non-adopters: to work slowly and quietly and without much pressure.</p>

indicated that they would keep their minds open on heifer synchronisation. This “constrained” group used two shared constructs in their decision not to adopt: high cost and labour intensive/time consuming. Other constructs mentioned by some other individuals in this group were: poor results and lack of facilities such as yard and feed. These “constrained” non-adopters considered all these constructs as their major constraints to their decision to adopt, which was not emphasised by the “wait-and-see” or the “discontinued” groups. The “would never adopt” non-adopters used one shared construct in their decisions not to adopt: not relevant. This construct was not mentioned by the other three groups of non-adopters. Other similar terms used were: no advantage, not useful and less important. Other constructs mentioned by some other individuals were: hassle, costly, complicated, risky and poor results. These constructs were also mentioned by some individuals in the other three groups of non-adopters.

Evaluation of cost and results

Costs and results were considered as the major constructs used by three groups of non-adopters: “discontinued”, “wait-and-see” and “constrained”. The “would never adopt” group did not seem to show clearly that they have done any evaluation of the cost and results (cost-benefit analysis) with respect to heifer synchronisation except for subject 18. The only indication that they had done the evaluation was that they had mentioned that their existing system was equally good or seemed to be better than heifer synchronisation.

Farm circumstances and working style

As mentioned previously, the “discontinued”, “wait-and-see”, and “constrained” non-adopters gave more evaluation to the costs and results. The “would never adopt” did not give a clear indication of their evaluation of cost and results related to the use of heifer synchronisation. However, some individuals in the “would never adopt” group have generated some constructs which they considered as important and were not mentioned by any individuals in the other three groups of non-adopters. For example, some have preferred to maintain their existing working style: to work slowly and quietly without much pressure. There was also one subject who strongly believed that the technique was of no relevance to his farming system because he was a town milk supplier. However, there was one adopter of heifer synchronisation who was also a seasonal and a town milk supplier. A discussion with a senior Livestock Improvement Officer confirmed that there

were some town milk suppliers who also used the synchrony technique to make the whole process more efficient and productive.

6.2.3 Other findings

Other findings generated from this research are: (1) that the five groups of decision makers were dynamic in nature, and (2) that some farmers can be placed in any of the five groups of decision makers for different innovations.

The five groups of decision makers under investigation showed that they were dynamic in nature. In other words, for a particular type of innovation some individuals might, over time, change from one group to another. For example, those individuals in the “discontinued” group had adopted heifer synchronisation but decided to reject it because of certain reasons. Those individuals in the “wait-and-see” had indicated that they were keeping their minds open on the innovation and may become adopters or “would never adopt” category.

This research also shows that depending on the particular type of innovation used, an individual can be classified into each of the five groups of decision makers. For example, subject 49 was classified in the “adopter” category for the innovation, use of nitrogen fertiliser, “constrained” for pivot irrigation, “wait-and-see” for moisture probe testing, “discontinued” for the embryonic transfer, and ‘would never adopt’ for inducing cows to calve.

6.2.4 Overview of comparisons

The results show that the adopters and the non-adopters have different constructs in their decisions to adopt or not to adopt heifer synchronisation. Similarly, between the four groups of non-adopters generally different constructs were used in their decisions to reject or not to adopt. Within each of the groups the constructs used were generally similar.

These results seem to suggest that although adopters and non-adopters may perceive the benefits of an innovation, these benefits may form part of the decision to adopt for

adopters but not be an important construct for non-adopters. The findings also suggest that the four groups of non-adopters construe the innovation differently from each other. However, in broad terms the results also suggest that the non-adopters seem to fall into two broad groups. First, the “would never adopt” seems to be the most distinct group and separable from the other groups of non-adopters. They seem to have a less favourable attitude towards change or new technologies. Second, the other three groups of non-adopters (discontinued, wait-and-see, and constrained) seem to show a more favourable attitude to change or towards innovations which may or may not result in adoption.

6.3 Discussion with reference to existing literature

This discussion will focus on the interpretation of the research findings with reference to two main approaches: (1) Kelly’s personal construct theory, and (2) other research. The aim is to illustrate how personal construct theory and other approaches can be used to enhance our understanding of adoption behaviour.

6.3.1 Interpretation of results in terms of Kelly’s personal construct theory

One of the most important findings generated from this study is that Kelly’s (1955) personal construct theory and the repertory grid technique can be used to identify those cognitive structures or constructs used by the adopters and the four groups of non-adopters in their decisions to adopt or not to adopt heifer synchronisation. This theory is used to provide explanation of the similarities and differences in the constructs used by the adopters and non-adopters. Hence, exploring the individual’s construct systems gives a wider understanding of adoption behaviour.

The findings show that, although the adopters and non-adopters perceived the benefits of heifer synchronisation in terms of genetic gain and concentrating the calving patterns in the herd, these benefits were considered as important constructs for the adopters but not important for the non-adopters. Among the four groups of non-adopters, although there seemed to show some similar constructs there were also other distinctive constructs used in their decisions not to adopt. Each of these groups has been shown to behave differently from each other.

The above construct systems or thought processes of how the farmers actually behave demonstrate Kelly's (1955) theory that people are like scientists constantly trying to understand, predict and give meaning to the world through the use of personal constructs. Kelly asserts that individuals may develop different personal constructs and interpret a certain event differently from each other. In other words, a person can have a number of alternative interpretations to understand an event. In Kelly's (1955) term this is known as *constructive alternativism or constructivism*. He also describes these differences in thinking between individuals in his *Individuality corollary*, which asserts that individuals use their own personal construct systems to make sense of their world.

Furthermore, the above similarities and differences in construct systems can also be explained using Shaw and Gaines's (1988) categorisation of constructs. Following Kelly's ideas, Shaw and Gaines (1988) suggest four types of constructs: (1) corresponding constructs - use of different constructs but have similar ways of thinking, (2) consensus constructs - use of the same constructs and similar ways of thinking, (3) conflicting constructs - use of the same constructs but different ways of thinking, and (4) contrasting constructs - different constructs and different ways of thinking. The thought processes of the adopters and the four groups of non-adopters can be explained following these concepts. First, the adopters and the non-adopters use *contrasting* constructs because they use different constructs and behave in different ways. For example, the adopters use three major constructs in their decisions to adopt: genetic gain, ease of mating management and profitability. The non-adopters do not use these constructs in their decisions not to adopt and instead use other constructs such as high cost, poor results and inconvenience which are different from the adopters. Second, three groups of non-adopters (discontinued, wait-and-see, and constrained) use one similar construct, high cost, in their decision to reject or not to adopt the innovation. Although they use this similar construct, their thought processes are different or they behave in a different way from each other. In other words, they use *conflicting* constructs to construe heifer synchronisation. Third, the individuals within the groups of adopters and the four non-adopters use one to three similar constructs in their decisions to adopt or not to adopt and they think or behave in similar ways. In other words, within the group these individuals therefore use *consensus* constructs to construe the innovation. Fourth, those individuals within each of the groups, in addition to some common constructs, also have some other different constructs but still have similar ways of thinking or behave in

the same way. These individuals therefore use both *consensus* and *corresponding* constructs to construe the innovation.

The above different types of personal constructs used by farmers in their decisions to adopt or not to adopt indicate that some farmers do not normally exist as homogenous groups of individuals. In other words, some farmers exist as heterogenous groups although they are in a similar farming system. For example, the adopters had construed that because their heifers were grazed off-farm the use of heifer synchronisation had helped them reduce their workload tremendously in terms of time and labour. It had created a lot of convenience and hence was more profitable. However, the non-adopters construed in a different way although their heifers were also grazed in a similar manner. They construed that the use of heifer synchronisation would create a lot of hassle and was labour-intensive, time-consuming and inconvenient and hence high cost and less profitable. It is observed that, even among the four groups of non-adopters, different constructs were used to construe heifer synchronisation. Briggs (1983) in his exploratory study on farmers' choice of crops using repertory grid technique also showed that farmers did not exist as homogenous groups as perceived by the extension officers because of their different construct systems.

Although some farmers do not normally exist as homogenous groups, there is homogeneity within each group of decision makers. The research shows that individuals within the adopters and each of the four groups of non-adopters have similar constructs or construction of their experience which is in accordance with Kelly's (1955), *Commonality corollary*, which asserts that individuals do sometimes have a similar construction system and hence behave in similar ways because they construe in similar ways. Hence, Kelly's theory does not only provide individual differences or similarities but also group or cultural differences.

This construct commonality within each group as conceptualised by Kelly is similar to Kaine and Lee's (1994) homogenous farmers based on their concordance of interest and Rogers' (1983) ideas of homophilous farmers sharing similar characteristics such as interest, experience and other social characteristics. However, from the perspective of personal construct theory, the difference is that while individuals may come from similar backgrounds, similar conditions, share the same experience or expose to a similar event,

they may still differ in their construction of an event or lack commonality in their construction because they interpret or construe things differently from each other.

This research supports Ilbery and Hornby's (1983) ideas in their study on farmers' decision making using repertory grid. They argue that there are diverging patterns or constructs of different groups of farmers although they have similar physical conditions. In other words, when trying to encourage farmers to innovate, it is advisable not to extrapolate from one person to another. It is observed that even if circumstances seem similar, farmers' constructions of the event may differ, and hence do not adopt because they have their own construct systems of evaluating the event. This research therefore provides one possible explanation of the limitation of Rogers' (1983) "trickle-down" approach of technology transfer from the perspective of personal construct theory. Rogers conceptualises that new technology is trickled down to the other farmers from innovative farmers. However, in the actual situation, other farmers do not adopt as predicted by this approach. In terms of personal construct theory, these farmers do not adopt because they have their own construct systems as explained in this research.

Furthermore, from the perspective of a technology transfer associated with heifer synchronisation, the farm management consultant or extension officers might just focus on one or two constructs such as genetic gain and ease of calving management and believe that publicising them may improve the chances of adoption. However, some farmers do not adopt because they have their own constructs which are different from farm advisers or extension officers. This study shows that there are a whole range of constructs for different groups of non-adopters and these are different from the adopters. This research supports the idea that farmers will not accept the information if it does not fall within their conceptual construct framework (Woog, 1978) or outside the range of convenience of an individual's cognitive structures (Salmon, 1981). Woog has used personal construct theory and repertory grid successfully in his study on the role of extension in the pig industry in Australia. By using such a technique Woog was able to identify those constructs farmers used to construe farm advisers and extension officers. For example, farmers expected extension officers to be expert in a specific field, to be thoroughly knowledgeable about their clients' situations and to be able to disseminate information which was immediately useful in solving the practical problems of their clients. However, the extension officers were not aware of: (1) the relevance of their advice or

information to their clients within their conceptual construct framework, (2) their varied roles as expected by their clients, and (3) the difficulties experienced by their clients in communicating with them.

This study also shows that the “discontinued” non-adopters had decided to reject the innovation because of their bad experience through poor results and high costs and the fact that they were not able to achieve their objectives. This is consistent with other findings which indicated that farmers are goal-oriented (e.g., Gasson, 1973; Rogers, 1983; Valentine, Hurley and Glass, 1993). According to Rogers (1983), this phenomenon is known as discontinuance or disenchantment because the individuals are dissatisfied with its performance. However, this study moves a step further by explaining psychologically why some farmers have decided to discontinue using a certain type of innovation if they have failed to achieve their goals. Following Kelly’s (1955) idea, Winter (1990) describes this type of construing as *preemptive* construing because the individuals in this group have initially set a target or objective to achieve and if they could not meet this target they would stop doing it. It is, therefore, important for those involved in a technology transfer to take cognisance that farmers have their own farm objectives to achieve and from their viewpoints it is rational if they have decided to discontinue using the innovation that does not meet their expectation. In other words, farmers used their construct system to rationalise their adoption behaviour.

The “wait-and-see” and the “constrained” groups have stated several reasons to justify their actions not to adopt and that they consider their decisions as correct. This idea corresponds to a process of rationalisation adopted by some farmers who prefer not to innovate for rational reasons (e.g., Vanclay, 1992; Jangu, 1993). Some researchers tend to reject the idea of innovativeness and instead emphasise farmers’ rationalisation in their decisions to change or to uptake new technologies (Fairweather, 1992; Jangu, 1993; Reid, McRae and Brazendale, 1993). In terms of personal construct theory these groups of farmers are construing in a *constellatory* manner (Winter, 1990) which means that these groups of non-adopters have put up a number of reasons to justify their actions or rationalise their actions. This research therefore gives insights into these different viewpoints of farmers or their rationalisation processes in their decision whether to adopt or not to adopt. Those involved in technology transfer should take note that based on

farmers' construct systems it is, therefore, justified if farmers do not change and innovate.

Previous studies have shown that farmers' need, circumstances and relevancy of the innovations are also important factors in the innovation-adoption (Reid, McRae and Brazendale, 1993; Brazendale, Reid and McRae, 1994). There is evidence in this research to support such proposition. For example, the "would never adopt" non-adopters had emphasised the relevancy and practicality of heifer synchronisation in their farming systems. They said such innovation was not relevant in their farming operation. In terms of personal construct theory, Fromm (1993), cited in Oades and Viney (1996), termed these type of constructs as *non-reflexive constructs* because the non-adopters have considered the technique as not meaningful or not relevant in their existing farming system. Accordingly, Woog (1978) in his study of the role of extension in the pig industry in Australia using a similar technique suggested that the information or an innovation is not relevant or practical to farmers if it does not fall within farmers' conceptual construct framework or outside the range of convenience of individual's cognitive structures (Salmon, 1981). Therefore, those involved in a technology transfer such as the extension officers or advisers have to note that the new practice has to be practical and relevant under the farmers' circumstances before recommending its use on their farms.

Another aspect of the findings of this research is related to the dynamic nature of these groups of decision makers. There is evidence from this research to suggest that decision makers might change from one group to another over time. Kelly's (1955) *Experience corollary* asserts that a person's construct system is continually changed and developed according to his experience. This implies that people normally revise their hypotheses or theories in the light of their experiences. As described by Earl (1983), this revision process of theories is termed as learning. In other words people will change their constructs or add new constructs as they learn based on their experience. For example, the data in this research have shown that the individuals in the "discontinued" group were aware that heifer synchronisation was related to genetic gain, ease of mating management and hence profitability and these constructs were shared by the adopters too. However, after they had their bad experience, the individuals had changed their

construct systems or constructs to poor results and high costs and hence were now in the “discontinued” group. In other words, previously this group was in the adopters’ group.

Similarly, in the light of Kelly’s (1955), *Experience corollary*, the individuals in the “adopters”, “wait-and-see”, “constrained” and “would never adopt” could possibly change their constructs or add new constructs and change from one group to another. However, certain group may take a shorter time to change and others may take a longer time to change to another group. It is also possible that some individuals would not change their construct systems. This extent of the change by the individuals is explained in Kelly’s *Modulation corollary* which asserts that there is a limit of change occurring within the construct system of an individual and the degree of this change is determined by two types of constructs: permeable and impermeable constructs.

Therefore, it is very likely that some individuals in a particular group might change if they have permeable constructs and would not change or remain in the group if they have impermeable constructs with them. It is possible that the individuals in the “wait-and-see” group would take shorter time to change either to the “adopters” or “would never adopt” because they seem to construe in a loose manner (Fransella and Dalton, 1990) towards heifer synchronisation. The “would never adopt” may take longer to change because they seem to construe in a tight fashion (Fransella and Dalton, 1990) towards the innovation. The “constrained” group may also take longer time to change unless they can eliminate some of the constraints.

Further to the dynamic nature of these five groups of decision makers, this research also shows that by using these categories, farmers can be placed in one category for a particular innovation and other categories for other innovations. This finding is, therefore, in contrast with Rogers’ (1983) proposition of categorising farmers as earlier adopters or laggards using personality and socio-economic variables. In other words, this research has established that farmers’ personal construct systems or cognitive structures provide an alternative explanation why farmers are placed in a particular groups of non-adopters for a particular innovation.

The finding also shows the importance of clustering of the innovations as reflected in the focused grids of the subjects which bears some resemblances to Rogers’ (1983) concept

of technology cluster or innovation package. While the adopters' focused grids showed that heifer synchronisation was tightly linked to artificial insemination and herd testing and formed a cluster, the non-adopters' focused grids showed that heifer synchronisation was tightly linked to embryonic transfer and herd testing. This result shows that the adopters and non-adopters may cluster the innovations differently so the adoption of one innovation will not necessarily trigger the adoption of another innovation(s) as predicted by Rogers' (1983) concept of innovation package. Therefore, the assumption that a particular type of innovation is related to a certain cluster of innovations and ought to be adopted by farmers may not be acceptable for certain group of farmers because of the differences in their construct systems.

The above discussion has illustrated how the psychological aspects of Kelly's (1955) personal construct theory can be used to explain some similarities and differences on the construct systems between adopters and non-adopters and also among the four groups of non-adopters. In other words, this theory has provided some psychological explanation in terms of how the constructs are used in the decisions and this has improved our understanding of the adoption behaviour. Although the ethnographic decision tree modelling has successfully identified the main decision criteria used in the decisions to adopt or not to adopt (Gladwin, 1989; Fairweather, 1992; Jangu, 1993) and can be used to subsequently categorise the subjects into groups of adopters and non-adopters based on the decision criteria elicited (Jangu, 1993), it does not provide a psychological explanation on the choice of the criteria.

Using personal construct theory in conjunction with ethnographic decision tree modelling, either simultaneously (Murray-Prior, 1994) or sequentially as implicitly used in this study could provide an understanding of decision criteria as well as give some clues as to why different people might go down different paths.

In a decision to adopt heifer synchronisation, the overriding criterion was genetic gain. It would appear that in Stage 1, the main decision criterion which is reflected at the top of the tree is genetic gain. It would seem that the "Wait-and-See" group were not yet convinced that there was genetic gain and hence would not adopt at this time. However, if they became convinced of genetic gain at a later date, they could go down the tree again and reach a different outcome, such as "adopt" or "Constrained" non-adoption.

The “Would Never Adopt” could also go down the same initial path as the “Wait-and-See” group but would pass through further criteria as well, such as hassle, high cost and not practical until they reach a “Would Never Adopt” position. They would be unlikely to shift from this position and go down the tree again at a later date because of the impermeability of their constructs. The adopters, however, considered genetic gain was important and would come down and pass through other criteria such as profitability, reduced workload and convenient and hence to a different decision path. Therefore, in going down the path that they have, there are constructs which can be reflected in a tree-like structure and have to be passed to a particular decision path or outcome.

Personal construct theory has successfully explored the cognitive structures or constructs used in the decisions and provided the psychological explanation for the decision to adopt or not to adopt. In other words, it has provided insights into the decision processes of the adopters and non-adopters of heifer synchronisation. Kelly (1955) had emphasised the importance of the definition of his client’s problem and this has to be elicited. He provided a summary of this position in the maxim: “If you want to find out what is wrong in a client’s life, ask him - he may tell you” (p.322-3).

6.3.2 Interpretation of results in terms of other research

While the main focus is on the interpretation of the results in terms of personal construct theory, other approaches used to understand farmers’ decision-making processes from the literature will also be taken into account.

In the adoption literature, previous studies on the adoption of innovations have shown the importance of the attributes of innovations such as relative advantage, (e.g., Rogers, 1983; Belgrave and Woodfield, 1996). For example, farmers would be willing to change and innovate if they believed that the innovation will provide concrete economic benefits and lower perceived risk. However, economic profitability is not necessarily the most important single factor for the farmers to change or to innovate. Some farmers place more value on lifestyle and other non-economic factors (e.g., Greer, 1982; Briggs, 1983; Fairweather and Keating, 1994). The findings from this research are also consistent with these previous findings in that perceived economic benefits of the innovation do not necessarily influence farmers to adopt although they are important to some farmers.

Some farmers have decided to adopt heifer synchronisation because they believe in genetic gain and ease of mating, and hence believe it is more profitable to them. The non-adopters do not consider these factors as important. This research therefore shows that technology transfer should not always be equated with economic profitability because some farmers may not see it in those terms and therefore will be put off adopting. If an innovation is defined in broader terms it may have broader appeal.

Previous studies have suggested risk and uncertainty play a very important part in farmers' decision making not to change (e.g., Sturm and Smith, 1993; Martin, 1994; Vanclay and Lawrence, 1995). The finding from this research is also consistent with the previous results. In this research it is shown that the individuals in the "wait-and-see" group have made the decision not to adopt because they have expressed their deep concern on the high costs and poor results in using heifer synchronisation. In other words, they are concerned with the perceived risk and uncertainty involved, and they perceive that the capital and other resources invested on the innovation will not result in any benefits to them. It is therefore necessary to understand farmers' circumstances when promoting new innovations in order to find out how farmers actually construe the innovation.

Some studies have also shown that some farmers do not accept new ideas because of constraints relating to land, labour, capital, time and relevancy of the innovation. (e.g., Saint and Coward, 1977; Reid, McRae and Brazendale, 1993; Guerin and Guerin, 1994). This study also demonstrates that such factors as labour, time, high cost, poor performance of the innovation and lack of facilities are construed as major constraints by the individuals in the "constrained" group for not adopting the innovation. Previous studies, however, merely identified factors that constrained farmers to adopt. In contrast, this research has studied how the various groups of non-adopters have used their constructs in their decisions to adopt, not to adopt or to reject the innovation. The finding from this research has demonstrated the importance of meaning to the farmers. This meaning is translated into their cognitive structures or construct systems in their construing of innovations.

In previous studies, personality attributes such as age and attitudes of farmers have been cited as important factors distinguishing adopters from non-adopters (Stewart, 1979; Rogers, 1983; Campbell and Junior, 1992). There is not enough evidence in the data

from this study to support the existence of such a relationship because of the small sample size. Nevertheless the “would never adopt” non-adopters seemed to be older. Some of the individuals in this group had mentioned that they would prefer to maintain their existing working style by working slowly, quietly and with less pressure. Therefore, we would expect the older farmers to have preferred a lesser workload or to adopt a new technology which they construe as less hassle in their farming systems. This finding implies that we have to be aware that some farmers, as exemplified by the “would never adopt”, do not consider or construe there is a need for a new innovation if it requires some changes in their existing working style.

In addition to studying the personality attributes of farmers and characteristics of innovations, some studies have also looked at the importance of information sources and the quality of information available in increasing the rate of adoption of new technologies (e.g., Fairgray, 1979; Greer, 1982). Greer (1982) suggested that one of the reasons for the slow uptake of new farm practices is the availability of inaccurate information to farmers. In this research all the four groups of non-adopters were aware of the information and knowledge about heifer synchronisation. The “discontinued” non-adopters had decided to reject because of their bad experience. Perhaps among the three non-adopters, (wait-and-see, constrained and would never adopt), the “wait-and-see” would probably try to seek for more information and more social reinforcement required for them to change. They will be likely to change and adopt if they are satisfied that they are happy with the information. As noted by Wärneryd and Holmlöv (1992) in their review article on the adoption of fax machines, this “wait-and-see” group will hesitate to adopt until there is a wide spread use of the innovation. According to them this group would like to see a “general critical mass of adopters” before they will adopt and gradually they face external pressure to adopt. As this research has explained, some farmers do not consider the information as relevant if it does not fit within their conceptual construct framework.

This research has also looked at the “discontinued” group of non-adopters and their reasons for discontinuing. The results support Rogers’ (1983) proposition which states that an individual will reject an innovation if he or she has experienced dissatisfaction or disenchantment with its performance or results. Rogers also suggests that later adopters are more likely to discontinue innovations because they have a lower educational level

and a lower socio-economic status. However, in this research, there is no evidence to suggest that the individuals in the “discontinued” group have these characteristics. Although there is no statistical evidence to prove the case, there is indication from this research that the characteristics of the “discontinued” group in terms of their educational background and socio-economic status are similar to that of the adopters and the other three groups of non-adopters. The implication of this finding is that some farmers are likely to discontinue using the innovation if they are dissatisfied with their performance. In other words those involved in a technology transfer should be aware that farmers use their personal constructs in their decisions to reject a particular innovation based on its performance, and these may be more useful than looking at the educational or socio-economic status of the farmers.

To conclude this section, it is important to reiterate that Kelly’s personal construct theory can be used to address some issues in the literature related to farmers’ decision making particularly among the adopters and non-adopters. This research has used personal construct theory and the repertory grid technique to explore and compare the cognitive structures or mental constructs of the adopters and non-adopters. The research has given more emphasis to understanding of the construct systems of the four groups of non-adopters of an innovation which have not been given much attention in farm management research and which are very important in trying to address the issues of increasing the uptake of new technologies by farmers in New Zealand.

6.4 Implications for farm management research and extension

The findings from this research have some implications for farm management research and extension. Generally, it adds to the knowledge and better understanding of the adoption behaviour of farmers particularly the non-adopter groups which have not been fully researched. This research has shown that exploring their construct systems is important in understanding their adoption behaviour.

Previous studies on the factors influencing innovation-adoption have focussed more on the characteristics of the innovation and the attributes of farmers. However, the non-adopters have not been fully researched. This research has successfully used personal construct theory to explore the cognitive structures of the adopters and the four groups

of non-adopters of an innovation. The adopters and non-adopters have used different constructs to adopt or not to adopt a particular innovation. It was observed that farmers were also not homogenous in their thinking or use of constructs even under similar conditions or within the same farming system. They have their own construct systems to construe the events in their environment. This is exemplified by the existence of the four groups of non-adopters who have used their own constructs not to adopt and behaved differently from each other. Therefore, those involved in a technology transfer need to be aware that farmers are unlikely to have construct systems similar to farm management consultants or extension officers, and that among the farmers themselves there are some differences in their construct systems. A new technology perceived to be economically profitable is unlikely to be diffused and adopted by some farmers because they have their own construct systems to construe the innovation.

This research has shown that three groups of non-adopters (wait-and-see, constrained and would never adopt) are aware and have thought about the innovation but decided not to adopt. This finding has some implications for extension approaches and communication media to be used if we were to publicise and encourage the use of heifer synchronisation. In terms of personal construct theory the “wait-and-see” non-adopters seem to construe the innovation in a loose manner and are also likely to have some permeable constructs about the innovation. Those involved in a technology transfer should concentrate their extension activities on farm discussion groups, individual contact, field days and distribution of technical information. Because of the nature of their construct systems, the individuals in this group have the potential to innovate faster than the other groups of non-adopters.

The “would never adopt” non-adopters seemed to be separable from the other three groups of non-adopters. They used one important construct, not relevant, or not practical in their decisions not to adopt. From a farm management research and extension perspective this shows that a particular information or an innovation ought to be relevant or practical from the farmers’ point of view or suit their farm circumstances for it to be accepted. In other words, if the information is not within the farmers’ conceptual construct framework or not within the range of convenience of their cognitive structures it will not be readily accepted by them.

This research has also highlighted the importance of two of the constructs, high cost and poor results, in the decision not to adopt heifer synchronisation. The “discontinued” non-adopters had stated that these two constructs were the main contributing factors in their decisions to discontinue using the innovation. The other two groups of non-adopters (wait-and-see and constrained) have thought about the innovation, but have decided not to adopt because of their deep concern on the high cost and the poor performance. In this respect there is a need for farm management research to look at these two factors and how to improve the performance under farmers’ circumstances. From a technology transfer perspective, perhaps there is a need for more information concerning the cost-benefit analysis on the use of heifer synchronisation. The finding from this study seems to indicate that some farmers are still not fully convinced of the actual benefits of using the innovation.

This research has shown that farmers have their own ways of looking at certain things through their own construct systems. These construct systems are continually changed and developed. If those involved in a technology transfer are able to explore these constructs from the viewpoints of farmers they may be able to understand better how and why the farmers think and do things in their own ways which may not be what the advisers or extension officers think. This would help to develop some commonalities in the construction of certain event among farmers and those involved in a technology transfer and consequently would help increase the uptake of new technologies among farmers by targeting their extension messages more precisely.

This finding also shows that non-adopters are dynamic in nature. In other words each individual in a particular group might go from one group to another. For example, the “discontinued” were originally from the adopters’ group. Because of some reasons they decided to reject the innovation. The “wait-and-see” non-adopters showed that they still kept their minds open on the innovation and might consider adopting the innovation. This result has some implications on information communication or its delivery system. For example, the extension officers or advisers should focus more on the “wait-and-see” non-adopters because they are the ones who are expected to change and innovate faster than the other groups of non-adopters. It therefore requires more interaction between the extension officers and the “wait-and-see” non-adopters in terms of identifying their actual needs, goals, farm circumstances and constraints. The research supports the ideas

of Reid, McRae and Brazendale (1993) who have noted the importance of farmers' goal, circumstance and constraints in their willingness and ability to change.

Parker and Townsley (1995) have also highlighted that there was a need to improve our understanding of "human behaviour" or farmer circumstances and their goals in decision making. For example, they said there is a need for a more qualitative approach to study farmer circumstances and their goals in decision making with regard to innovation adoption. They have also indicated the importance and contribution of the disciplines of behavioural and social psychology to farm management. This research is, therefore, moving in this direction. By exploring the cognitive structures or mental constructs of the adopters and non-adopters, this thesis has therefore offered explanation why farmers do what they generally do through the use of their own personal construct systems

6.5 Research limitations

There are some limitations related to this research. These can be classified as follows: (1) time-limitation, (2) attitude towards computer use, and (3) problems of getting full cooperation from the non-adopters. These are explained as follows.

One of the weaknesses of this research is that the use of repertory grid in eliciting constructs is a very time-consuming exercise. Other researchers who have used this software programme have also mentioned such a limitation. In this research, the subjects were given about 12-17 different innovations and were initially asked to put themselves into one of the five categories: adopters, discontinued, wait-and-see, constrained and would never adopt. Time was needed because they had to give some reasons why a particular type of innovation was put in a particular group. Furthermore, because of the constraints of time the researcher was only able to select one innovation, heifer synchronisation, for this study. for the exploration of the cognitive structures of individuals associated with this innovation. The researcher was not able to study other innovations and to see whether a subject in a particular group would have a similar or different construct systems for a different innovation.

The second limitation of the research is related to the attitude of some of the subjects towards the use of the computer. The researcher has observed that, generally, subjects with a higher educational background provided answers or constructs quickly to the

question: "In what way two of these elements are similar and different from the third?" More time was needed to guide those who had a lower educational background to help them produce the construct. The researcher also observed that the younger and more educated subjects seemed to be quite comfortable looking at the computer screen or giving responses to the questions displayed on the screen. Some of the older ones indicated that the letters on the screen were too small and difficult to read. The researcher needed to read the words or statements displayed on the screen. Throughout the interview the mouse was controlled and moved by the researcher to speed up the interview.

The other limitation of this research was in terms of getting good cooperation from the non-adopters of heifer synchronisation. The researcher found that there was a very good response from the adopters. The adopters were all very willing to be interviewed. However, there was a poor response from the non-adopters, although, initially they seemed to be quite willing to be interviewed. Some of the reasons for not willing to participate were: (1) they were busy with their farm work, and (2) they were not interested (but were not willing to give reason why they were not interested).

6.6 Suggestions for future research

This research has used the repertory grid technique to explore the cognitive structures of some groups of decision makers giving more emphasis to the groups of non-adopters which have not been fully researched. Because of the time constraint, the researcher was only able to focus on one innovation, heifer synchronisation. For future research could explore: (1) to increase the number of innovations to be studied, (2) to extend the study to other types of farming systems, and (3) to increase the sample size. There are described as follows.

First, the number of innovations to be studied can be increased within the same farming system. In this research the researcher used heifer synchronisation as an example to explore the cognitive structures of some groups of dairy farmers in their decisions to adopt or not to adopt the innovation. Future research could look at other types of innovations which are also related to the dairy industry such as inducing cows to calve, moisture probe testing and so on. Using two or more innovations for one particular

individual would allow the researcher to determine whether that individual can be fitted into another adopter category for different innovations. This research would also allow the researcher to explore more cognitive structures from that individual for another type of innovation.

Second, future research can also expand the study to include other types of farming systems such as sheep, beef and deer. This would enable comparison of cognitive structures of the various groups of non-adopters across industries.

Third, there is also a need to increase the sample size particularly among the various groups of non-adopters for a particular innovation within the same type of farming system. This would allow us to have a possible refinement in our understanding of constructs of adopters and non-adopters.

6.7 Summary and conclusion

The review of literature has shown that there is still some concerns about the low uptake of new technologies by some farmers in New Zealand. Studies on the factors influencing adoption of innovations focussed more on the characteristics of farmers, attributes of innovations and sources of information. There is, however, not much information or knowledge about the various groups of non-adopters. This is important if the uptake of new technologies among the farming community is to be improved. Therefore, the objectives of this research were to explore the cognitive structures or mental constructs of the adopters and four groups of non-adopters to see whether there is any (1) homogeneity among individuals within the group that follows the same decision pathway, and (2) heterogeneity among individuals between the groups that follow different decision pathways.

In order to achieve these objectives, a RepGrid computer software programme compatible with Apple Macintosh, was used to study the decision processes of 25 dairy farmers in Canterbury region in their decisions to adopt or not to adopt heifer synchronisation. This research was exploratory in nature and uses the Repertory Grid of Kelly's (1955) Personal Construct Theory to explore these cognitive structures or constructs used by the individuals in their decisions.

The findings from this research show that farmers have used their own personal constructs or construct systems in their decisions to adopt or not to adopt an innovation. They used different types of constructs to construe the innovation. The adopters and non-adopters use different constructs in their decisions to adopt and not to adopt respectively. However, among the four groups of non-adopters it is not necessary that they have to have different constructs in order to have different thought processes or behave differently from each other. Sometimes the individuals among the groups used similar constructs but still use other distinctive constructs which led them to think and behave differently from each other, and so lead to heterogeneity among the groups. Within each group, the individuals generally used similar constructs along with some other different constructs but still thought and behaved similarly to each other and maintained homogeneity within the group. In other words, personal construct theory provides an explanation for individual differences and also for group or cultural differences which provides the basis for exploring some similarities and differences of the thought processes of the adopters and the four groups of non-adopters.

The findings also showed that these five groups of decision makers were dynamic in nature and can possibly change from one group to another. This is possible because their personal construct systems are constantly changed and developed in accordance with their experiences.

Therefore, because we are able to identify the four groups of non-adopters and their personal construct systems, we are then able to know their own reasoning behind their action or behaviour. This has, therefore, a wide practical implication to farm management research and extension in terms of understanding farmers' circumstances in trying to develop some policies and strategies of increasing the uptake of new technologies by farmers. In other words, by understanding the personal construct systems of the adopters and various groups of non-adopters provides useful guidelines to the development of technology transfer programmes in order to educate the clientele and to reap the benefits from using the new technologies.

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Appendix 1

Results of Analyses of the Repertory Grids of Adopters and Non-adopters

A1.1 Introduction

This appendix presents the detailed results of analysis of the repertory grids of the adopters and non-adopters. A brief description of the background information of all the subjects is presented before the analyses.

A1.2 Adopters' Constructs

A1.2.1 Subject 3's Constructs

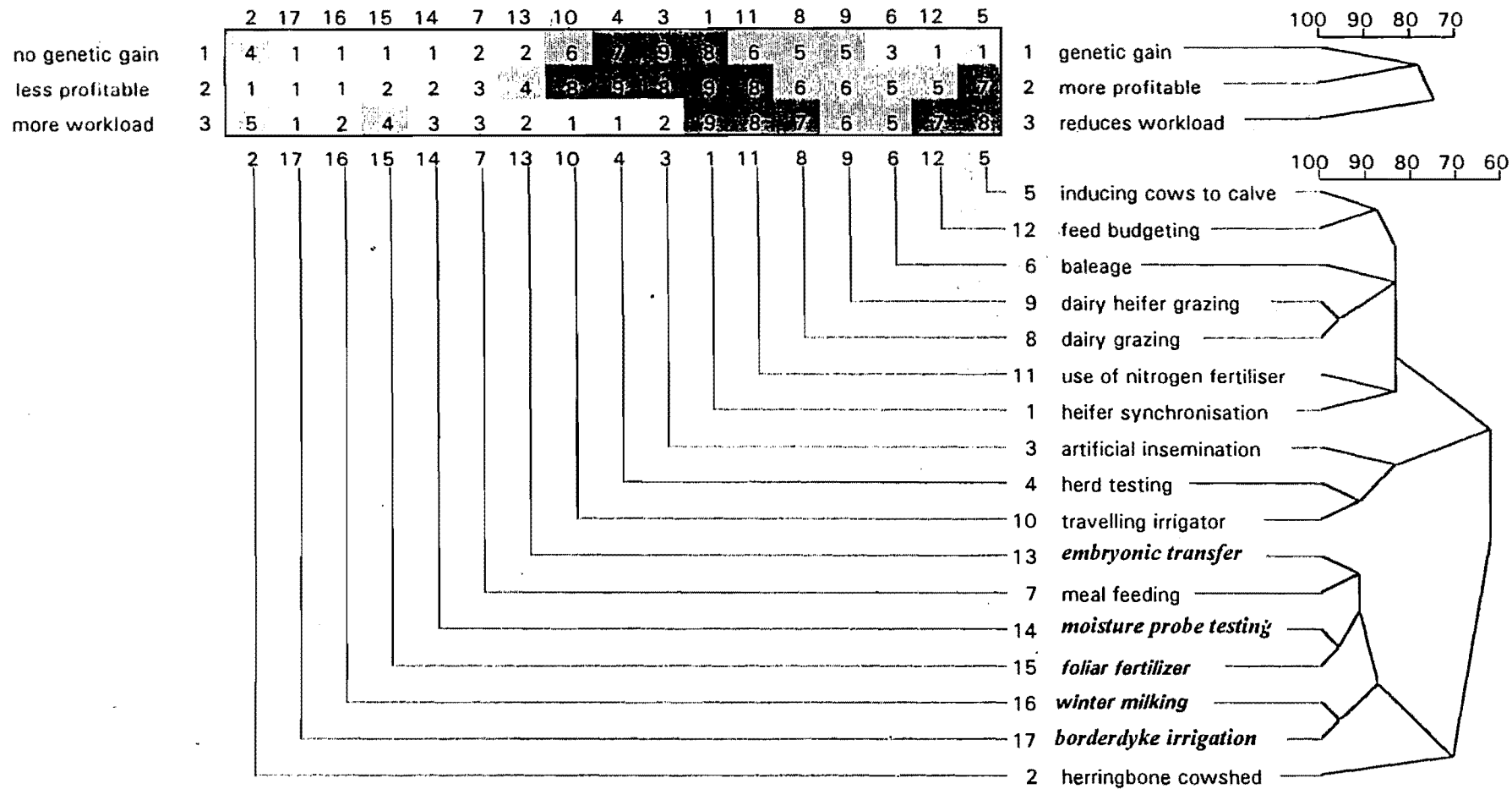
Subject 3, aged 48 years, has a Diploma in Agricultural Science/Farm Management. He has an 82-hectare dairy farm with 200 milking cows. He indicated that when he first bought the property it was originally a cropping farm with poor soil structures, no pastures, no fences and no irrigation. About seven years ago he decided to convert it into a dairy farm by putting in irrigation, upgrading the pastures, buying cows and also leasing cows from other farmers. According to him his farming objectives were to use modern farming ideas and to feed his stock well. He also indicated that his personal objective was to have enough spare time and money for the family for their leisure activities.

One of the modern techniques which he has adopted in order to achieve his farm objectives was the use of heifer synchronisation in cattle. He has been using this technology for about three years. He said he was very pleased about the technology in terms of its performance and his expectation of its benefits.

Focus analysis

The focus analyses results for subject 3 are shown in Figure A1.1. One general comment made by subject 3 with regard to the Element Tree was that the adopted innovations (marked clear) are generally separated from the non-adopted ones (marked in bold and

Figure A1.1: Focused grid for subject 3



italic). The adopted innovations occur at the top and form one cluster and the non-adopted ones occur at the bottom and form another cluster. However, the herringbone cowshed has been adopted but is located among non-adopted innovations, while embryonic transfer has not been adopted but is located among the adopted innovations.

The subject was asked to give his comment on this form of arrangement. In reply, he indicated two important factors in his farming system: (1) profitability and (2) suitability of the innovations. He said that those adopted innovations, such as heifer synchronisation, travelling irrigator and nitrogen fertiliser are related to profitability. According to him he would not be able to farm without irrigation and application of nitrogen fertiliser. Similarly, using heifer synchronisation in association with artificial insemination and dairy heifer grazing would allow him to increase his farm cash flow. There were five non-adopted innovations: borderdyke irrigation, winter milking, foliar fertiliser, moisture probe testing and embryonic transfer. Subject 3 indicated that borderdyke irrigation and moisture probe testing were not needed because the existing soil types on his farm were not suitable for them. He said that the embryonic transfer technique was very expensive and therefore not applicable in his farming system.

Subject 3 observed that dairy grazing and dairy heifer grazing are very tightly matched at 96 per cent and these are clustered with baleage, use of nitrogen fertiliser and heifer synchronisation at 83 per cent. He said they are all concerned with pasture management and milk production, and hence with increasing profitability. Dairy grazing and dairy heifer grazing are both associated with grazing the animals off-farm away from the main property. The only difference is that in dairy heifer grazing the heifers are grazed on another farmer's property on a contract basis. The subject also indicated that he has also owned a run-off property away from the main property for his dairy grazing. During the interview the subject indicated that half of his cows were on the run-off and the other half was off-farm on another farmer's farm. Subject 3 also indicated that baleage, feed budgeting and inducing cows to calve are matched at 83 per cent. According to him, he used baleage as a form of supplementary feed for his animals and therefore used as feed budgeting. He said he has

been using the technique of inducing cows to calve for seven years which required a sufficient amount of feed, such as baleage.

He also observed that herd testing and a travelling irrigator are very tightly matched at 92 per cent and that these are clustered with artificial insemination transfer at 83 per cent. The subject explained that these innovations were all connected to profitability. Herd testing and artificial insemination were related to genetic improvement. He said he had to use travelling irrigator to boost his pasture production.

The above interpretation provided by subject 3 of the clusters of elements in the Element Tree suggests that some of the innovations are related to each other in terms of their usefulness and importance in his farming system. In other words, in the decision to adopt or introduce a new innovation on his farm, subject 3 makes some reference to the aspects of the existing innovations(s) and its contribution in terms of achieving his farming objectives.

The constructs obtained from the triadic comparison of elements were shown in the Construct Tree at the top of Figure A1.1. The subject used three important construct dimensions to construe the innovations: genetic gain, profitability and workload. The rating scale value was numbered from 1 to 9. Number "1" indicates a very strong rating with respect to construct pole labels on the left of the grid, and number "9" represents a high rating of the labels on the right of the grid. The subject has shown three construct dimensions in his decision to adopt heifer synchronisation: genetic gain, profitability and workload. The following sub-section examines each of the three construct dimensions:

Genetic gain

In this study, the subject believed that one of the most important constructs he used to construe heifer synchronisation was genetic gain. He gave a very high rating of "8" to heifer synchronisation on this dimension. The subject pointed out that the genetic gain derived from using heifer synchronisation was a long-term benefit to him. In other words, he viewed the technique as having the ability to increase the genetic quality in his herd in terms of the

future increase in milk production and hence profitability. He also noted the important aspects of breeding index and reduction of the generation interval which contribute to the increase in the rate of genetic gain.

It is important to note that veterinarian scientists argue that heifer synchronisation is essentially a management tool and only partly related to increase in genetic gain. Subject 3 emphasises genetic gain more than that of the veterinarian scientists. His emphasis is more on the long-term benefit as a result of using the programme.

Profitability

The second construct dimension used by subject 3 is profitability. He gave a high rating of "9" to heifer synchronisation on this dimension, meaning that it improves profitability. As described earlier, the genetic gain derived from the use of heifer synchronisation is construed as a long-term benefit by subject 3. In other words, using heifer synchronisation is much like a "business investment" where an individual is expected to get the profit at a later stage. He also sees heifer synchronisation contributing to his farm profitability. This was in relation to the incorporation of heifer synchronisation in the leasing of dairy cattle. Leasing of dairy cattle is one of the strategies used in order to increase milksolid production on New Zealand dairy farms (Deane *et al.*, 1991). In this type of farming activity the agreement benefits both parties - the lessor and the lessee. It provides a useful means for a farmer (who may have a capital constraint) to increase milking cow numbers without committing himself to purchase, and for another farmer to earn additional income without having to manage their animals.

During the interview, the subject indicated that he had just purchased additional property, thus increasing his effective farm size. Therefore more milking cows were required. However, he had limited capital to purchase new stock. He said he had two options which allowed him to increase his cow numbers: (1) to obtain credit from the commercial bank, or (2) to lease cows from other farmers. With the bank interest rate of 12-13 per cent he decided to lease cows from other farmers instead of getting credit from the bank. He said that he had made the right decision to lease cows in order to increase their numbers. The

first construct related to heifer synchronisation was genetic gain. As explained earlier, using this technique subject 3 argued that he was able to have higher genetic value calves back in his herd. In other words, he believed that he would have more heifers and extra heifer calves to choose from. He believed that this new technique therefore helps him to increase his cash flow and also to reduce the number of his leased cows. In this lease agreement, he said, he took delivery of the cows before calving. He kept the calves and the proceeds from the sale of calves. He also milked the cows for his income. At the end of the agreement he was required to return the cows in-calf to the other farmer.

People can go to the bank when they have a capital constraint on certain business activities such as buying in more cows. However, if the term and conditions, such as the interest rate, are not conducive for borrowing, people may turn down the option and look for an alternative. Subject 3 has considered such borrowing but prefers to lease to increase cow numbers. The subject believed that in increasing the cow numbers he also increased the genetic quality of his heifer calves. Because he was able to increase his herd size with good genetic material he does not now have to lease in so many cows from other farmers.

Workload

The third construct dimension relates to workload. Subject 3 also gave a very high rating of "9" to heifer synchronisation on this dimension, meaning that it reduces his workload. He indicated that one of the short-term benefits of using heifer synchronisation was in terms of reducing workload associated with milking of cows. The subject means that reducing workload helps him to save his time, labour and effort in terms of breeding or milking cows. According to the subject, the basic principle of heifer synchronisation is that it results in a concentrated calving pattern for the animals. In other words, the innovation allows him to have his heifers calve as early as possible and at the same time. He indicated that this sort of calving pattern is important to him because he is a seasonal milk supplier and has to ensure that he produces as much milk within a specified period of time. According to him, the whole process would only be done once or twice by the technician.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 3's grid attributable to the first principal component is 60.3 per cent. This shows that most of the variables are located on this component. In Figure A1.2a, the positive end of the first principal component shows two construct labels, more profitable and genetic gain, which score highly on this component as do the four elements consisting of heifer synchronisation, artificial insemination, herd testing and inducing cows to calve. A general theme that best describes this first component is "genetic gain for profits" (Figure A1.2b). These four innovations are important to subject 3 because they contribute to achieving his farm objective of increasing profitability through genetic gain or improvement of genetic merit in the herd. The negative end of the first principal component shows two construct labels which score highly on this component: less profitable and no genetic gain. There are six elements which score highly on the component: meal feeding, foliar fertiliser, moisture probe testing, herringbone cowshed, winter milking and borderdyke irrigation. Obviously none of these elements are not related to genetic gain. Five elements, consisting of foliar fertiliser, winter milking, embryonic transfer, moisture probe testing and borderdyke irrigation, were not adopted by this farmer because they were less important and did not contribute towards achieving his goal of increasing profitability.

In the second principal component, the percentage of variance in subject 3's grid attributable to the component is 29.7 per cent. The positive end of the component shows one construct label, reduces workload, which loads heavily on this component as do the three elements consisting of feed budgeting, uses of nitrogen fertiliser and travelling irrigator. A general theme that can be used to describe this component is "convenience". The three innovations mentioned above are important to this subject because they help reduce subject 3's workload; that is, work pressure on his farm. Thus the innovations will make him more convenient to operate his farm.

A1.2.2 Subject 5's Constructs

Subject 5, aged 38 years, has completed his school certificate. Previously he was a sharemilker operating a small family town-supply farm. The family moved to their new 200-hectare property three years ago hoping to expand his operation by milking more cows.

Figure A1.2a: PrinCom analysis for subject 3

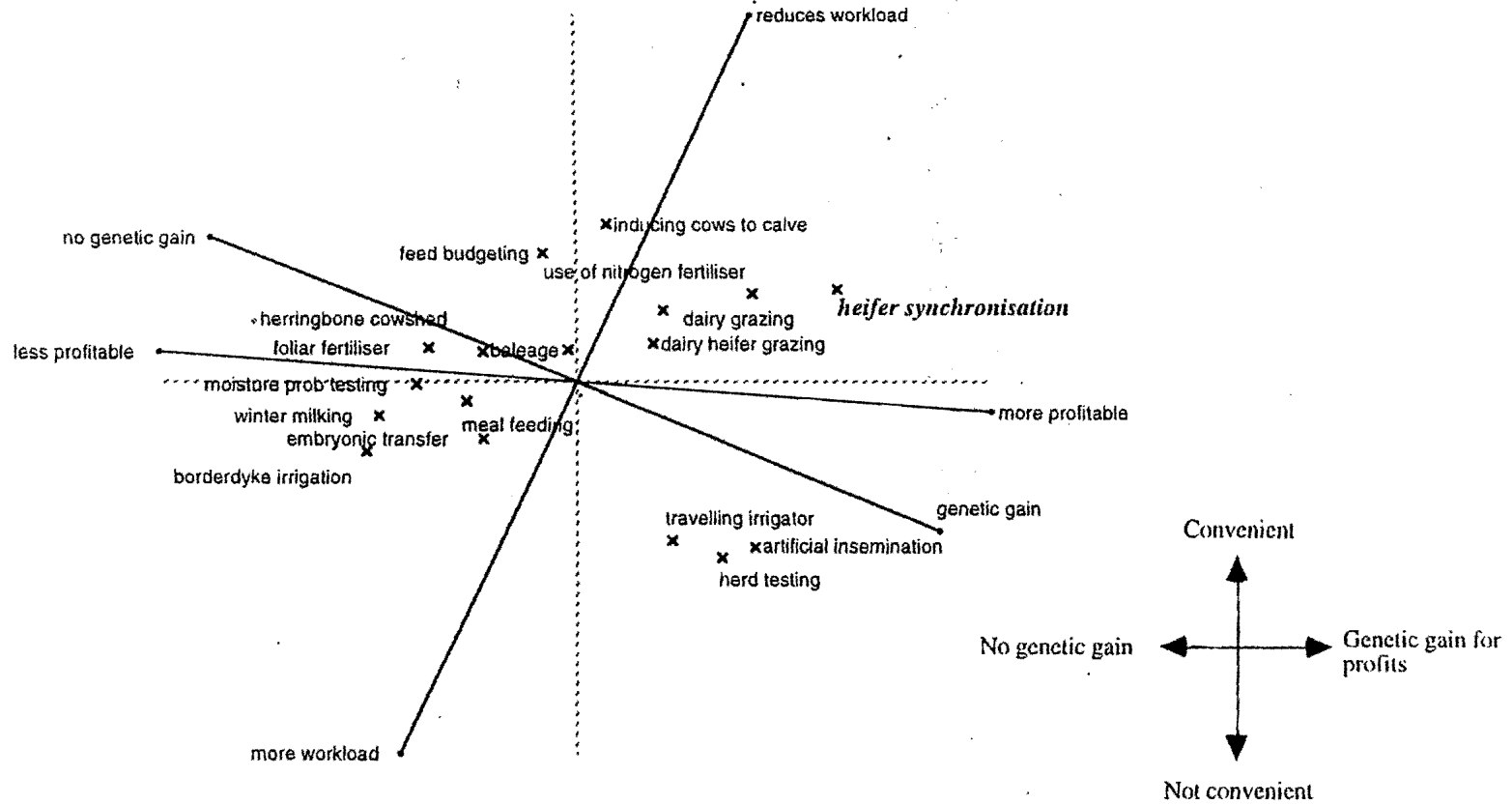


Figure A1.2b: Principal components for subject 3

Presently he has 350 milking cows. He indicated that his main farm objective was to keep his farm running and producing at its full potential.

Subject 5 has been using heifer synchronisation technique for about eight years. He indicated that his main reason for using the technique was to speed up the breeding programme in order to produce better quality genetic material in his herds. He indicated that he was very pleased with the technique. The results of the analysis of his grid are presented as follows.

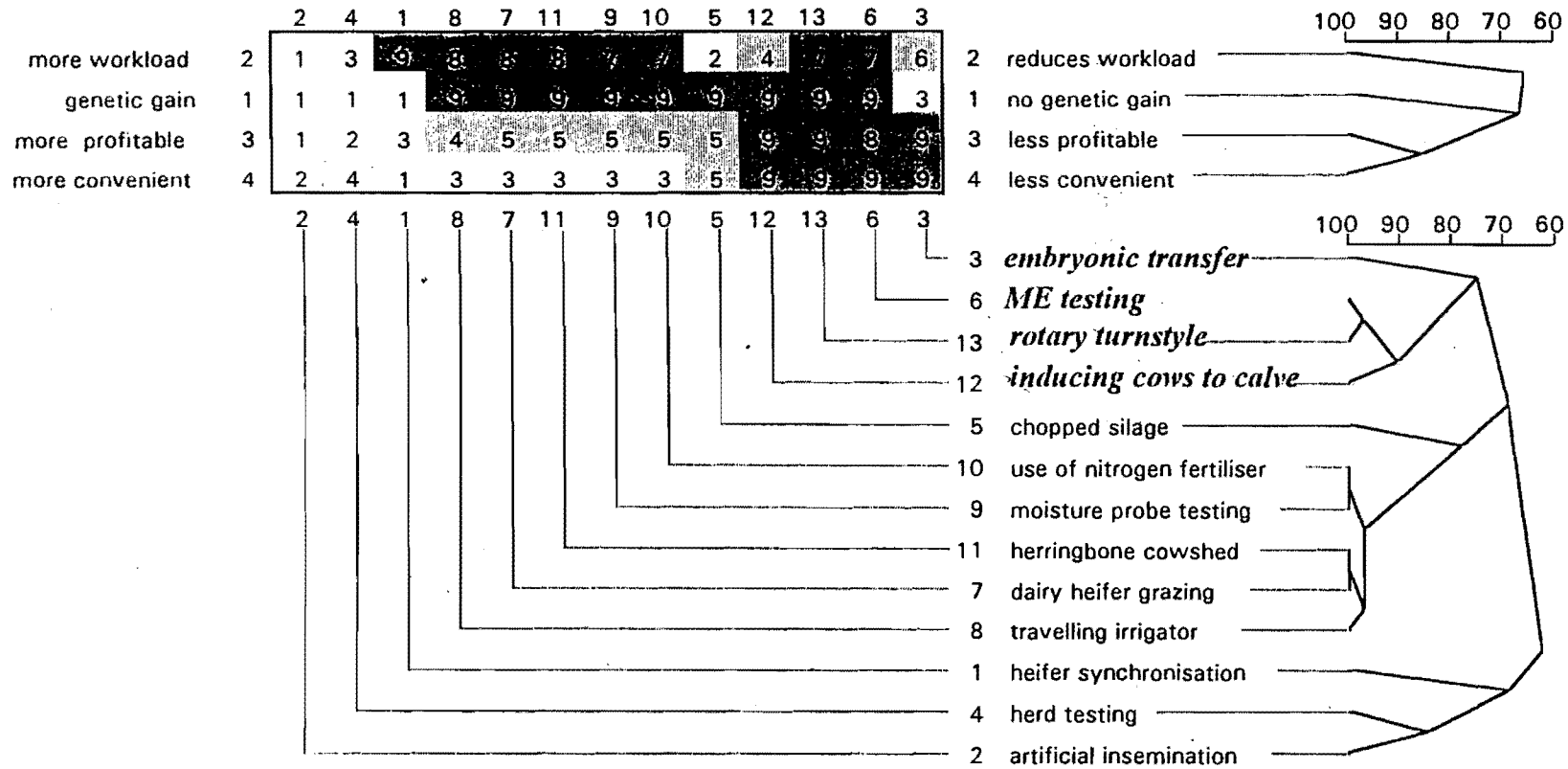
Focus analysis

The focus analysis results (focused grid) of subject 5 are shown in Figure A1.3. It consists of 13 elements displayed on the Element Tree and four construct dimensions shown on the Construct Tree. His assessment of the grid is as follows.

The subject was asked to give his interpretation or assessment of the focused grid. In other words he was asked to comment what it meant to him in terms of the clustering of some of the elements. By looking at the Element Tree, his initial reaction was that the non-adopted innovations consisting of embryonic transfer, metabolisable energy testing, rotary cowshed and inducing cows to calve were clustered together at the top and the adopted ones formed another cluster at the bottom of the Element Tree.

Metabolisable energy (ME) testing and rotary cowshed are tightly matched at 97 per cent and these are clustered with inducing cows to calve at 90 per cent. These are then clustered with embryonic transfer at 75 per cent. Subject 5 said the four non-adopted innovations were tightly matched because they were not needed in his farming system. He indicated that embryonic transfer and rotary cowshed were too expensive in his present system. He said that the rotary turnstyle cowshed was meant for those having a larger herd. He was still evaluating the benefit of using metabolisable energy testing. He indicated that he would never adopt the technique of inducing cows to calve because he was a town milk supplier and has to supply milk throughout the year. The other important consideration associated with using this technique was because of the concern from the local animal environmental group which does not want to see the calves to be killed prematurely.

Figure A1.3: Focused grid for subject 5



With regard to subject 5's adopted innovations, herd testing and artificial insemination are tightly matched at 84 per cent and are then clustered with heifer synchronisation at about 70 per cent. He said these two elements were both related to genetic improvement in the herd. Using herd testing enabled him to monitor his herd or to select the most profitable animals in terms of their ability to improve the genetic gain. The artificial insemination programme helped him to increase the rate of genetic gain. The synchronisation programme helped him to synchronise the oestrous cycle of the heifers so that they calved as early as possible. He also believed that synchronisation was related to improvement in the genetic gain in the herd.

The use of nitrogen fertiliser and moisture probe testing are very tightly matched at 100 per cent, and are then clustered with herringbone cowshed, dairy heifer grazing and travelling irrigator at 95 per cent. Subject 5 indicated that his farm depended heavily on irrigation as a source of water for his pasture and stock. In order for him to be able to use the irrigation efficiently he used moisture probe testing to monitor the soil moisture levels. He used a lot of nitrogen fertiliser on his farm in conjunction with the soil temperature and moisture for maximum pasture growth and high quality feed for the animals.

The herringbone cowshed and dairy heifer grazing are matched very tightly at 100 per cent and are then clustered with travelling irrigator at 97 per cent. These three are then clustered with moisture probe testing, use of nitrogen fertiliser and chopped silage at 96 per cent. This group of elements are more closely related to non-adopted innovations than to the other three adopted innovations comprising of heifer synchronisation, herd testing and artificial insemination. Subject 5 indicated that the reason for this could be that they were not related to genetic improvement, while the other three elements consisting of heifer synchronisation, artificial insemination and herd testing, are all directly related to genetic improvement.

Subject 5 has disclosed two major forms of activities from his focused grid which he believed would help achieve his objectives: (1) genetic improvement, and (2) increases quantity and quality of feed. His farm objectives were to keep his farm running and producing at its full potential through increasing its profitability.

Figure A1.3 shows the four construct dimensions used by subject 5 to construe the elements: genetic gain, workload, convenience and profitability. The following sub-sections describe each of these dimensions.

Genetic gain

The first construct dimension used by subject 5 is genetic gain. He gave a strong rating of "1" to heifer synchronisation on this dimension.

Subject 5 believes that heifer synchronisation technique is directly related to improvement in the rate of increase of genetic gain in the herd. He indicated that, in the synchrony programme, he incorporated artificial insemination into the system, which utilises the latest semen available. He later kept the offspring from the better animals. The scientists perceive that the main objective of the synchrony programme is to get the heifers to calve as early as possible and not so much on increasing the rate of genetic gain. However, subject 5 perceives that heifer synchronisation helps increase the rate of genetic gain in the herd in addition to concentrating the calving patterns in the herd. He construes this process as "...jumping one year of your breeding programme". He said he had been using the technique for about eight years and the results were satisfactory. By using one insemination, he indicated that he was only able to achieve a 50 per cent conception rate. However, when using two inseminations the conception rate was as high as 70 per cent. He also mentioned that one of the main problems in using heifer synchronisation was getting sufficient number of female offsprings. In other words, his experience shows that he was getting more male offsprings instead of females. However, although he experienced that the conception was as low as 55 per cent (from a single insemination), and that he has also the problem of getting not enough female offspring, these results did not deter him from using the programme. He was in fact very happy with its performance.

Workload

The second construct dimension used by subject 5 to construe the innovations is workload. He gave a high rating of "9" to heifer synchronisation on this dimension, meaning that it helps reduce his workload. From his perspective heifer synchronisation plays a very important part in his farming system in terms of time and labour.

Subject 5 explained that at present all his heifers were grazing off-farm at another farmer's property. They were a distance away from his farm. He said the only way to reduce costs in terms of labour and transport was to use the synchrony programme. He said he has two labour units which were just sufficient to keep the farm running. He indicated that by using such a programme he did not have to go out to the herd and take all the hassle to observe those heifers which are in cycle.

The explanation given by subject 5 on the importance of heifer synchronisation in terms of reducing workload implies the significance of time and labour in his farming system. Time and labour are considered as costs in his farming operation. As specified in his farming objective, he needs to expand his farm by increasing the cow numbers and having the farm produce at its full potential. In order to achieve this objective, he needs to reduce his operational costs, such as time and labour inputs. He, therefore, believes that the synchrony programme is able to do this.

Convenience

The third construct dimension used to construe heifer synchronisation is convenience of its use. Subject 5 gave a strong rating of "1" to heifer synchronisation on this dimension.

Subject 5 has mentioned that all his heifers were grazed off-farm at another farmer's property. Using heifer synchronisation he said he did not have to worry about going to the farm several times or about the supply of additional labour in order to identify all those heifers which were in cycle. He said once the programme was done he did not have to worry

about the animals again. In this way he indicated that the programme gave him a lot of convenience in managing those heifers in calf.

Another important aspect concerning the convenience of using the programme, as indicated by subject 5, is related to operating the batch mating of his heifers. Firstly, he said he did not have to worry about doing the insemination because this was done by the technician. Secondly, he did not have to travel frequently to the grazier's property to do the insemination. Thirdly, he did not have to worry about identifying those heifers which were in cycle and ready for insemination. He considers that these aspects made his work more convenient and efficient. Therefore, using heifer synchronisation provides him a lot of convenience in terms of synchronising and inseminating his heifers.

Profitability

The fourth construct dimension used by subject 5 is profitability. The subject gave a rating value of "3" to heifer synchronisation on this dimension, meaning that it improves profitability. The subject also considered profitability an important factor in relation to heifer synchronisation. He explained that the programme allows him to have his heifers calving earlier with the same calving pattern. It therefore increases the amount of milk produced, and hence profitability.

The other reason why subject 5 thought heifer synchronisation is more profitable is in terms of the selection of heifers. He argued that this synchrony programme has given him a greater nucleus from which to select his heifer calves. In other words, he has more heifers to select from for his breeding stock.

Subject 5 also said he viewed heifer synchronisation as a long-term financial benefit. He believes that the use of heifer synchronisation would enable him to improve the genetic quality in his herd and hence future profitability.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 5's grid attributable to the first principal component is 56.6 per cent. The positive end of the component shows two construct labels which score highly on this component: more profitable and genetic gain (Figure A1.4a). There are three innovations which score highly on this component: heifer synchronisation, artificial insemination and herd testing. A general theme that best describes this first component is "genetic gain for profits" (Figure A1.4b). These three innovations are believed to be very important to this subject because they are all related to genetic improvement. The synchrony programme allows the heifers to have their cycles synchronised before they are artificially inseminated so that they will calve earlier and at the same time. In the long term, he said, the programmes also help improve the genetic quality in the herd. Therefore these three innovations are important to the subject because they contribute both short- and long-term benefits of increasing farm profitability.

In the second principal component the percentage of variance in subject 5's grid attributable to the component is 28.5 per cent. The positive end of the component shows two construct labels which score highly on this component: reduces workload and more convenient. Some of the elements which score highly on the component are: travelling irrigator, dairy heifer grazing, herringbone cowshed, use of nitrogen fertiliser and moisture probe testing. A general theme that best describes this component is "genetic gain for profits". The innovations just mentioned are important to the subject because they reduce this subject's workload, and are therefore seen as convenient.

A1.2.3 Subject 6's Constructs

Subject 6, aged 56 years, holds a Diploma in Agricultural Science/Farm Management. He operates the 200-hectare family property in partnership with his brother. Because of a health problem he lives off the farm and takes care of the farm administration, such as financial management of the farm. His brother lives on the farm, and runs the farm with three staff. At present they have about 400 milking cows. Their farming objective is to be able to develop the farm to a maximum level of production from the 400 cows and make it financially stable. The subject also indicated that because of old ages they have a plan to move out physically

Figure A1.4a: PrinCom analysis for subject 5

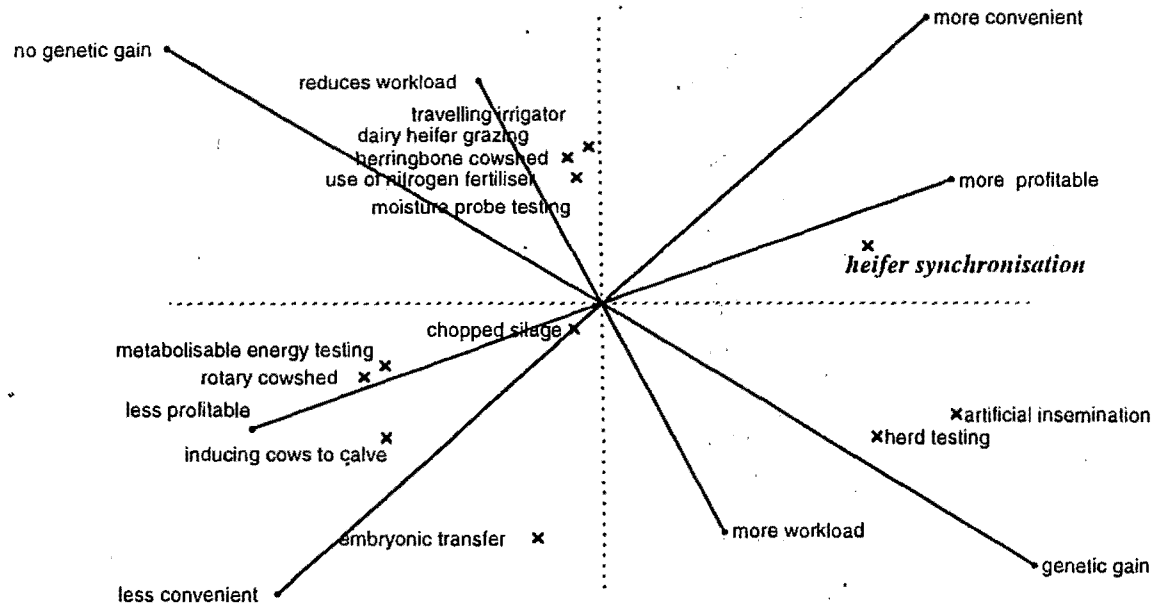
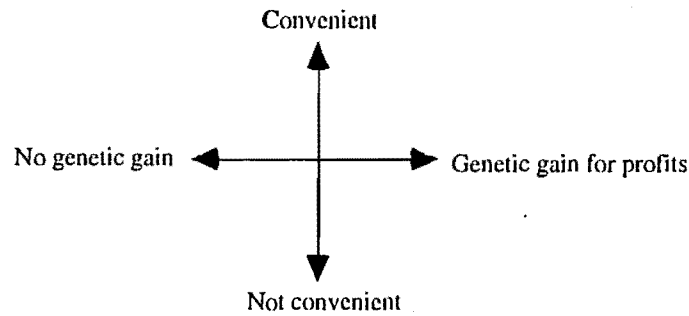


Figure A1.4b: Principal components for subject 5



from farming within the next two or three years. They propose either to put a sharemilker, a manager, or a contract milker on the farm.

The subject had stated that he has been using heifer synchronisation for about four years. According to him he was very happy with the technique in terms of the benefits he could get from it.

Focus analysis

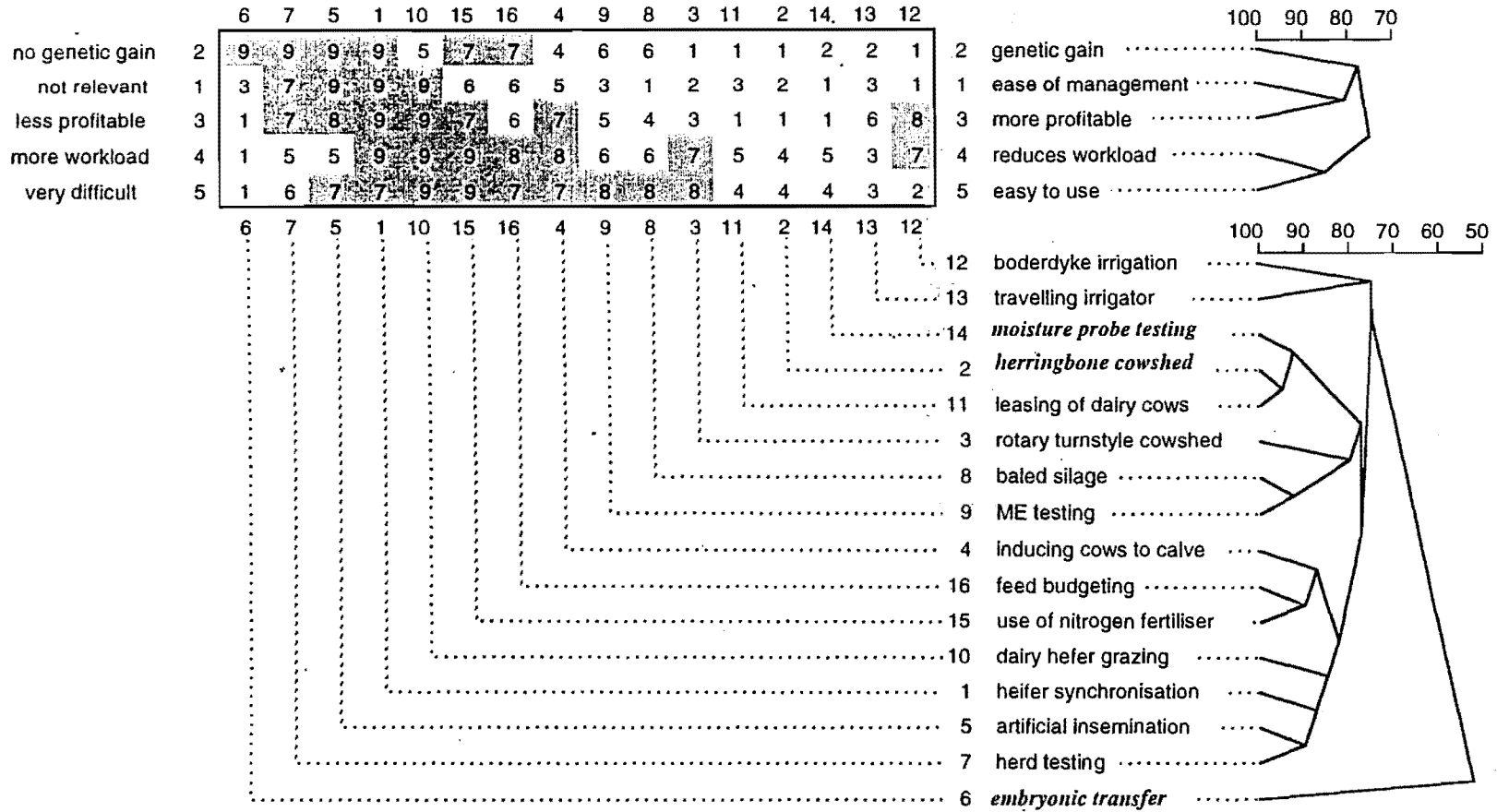
The focus analyses (focused grid) results for subject 6 are shown in Figure A1.5. It consists of 16 elements on the Element Tree and five construct dimensions on the Construct Tree. His interpretation of the grid is as follows.

The subject indicated that the Element Tree consists of the non-adopted and adopted innovations. He gave reasons for not adopting the innovations and also his interpretations of the clusters of elements.

He pointed out there were three innovations on the Element Tree which he did not adopt: moisture probe testing, embryonic transfer, and the herringbone cowshed. He said embryonic transfer is related to genetic gain, but, that he did not adopt this technique because it was too technical and not practical for an ordinary farmer like himself. He did not use moisture probe testing to test the moisture level in his area because they were operating the water system in a group with their neighbours, and did not consider the technique to be useful.

They took turns and would share the water around among themselves without considering whether the soil would need water or not. He had used a herringbone cowshed for nearly 30 years. However, when he decided to expand the operation in 1983 by increasing his cow numbers, he had to switch over to a better system, that is, a rotary turnstyle cowshed. He said that a herringbone cowshed was suitable for small cow numbers but not suitable for more than 200 milking cows.

Figure A1.5: Focused grid for subject 6



Subject 6 observed that herd testing and artificial insemination are tightly matched at 90 per cent and that these are clustered with heifer synchronisation at 87 per cent. He explained that herd testing and artificial insemination were both directly related to genetic improvement in the herd. Heifer synchronisation was a management tool and was also related to genetic improvement. He said his heifers were grazed off-farm and for practical reasons he needed to do both artificial insemination and synchronisation at the same time. Similarly, he said that if he wanted to get more value from artificial insemination he needed to do herd testing, so that he would be able to pick his best and worst animal. In other words, from his point of view all three types of innovations were related to each other.

Feed budgeting and use of nitrogen fertiliser are tightly matched at 90 per cent, and these are clustered with dairy heifer grazing at 85 per cent. Subject 6 said that feed budgeting was very useful because it allows him to determine the quantity and quality of feed available at a particular time of the year. In other words, feed budgeting dictates the amount of nitrogen fertiliser required at a particular time. He said he must ensure that feeds were always sufficient because he was also using the induction method of producing milk.

Baled silage and metabolisable energy (ME) testing are also tightly matched at 92 per cent and these are clustered with rotary turnstyle cowshed at 82 per cent. According to him, baled silage and ME testing were related because one was a product of the other and both were used in feed management in a dairy herd. He said that there was a need to carry out the test on the silage to determine its nutritional value for the herd.

Leasing of dairy cows and the herringbone cowshed are tightly matched at 92 per cent and are then clustered with moisture probe testing at 91 per cent. Subject 6 did not think there was a strong linkage between these two elements. He said the possible connection between them was in terms of their level of use on his farm. He did not make much use of leasing dairy cows because he was quite happy with his present herd size. He had used a herringbone cowshed, but because of an increase in the number of milking cows, he decided to change to a bigger capacity rotary turnstyle cowshed. Moisture probe testing also was not applicable in his farming operation.

Figure A1.5 shows the focused grid of subject 6 displaying the five construct dimensions which he used to construe the elements. These five construct dimensions are: genetic gain, ease of management, profitability, workload and ease of use. The following sub-sections explain each of the five construct dimensions.

Ease of mating management

The first construct dimension used to construe the innovations is their ease of mating management. As shown in the Construct Tree the subject gave a very high rating of "9" to heifer synchronisation on this dimension. This implies that the heifer synchronisation programme is very important to him in relation to mating management in his herd.

Subject 6 indicated that all his heifers are grazing off-farm at the grazier's property, which was an hour and half away from the main property. He said he was grazing his calves away from his farm from the time they were six months until they were 22 months old, or when they were ready for mating. His objective was to use artificial insemination because he wanted to have the heifers mated to good quality bulls. However, because the heifers were away from the main property, he considered the heifer synchronisation technique offered a practical approach to the mating of those heifers. According to him, under his farm situation using heifer synchronisation technique has provided him with an ease of mating management of his heifers. He said synchronisation technique on his farm basically involves basically six stages: (1) Day 1 - insertion of CIDR by the farmer, (2) Day 6 - injection of prostaglandin by the technician, (3) Day 10 - removal of CIDR by the farmer, (4) Day 12 - first insemination by the technician and (5) Day 14 - second injection by the technician.

He explained that this technique allowed him to have most of his heifers calving earlier. In other words, it allows him to manipulate the calving pattern of the heifers so that most of them would calve earlier than the normal period. Consequently, it would allow him to have a more concentrated pattern of calving.

Genetic gain

The second construct dimension used is “genetic gain”. As shown in the Construct Tree, the subject views this dimension as very important in terms of improving the genetic merit of his herd. He gave a rating scale of “9” to heifer synchronisation on this dimension. In other words he has a strong belief that heifer synchronisation would be able to improve the genetic gain in his herd.

He indicated that the best way for him to get a high genetic gain in his herd was to use the bulls from the New Zealand Dairy Board, and that artificial insemination would be used. However, because all his heifers were away from the farm, he said the best way to manage the artificial insemination was to use synchronisation programme. If he did not synchronise these heifers it would be impossible for him to go out and artificially inseminate them on a daily basis. He reiterated that if he were to run the heifers using the ordinary bulls, he would not be able to get the same genetic gain as those using heifer synchronisation and the good bulls.

Profitability

The third construct dimension used is “profitability”. Subject 6 gave a high rating of “9” to heifer synchronisation on this dimension. He indicated two aspects of profitability from using heifer synchronisation: (1) it enabled him to use artificial insemination and (2) it also enabled him to have an earlier calving of heifers.

Subject 6 said heifer synchronisation was more profitable because it enabled him to use artificial insemination from good bulls. As a consequence he said it has shortened the generation interval of these heifer progenies. He claimed that these progenies had a much higher breeding and production worth than their parents. He argued that by using heifer synchronisation he was basically lifting the genetic quality in his herd, lifting the potential milk production, and hence lifting the profitability.

The other aspect of profitability in using heifer synchronisation, as pointed out by the subject, was related to early calving of heifers. He claimed that this was important to him because he was a seasonal supplier of milk, and should therefore ensure a peak supply of milk at certain time of the year.

He explained that their factory was only open from the 1st of August until the 30th of May the following year. The closer the cows calve to the 1st of August, the more profit they would have in terms of milk production. He claimed that this was made possible through the synchronisation technique because a large number of cows calve very close to the 1st of August. In other words, he said these cows have the potential for more days in milk by the end of May the following year.

Workload

The fourth construct dimension used is workload. Subject 6 gave a rating of "9" to heifer synchronisation on this dimension. He claimed that using heifer synchronisation helped him reduce or lessen his workload in terms of breeding or mating his animals, compared to those non-synchronised heifers, especially if artificial insemination was used. According to him, using the synchronisation programme replaced a batch mating approach where he only had to visit the herd once a day. By doing so, he was then able to do all the work needed in that short period of time. He argued that if he were to use a non-synchronised artificial breeding system, he would have to go out to the herd of heifers every day. In this case he would have to select for artificial insemination only those heifers which were in oestrous. He did not agree to this non-synchronised artificial insemination technique, because from his opinion it would create a lot of work for him to proceed with the mating. Moreover, under his farming situations where the heifers were grazed off-farm, he claimed that it was practically impossible to do the batch mating of his heifers. In other words, using heifer synchronisation allows him to concentrate the calving within six weeks, and hence reduces workload. Non-synchronisation technique means enabling the heifers to calve and spread out over a two or three months period.

Ease of use

Subject 6 also chose “ease of use” as one of the construct dimensions used to construe the innovations. He gave a rating of “7” on heifer synchronisation on this dimension. He said the heifer synchronisation technique was easy to use. Most of the work involved handling of CIDRs, because artificial insemination was done by the veterinary technician. The major steps of handling the synchrony programme and artificial insemination as described by the subject were as follows: (1) going to the property where the heifers were being grazed, (2) putting the CIDRs across and tailpainting the heifers, (3) removing the CIDRs, (4) artificial inseminating by the technician, and (5) artificial re-inseminating for those heifers which did not conceive.

The subject indicated that the whole process was very easily done by the farmers themselves because once the injection was done the job is finished. He indicated that because his heifers were away from the main property using heifer synchronisation was much easier to do than mating. Once the synchronisation programme and artificial insemination were done, the job was completed. Subject 6 has revealed that synchronisation technique is easy to use. It does not involve any technical or complicated procedure, and this is important in his decision to adopt the new technique.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 6’s grid attributable to the first principal component is 60.8 per cent. In Figure A1.6a, the positive end of the component shows four construct pole labels which load heavily on this component: more profitable, ease of management, easy to use and genetic gain. Some of the elements which score highly on the component are: heifer synchronisation, artificial insemination, herd testing, use of nitrogen fertiliser and dairy heifer grazing. One general theme that best describes this component is “genetic gain for profits” (Figure A1.6b). These innovations stated above are important to this subject because they all contribute to farm profits through better mating, pasture management programmes and genetic improvement. The negative end of the pole shows three construct labels, less profitable, not relevant, very difficult and no genetic gain,

Figure A1.6a: PrinCom analysis for subject 6

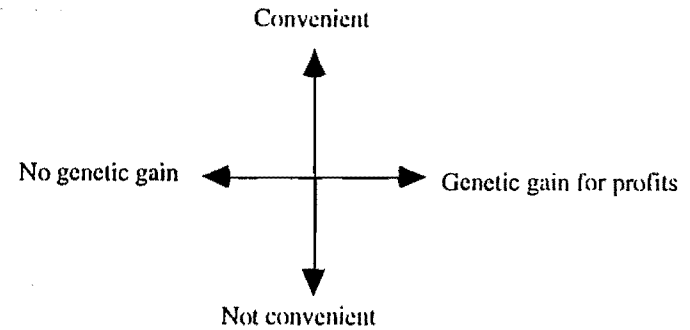
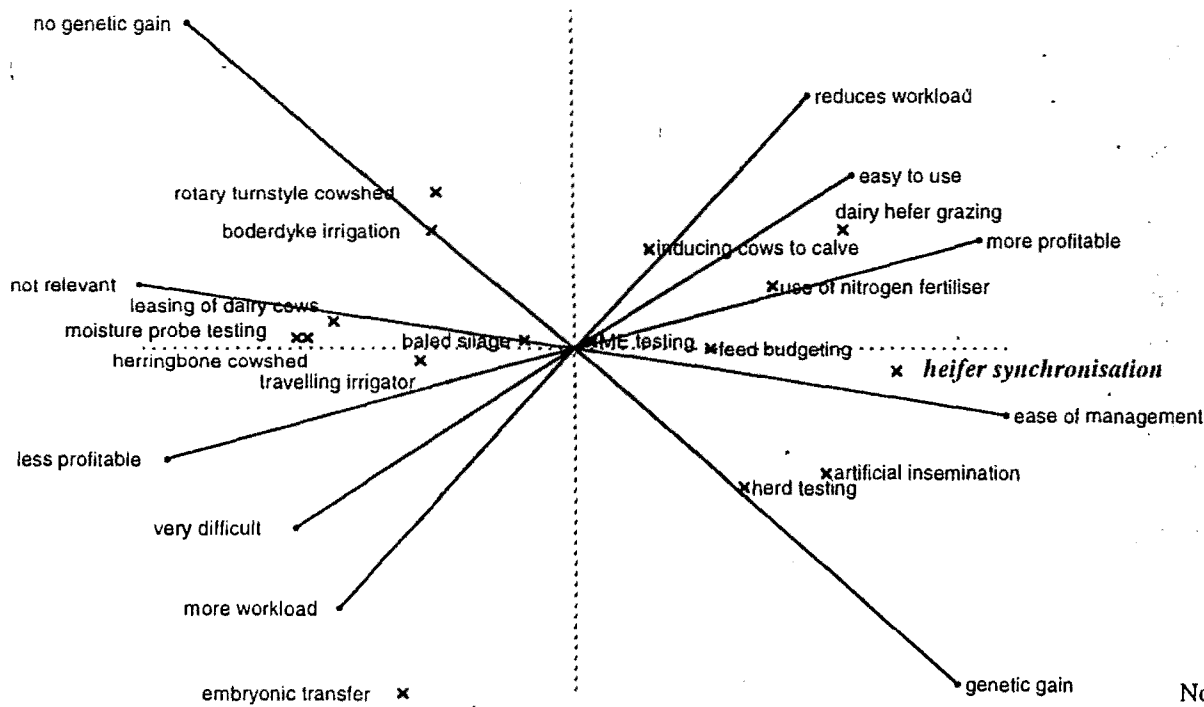


Figure A1.6b: Principal components for subject 6

which score highly on this component, as do the elements moisture probe testing, leasing of dairy cows, herringbone cowshed, embryonic transfer and rotary turnstyle. Some of the above innovations are not adopted because they are considered as irrelevant and not needed by the subject. One innovation, embryonic transfer, was very difficult to operate, and hence was not adopted by this subject.

A1.2.4..Subject 8's Constructs

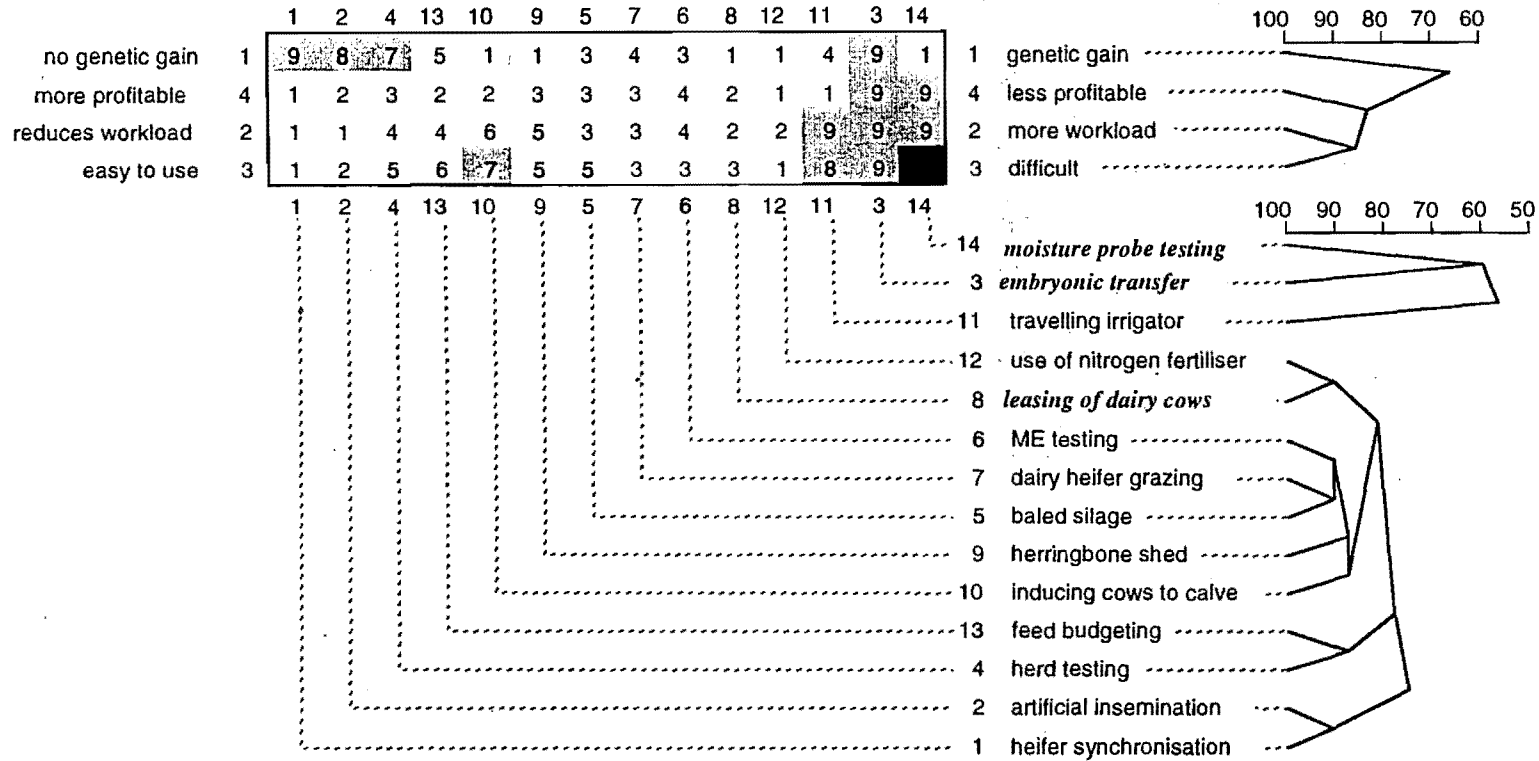
Subject 8, aged 42 years old, has a school certificate qualification. He has been farming his 64-hectare property for about 14 years. At present he has 250 milking cows. One of his farming objectives was to be able to increase milk production per cow through the use of new ideas. One of the few technologies that he has adopted was the use of the heifer synchronisation technique. He has been using this technique for the past three years. He indicated that he was very pleased with its performance in terms of achieving his farm objectives.

Focus analysis

The focus analyses results of subject 8 are shown in Figure A1.7. The focus grid displays the Element Tree and Construct Tree. The Element Tree shows a total of 14 elements relevant to the research. The Construct Tree shows four construct dimensions which demonstrate how the subject construes heifer synchronisation.

The subject was asked to give his interpretation or construction of the grid. Firstly, he gave the reasons for not adopting some of the elements. Secondly, he provided his own interpretation on the clustering of the elements. Three elements appeared at the top of the Element Tree that he did not adopt. The first element was moisture probe testing. He said that he had heard of other farmers who had used this technique. He had thought about this earlier. The main reason he did not use it was that the irrigation system, or the type of irrigator, that he was using did not allow much movement from one end of the farm to the other. It was set up in a fairly strict rotation. In other words, he said that if he were to use this probe it would be too labour intensive for him.

Figure A1.7: Focused grid for subject 8



He tried embryonic transfer earlier but decided to stop because it was too expensive and labour intensive. However, he said he might consider the benefit of using it in the future.

Further, he said that he would never try “leasing of dairy cows” in his system because it did not suit his system. He did not intend to increase his stock numbers because he was more concerned in maintaining the production per cow.

Subject 8 observed that artificial insemination and heifer synchronisation are matched at 91 per cent, and these are clustered with feed budgeting and herd testing at 80 per cent. He mentioned that he has been using artificial insemination for about 10 years, and heifer synchronisation for three years. He claimed that using artificial insemination helped him improve the genetic gain much quicker in his herd compared to using bulls, although at a lesser cost. According to him, heifer synchronisation technique was related to artificial insemination because the former was also related to improvement in the genetic gain in the herd. Using the technique, he argued, enabled him to manipulate the calving pattern of heifers by having more of them calve earlier than the normal pattern. He was then able to have his selection potential much higher and thereby improve the genetic quality in his herd. In other words, he said both of these elements are very closely related because they both are related to genetic improvement in order to “make life a little bit easier for him”.

Dairy heifer grazing and baled silage are tightly matched at 91 per cent and these are clustered with ME testing, the herringbone cowshed, and inducing cows to calve, at 88 per cent. Subject 8 said his heifers are grazing off-farm and that he also used baleage to feed his animals. He commented that dairy heifer grazing and baled silage were related to feed management on his farm. Similarly, he said they were related to ME testing, herringbone cowshed, and inducing cows to calve because they were used on his farm to achieve his common objective. They all helped him to make his work on the farm much easier, more efficient and more productive.

Feed budgeting and herd testing are tightly matched at 88 per cent and are clustered with artificial insemination and heifer synchronisation at about 80 per cent. He argued that feed

budgeting was important because it helped to make sure that he has sufficient feed available throughout the year and that the feed was of good quality. The other three elements are connected with the animal breeding programme in relation to improving the genetic quality of his animals. He said that he has to make sure that the quantity and quality of feed is managed properly on his farm if he is to maintain animals of good breeds.

On the Element Tree the use of nitrogen and the leasing of dairy cows are tightly matched at 91 per cent, and these are then clustered with other elements including ME testing, dairy heifer grazing, baleage and inducing cows to calve. He did not agree with this matching percentage because the leasing of dairy cows was not applicable in his system. He said he did not intend to increase his cows numbers, although he used a lot of nitrogen on his farm. The use of nitrogen is linked to other elements because they are all related to feeding regime.

Moisture probe testing and embryonic transfer are matched at 59 per cent. He said they have a low matching percentage because they were not relevant on his farm. He also commented that the travelling irrigator should be linked tightly to the other adopted innovations because it was very important in his running of the farm. He said borderdyke irrigation was not practical and that he has to rely on the travelling irrigator to irrigate his farm.

Figure A1.7 is the focused grid of subject 8 showing the main construct dimensions he used to construe the elements. Subject 8 used four construct dimensions: genetic gain, workload, ease of use and profitability. The following sub-sections explain each of these dimensions.

Genetic gain

The first construct dimension used by subject 5 is genetic gain. The subject gave a very high rating of "9" to heifer synchronisation on this dimension, meaning that the programme provides genetic gain or improves the genetic quality in his herd.

According to him, using heifer synchronisation technique was related to a higher genetic herd replacement, and he believed that would be achieved in two years' time. Like the perception

of other adopters of heifer synchronisation, subject 8 also believed that he was making a maximum use of high genetics to breed his own herd replacement. Similarly, like most other farmers who were using heifer synchronisation he also uses this programme in association with artificial insemination. This involves the placement of CIDRs followed by artificial insemination. In other words, subject 8 said that by using heifer synchronisation he is able to improve the genetic gain in his herd replacement, and hence increase farm profits.

Workload

The second construct dimension used by subject 8 to construe the innovations is “workload”. The subject gave a very strong rating of “1” to heifer synchronisation on this dimension, meaning that it reduces his workload on his farm. This value implies that, from his point of view, reducing workload is very important in his construing of heifer synchronisation. In other words he strongly believes that heifer synchronisation helps him reduce his workload in terms of the mating management of his heifers.

He explained that, prior to using heifer synchronisation, he used his visual judgement to identify those heifers on heat. This procedure would require his time to go around checking the heifers. It took him at least twice-daily checks to identify which ones were on heat before carrying out artificial insemination on them. Moreover, he said that this required a lot of hard work and was time-consuming because all those identified as on heat had to be taken into the yard, and after artificial insemination he has to take them out to the paddock again.

Subject 8 claimed that the heifer synchronisation technique enabled him to remove all the labour involved in the heat detection process and in moving those heifers during and after the artificial insemination. He explained that, with the use of heifer synchronisation, he was able to carry out a blanket artificial insemination on the whole lot of heifers at one time over two days only. In this case, there was no need for him to visually assess which one heifers had been on heat and which had not. In other words, the subject is very delighted with how such new technology was able to save him time, labour and effort in terms of the mating

management of his heifers. As he mentioned earlier, such a technique is therefore able to make life much easier for him.

Ease of use

The third construct dimension used to construe the innovations is their ease of use. He also gave a strong rating of “1” to heifer synchronisation on this dimensions, meaning that it is easy and simple to use. According to subject 8, heifer synchronisation was easy to use because it did not involve any technical work. He said that it only involved tail-painting the animals and placing the CIDRs. The injection or artificial insemination was done by the technician from the Livestock Improvement Corporation.

Profitability

The fourth construct dimension used is profitability. The subject gave a strong rating of “1” to heifer synchronisation on this dimension also meaning that it improves profitability. This shows that this profitability factor is also very important in his construing of heifer synchronisation. The subject explained that this profitability factor was directly associated with genetic gain. By using heifer synchronisation he believed that he would be able to get a maximum genetic gain in a short period of time. At the same time he claimed that such a programme would also be able to reduce his labour input or reduce cost. In other words, the subject believes that profitability would be gained from being able to improve the genetic quality in the herd, in terms of increasing milk productivity from the cow.

PrinCom analysis

The percentage of variance in subject 8’s grid attributable to the first principal component is 53.3 per cent (Table A3.1). In Figure A1.8a, the positive end of the component shows three construct labels which score highly on this component: reduces workload, easy to use and more profitable. There are three elements which score highly on the component: heifer synchronisation, artificial insemination and use of nitrogen fertiliser. A possible theme that best describes this first component is “reducing workload for profits” (Figure A1.8b). The

Figure A1.8a: PrinCom analysis for subject 8

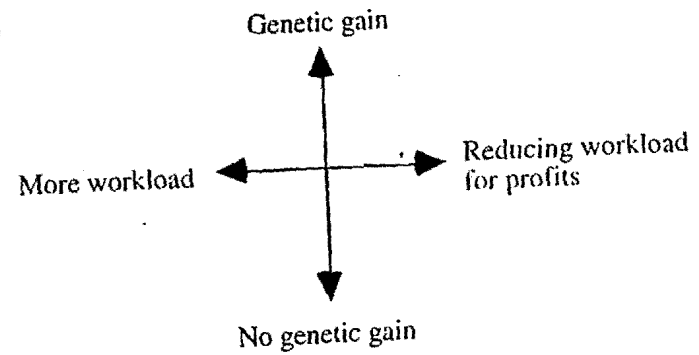
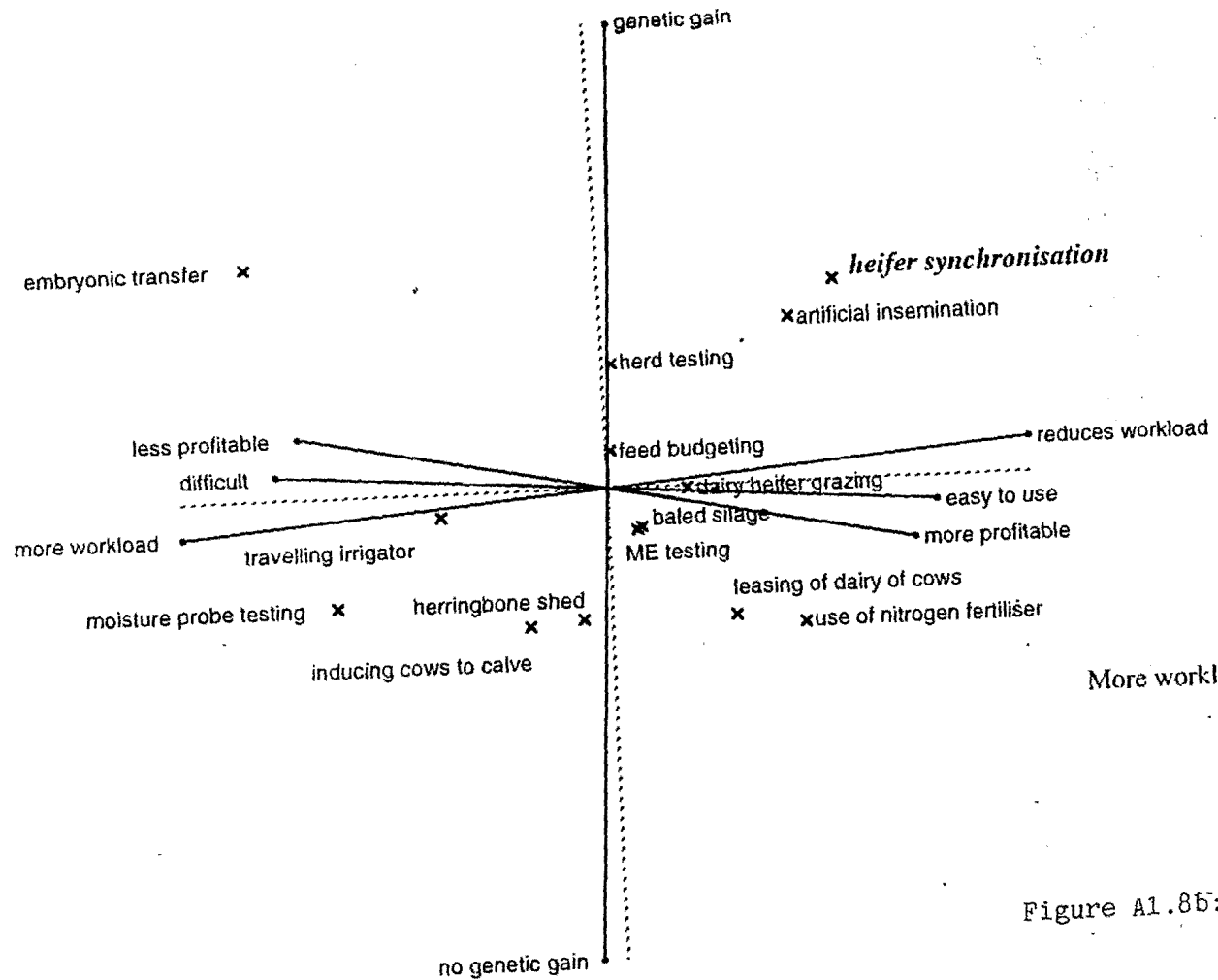


Figure A1.8b: Principal components for subject 8

three innovations just mentioned are important to this farmer because they contribute to goals of reducing workload for profits. Subject 8 has stated that one of his farm objectives is to increase the milk production level from about 420 kg ms per cow through the use of new ideas. He has also indicated that the innovations that he has adopted make his life much easier. In other words, from the viewpoint of subject 8, innovations which can help decrease the workload or make his life much easier on his farm are considered as more desirable or profitable.

In the second principal component the percentage of variance in subject 8's grid attributable to the component is 29.4 per cent. The positive end of the component shows one construct which scores highly on the component: genetic gain. The elements which score highly on the component are heifer synchronisation and herd testing. One general theme that best describes the component is "genetic gain for profits". The subject relates genetic gain with profitability. In other words, the subject believes that innovations which can improve genetic quality in the herd would lead to profitability.

A1.2.5 Subject 9's Constructs

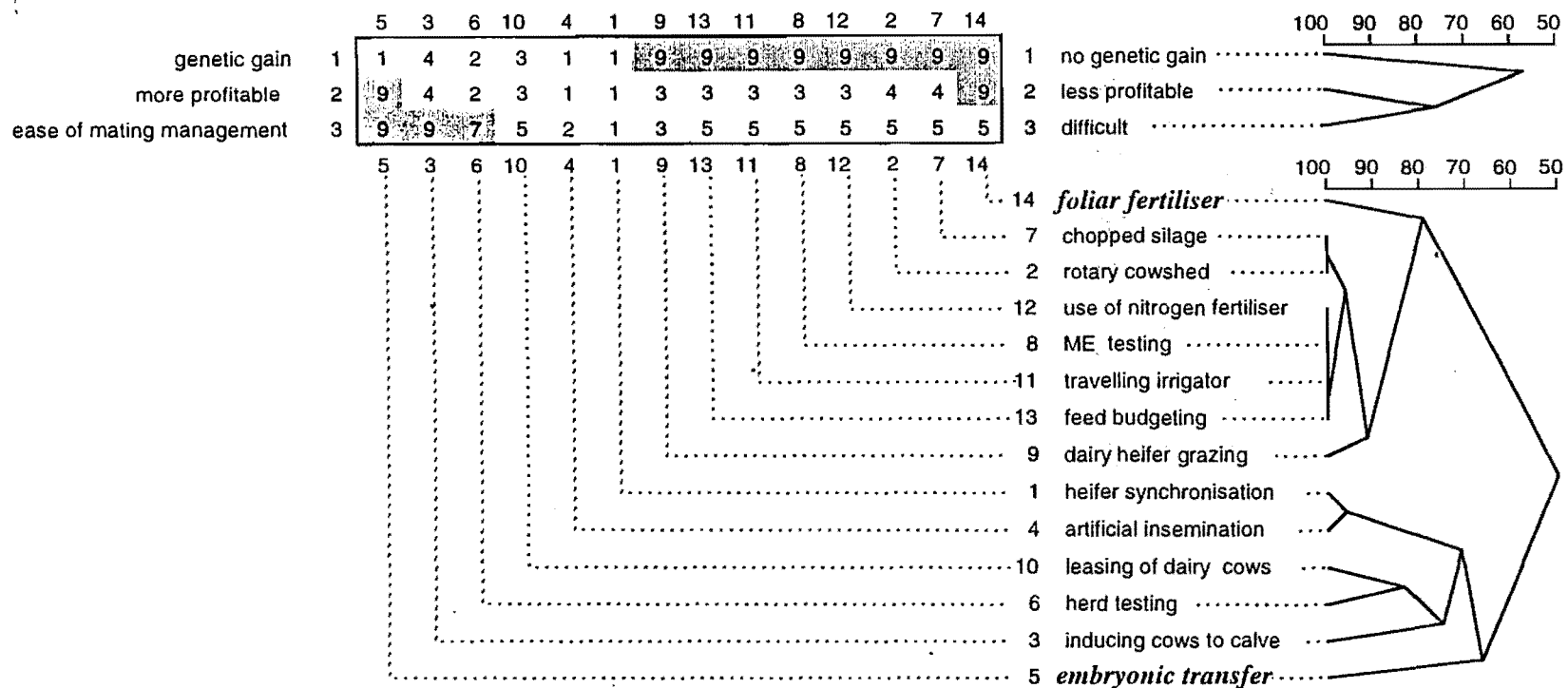
Subject 9, aged 41 years, has completed his high school certificate. He is a sharemilker on a 50/50 share basis and has been at the 150-ha property for about 13 months. He is milking 300 cows during the season. His long-term objective as a sharemilker is to build up "an acid-base" to give the family the long-term goals of having enough equity in their cows with the intention of buying their own farm so they would be able to retire from farming comfortably in the near future.

Subject 9 has been in dairy farming for about five years. He has used heifer synchronisation breeding technique for about three years.

Focus analysis

The focus analyses results for subject 9 are shown in Figure A1.9. It displays the Element Tree and construct Tree. The Element Tree consists of 14 elements, of which 12 were

Figure A1.9: Focused grid for subject 9



adopted and two were not adopted by the subject. The construct Tree shows three main construct dimensions used by the subject to construe heifer synchronisation.

He was asked to provide his interpretation of the Element Tree in terms of how the innovations were related to each other. His initial reaction was to those non-adopted innovations: foliar fertiliser and embryonic transfer. He did not adopt foliar or liquid fertiliser on this property because he did not think it was workable or practical in his system. He considered he would not or would never adopt it. He said embryonic transfer was not adopted because of the cost factor. It was too expensive for the average farmer like himself. Therefore, the reasons for not adopting the innovations seem to suggest that he was concerned about the practicality or workability of the innovations in his farming system. Secondly, he was concerned about the cost in relation to his own capability.

He observed that heifer synchronisation and artificial insemination are very tightly matched at 96 per cent and that these are clustered with leasing of dairy cows, herd testing and inducing cows to calve at about 72 per cent. He said heifer synchronisation and artificial insemination were tightly matched because they were directly related to breeding replacement stock and hence improvement in genetic gain. They were both very important to him in the operation of his farm. He also commented that these two elements were more connected to herd testing in terms of animal breeding and less with the leasing of dairy cows and inducing cows to calve. However, he said all of them were linked to farm profitability.

Leasing of dairy cows and herd testing are matched at 83 per cent, and are clustered with inducing cows to calve at 77 per cent. Subject 9 commented that leasing dairy cows and herd testing should not be closely linked. He said leasing of dairy cows was carried out in order for him to increase the cow numbers. He explained that he had to lease the cows because he was a share-milker in this property and did not have sufficient capital to purchase them. Herd testing, he said was related to monitoring the performance of the cows. However, he claimed that both were important to him in terms of farm performance and profitability.

Feed budgeting, the travelling irrigator, metabolisable energy testing and use of nitrogen fertiliser are very tightly matched at 100 percent and these are clustered, with chopped silage and the rotary turnstyle cowshed, at 97 per cent. Subject 9 pointed out that all these elements were similar in their functions and were closely linked because they were concerned with feeding regime except for the rotary cowshed. This was very important to him, he said, because feed availability in terms of quality and quantity was his prime concern. He indicated the feeding regime was again closely linked to farm profitability. He said that, although the rotary turnstyle cowshed was not directly linked to feeding regime, it was a management tool in his farm operation to make sure he has the right machine with which to milk his cows efficiently and effectively.

Figure A1.9 shows the focused grid of subject 9. It displays the three main construct dimensions he used to construe the innovations: genetic gain, profitability, and ease of mating management. The following sub-sections explain each of these dimensions in respect of heifer synchronisation.

Genetic gain

The first construct dimension used by subject 9 to construe the innovations is genetic gain. He gave a very strong rating of "1" to heifer synchronisation on this dimension, meaning that it provides genetic gain or improves the genetic quality in his herd. According to subject 9, using heifer synchronisation would help him improve the genetics of his heifers faster than if he did not synchronise them. He claimed that, genetically, his heifers are the highest ranking animals in the herd as specified by the New Zealand Dairy Board. Therefore, he said that if he were to mate them to a good quality bull, the progenies would be higher than those of others in the herd.

In other words, he believes that, since his heifers are of good genetic quality, using the heifer synchronisation technique would help him speed up the rate of genetic gain in his herd, and hence its profitability. His main interest is how best to improve the genetic quality in the herd, based on the existing quality that he has.

Profitability

The second construct dimension used is profitability. The subject gave a very strong rating of "1" to heifer synchronisation on this dimension, meaning that it improves profitability. This implies that he construes heifer synchronisation as a way of increasing profitability. He said this was possible because heifer synchronisation enabled him to obtain a better choice or selection potential for his replacement calves. For example, he said that if he was calving 400 cows, and 100 heifers and if he only has the 400 cows to calve to artificial insemination, his potential selection of calves for future cows would only come from the 400 cows. But if he was synchronising the 100 heifers and obtaining 40-50 heifer calves from them, then these would be another 40-50 that he could choose from for replacements. This was again related to genetic improvement in the herd.

He argued that in this way he could increase the number of calves to choose from i.e., a bigger selection for him where he could actually drop the bottom end of his artificially inseminated calves, and just kept the best.

Ease of mating management

The third construct dimension used is "ease of mating management". Subject 9 also gave a very strong rating of "1" to heifer synchronisation on this dimension. This strong rating value indicates that this pole was important to the subject in his construing of heifer synchronisation.

The subject referred to ease of mating management in terms of obtaining the early calving pattern, or concentrated calving, for the heifers. For example, he said that if he had 40-50 heifers it was a lot easier to have them calve early in the season compared with the 100 heifers to calve. His experience was that having this early calving enabled him to have more time with the heifers. Another advantage, he said, was that it would also allow a lot longer time between calving and mating and hence more chance for the heifers to settle down and

start cycling. In other words, this synchrony programme would increase the number of lactation days for these heifers.

Subject 9 was also concerned with the time factor in his farming operation. He said that heifer synchronisation in dairy cattle enabled him to save time by giving him more time to give attention to his milking cows, and by increasing the lactation days. Therefore, he said this would give reproductive benefits to the heifers.

PrinCom analysis

The percentage of variance in subject 9's grid attributable to the first principal component is 56.2 per cent (Table A3.1). The positive end of the first component shows one construct label, genetic gain, which loads heavily on this component, as do the three innovations comprising of heifer synchronisation, artificial insemination and herd testing (Figure A1.10a).

One general theme that best describes this component is "genetic gain for profits" (Figure A1.10b). These three innovations are considered important to this subject because they contribute to achieving his farm objective of increasing profitability through genetic improvement in the herd.

The negative end of the first principal component shows one construct label, no genetic gain, which scores highly on this component. There are four elements which score highly on this component: use of nitrogen fertiliser, the travelling irrigator, metabolisable energy testing and dairy heifer grazing. In other words, at one end of the component it shows that these innovations are not directly related to genetic gain, but still play a very important role in achieving farm objectives or profitability.

In the second principal component, the percentage of variance attributable to the component is 34.6 per cent. The positive end of the component shows two construct labels which score highly on this component: ease of mating management and more profitable. There are two elements which score highly on the component: heifer synchronisation and artificial insemination. One possible theme which best describes the component is "ease of mating

Figure A1.10a: PrinCom analysis for subject 9

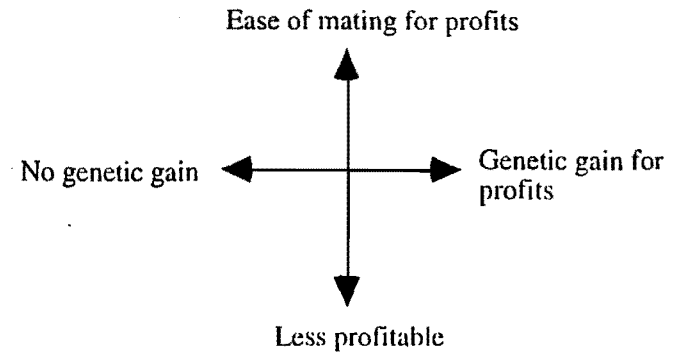
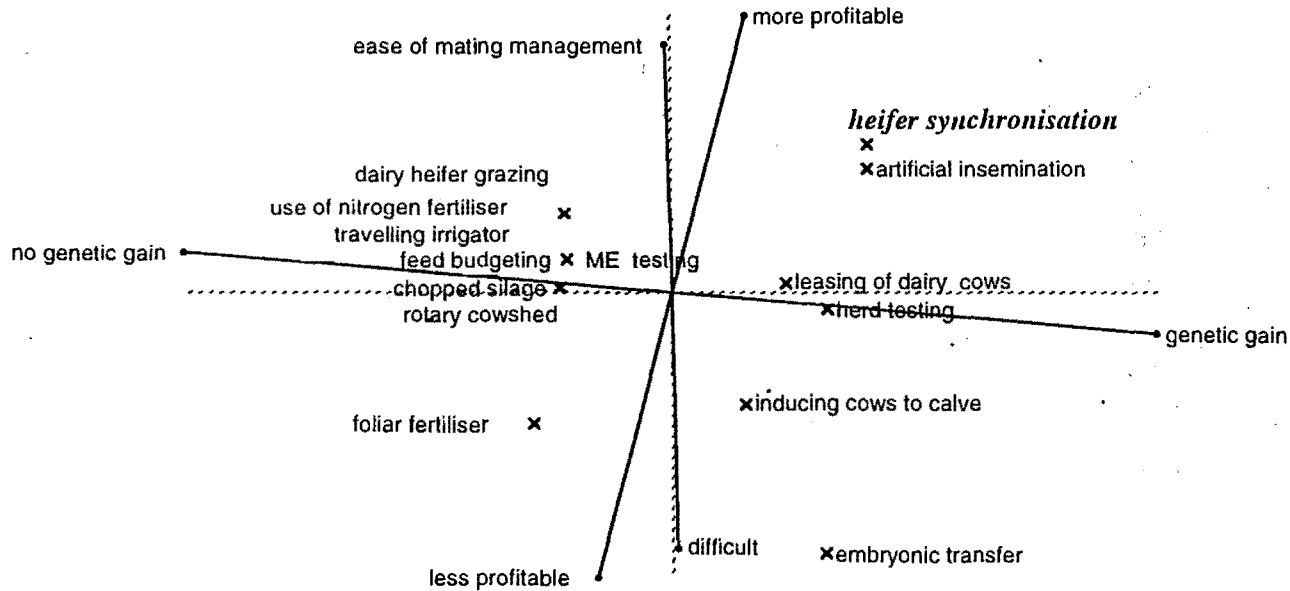


Figure A1.10b: Principal components for subject 9

management for profits". These two innovations are equally important to the subject because they help ease the mating management, increase milk production, and hence profitability. They enable him to have his heifers calve earlier and have longer lactation days, and hence, the ease of managing the heifers when they calve without much hassle. Because he is a seasonal milk supplier, the synchronisation programme is of great financial benefit to him and hence to his profitability.

A1.3.1 Subject 1's Constructs

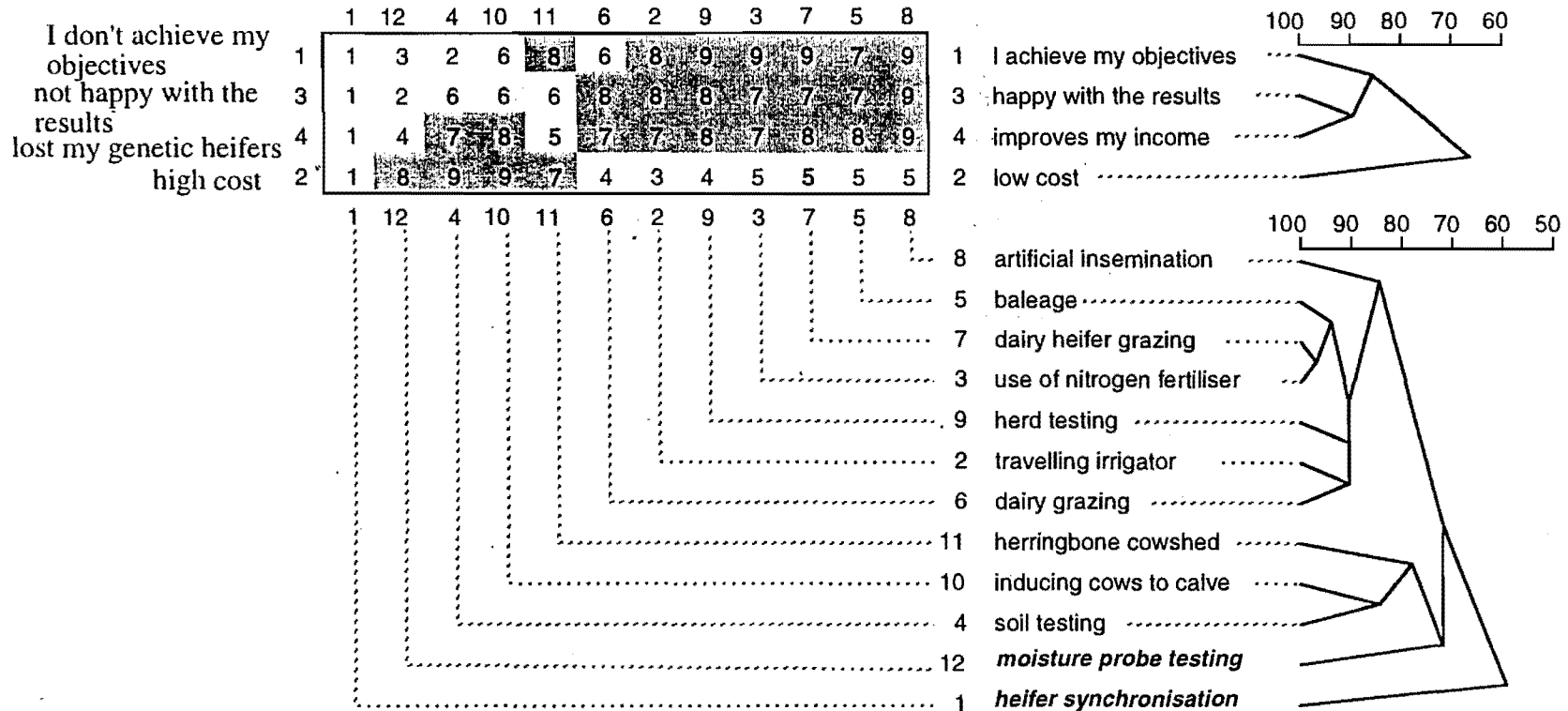
Subject 1, aged 50 years, has attained a two-year secondary education. He is the second generation on the farm and has been operating the 68-hectare dairy farm for more than 20 years. At present he has about 210 milking cows of Friesian breeds with an average production of 340 kg ms per cow. He is an owner-operator and a seasonal supplier of milk. His farming objective is to have a reasonably good income by using animals with high quality genetic material. One of the new ideas he adopted in 1994 in order to achieve his farm objective, was the use of the heifer synchronisation breeding technique. He has used the new technique in the last two seasons but later decided to discontinue because of unsatisfactory performance. He said his experience for the last two seasons showed that it was not justified for him to continue.

Focus analysis

The focus analyses results for subject 1 are shown in Figure A1.11. The grid consists of 12 elements displayed on the Element Tree and four construct dimensions shown on the Construct Tree. His interpretation of the Element Tree is as follows.

His first comment was on the two non-adopted innovations located at the bottom of the Element Tree: moisture probe testing and heifer synchronisation. He said that the moisture probe testing was not necessary because of two main reasons: (1) he has a very good soil conditions, and (2) he considered some amount of moisture was available in all sections of the property. Although he said that the cost associated with moisture probe testing was less expensive, he still considers it to have no benefit to him. He said he has used heifer synchronisation for two years with the main objective of being able to AI and calve together.

Figure A1.11: Focused grid for subject 1



However, his two-year experience showed that the results from using this technique were below his expectations. He later decided to discontinue using the technique. However, he continues mating his heifers to his Friesian bulls followed by artificial insemination, but no synchronisation is used.

Use of nitrogen fertiliser and dairy heifer grazing are tightly matched at 98 per cent and these are clustered with baleage at 92 per cent. He said they were related in terms of increasing income. Nitrogen fertiliser was used to increase the pasture growth. He said he strategically applied nitrogen fertiliser to grow grass by applying it in the spring and also in the autumn. This was important to him because it allowed him to make sufficient feed available for his stock and hence improved farm income. The use of dairy heifer grazing enabled him to graze some of his stock at another grazier's property. The existing farm situation did not permit him to milk more cows in his own property or to increase income. He said the only option to increase his cow numbers was to graze some heifers on another farmer's property. In other words, if he had all the dairy heifers on his own property he would milk less cows and hence obtain less income. Subject 1 also indicated that he has used his wrapped baleage feed his cows for the past three years.

The travelling irrigator and dairy grazing are also tightly matched at 81 per cent. He said his irrigation system was also very important on his farm. He adopted the travelling irrigator because he considered it was more convenient and efficient in terms of irrigating the farm. Without this technology he said it would be impossible to have the pasture or feed available for the stock, or to get pasture production from the farm. He considered it was an "insurance" in his property, especially during a dry year. In other word, the travelling irrigator, he said, was also directly linked to farm income on his property.

The subject also observed that artificial insemination was then linked to the above six stated adopted innovations at 90 per cent. He said artificial insemination was the most "electrifying" type of innovation on his farm because it was directly linked to genetic improvement of the herd, especially the replacements of heifers. He was mating all his heifers to a Friesian bull followed by artificial insemination. Herd testing was also very important in his system. He

said herd testing was the key to his whole programme because it would allow him to identify the good cows from the bad ones. The production figures at the end of the season revealed to him the attributes of the good cows. In other words, herd testing enabled him to know how his cows perform in his system.

Figure A1.11 shows the focused grid of subject 1, displaying the four construct dimensions he used to construe the elements. These four dimensions are: achieving farm objective, cost, results and genetics. The following sub-sections explain each of these dimensions.

Achieving farm objectives

The first construct dimension used by subject 1 to construe the innovations is related to his farm objective. The subject gave a very strong rating of "1" to heifer synchronisation on this dimension, meaning that it does not help him to achieve his farm objectives.

Subject 1 was a seasonal supplier of milk and would only have all his cows calve once a year. His main farm objective was to have a concentrated calving period for all his cows. He had thought that by using the synchronisation technique he would be able to bring all his cows into season at once after initiating a blanket artificial insemination on them. He also believed that this technique would allow him to produce more Friesian animals or more heifer calves to select from.

Unfortunately, after using the programme for two seasons he concluded that it was not successful under his present practice. He stated that the main reason for this was that he was not able to obtain an intensive calving period for his heifers as expected. He claimed that most of his heifers did not conceive to artificial insemination but only conceived to the bull that was running with them. He concluded that he did not achieve his farm objectives and the programme was therefore of no benefit to him.

Cost

The second construct dimension used is related to cost. The subject gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that the programme is very expensive.

The subject has revealed that some of the costs involved in synchronisation are: the purchase of drugs and CIDRs, veterinary fees and transportation costs. In addition to these costs, the subject also included all the expenditure incurred in rearing the heifers up to two years of age. He explained that it cost about \$1,200 to rear one calf to this age. This cost was important because the conception rate he experienced from his herd was only 47 per cent, and he had had to sell all those heifers which were not in calf. To this end he said he was blaming the synchrony programme for the low rate of conception, and hence construed it as an expensive exercise.

Results

The third construct dimension is related to the results produced from the programme. The subject gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that the programme has produced poor results. The subject has specifically stated that the main reason for his decision to adopt heifer synchronisation was to produce a concentrated calving for his heifers. However, he was very unhappy and disappointed with the results from heifer synchronisation because: (1) he was not able to get a concentrated calving for his heifers despite the fact that it was supposed to do that, (2) the long spread out calving period was not acceptable to him, and (3) he was not able to achieve an acceptable conception rate for his heifers, with a lot of his heifers being empty. He claimed that a conception rate of 47 per cent was unacceptable to him.

Genetic - income

The fourth construct dimension is related to genetics. The subject gave a strong rating value of “1” to heifer synchronisation on this dimension, meaning that the programme resulted in the subject not achieving genetic improvement in his herd.

He gave an example of how heifer synchronisation could result in the loss of his best genetic heifers. His experience was that 6 out of 34 of his best genetic heifers (17.6 per cent) had to be sold because they were not in calf even with the use of the synchrony programme. He claimed that, from his experience, this was a great loss to him both genetically and financially. He agreed that using a heifer synchronisation programme would help improve the genetic material of the ones which conceived and were in calf, but not otherwise. From the financial point of view he said he was losing \$1,200 from the loss of one heifer because it cost him this amount to bring the animal to two years of age.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 1's grid attributable to the first principal components is 66.0 per cent. The positive end of the component shows three construct labels which score highly on the component: not happy with the results, I don't achieve my objectives, and lost my genetic heifers (Figure A1.12a). There were two elements which scored highly on the component: heifer synchronisation and moisture probe testing. A general theme that best describes this first component is “effectiveness and achievement” (Figure A1.12b). This subject is not happy with the use of heifer synchronisation because it is not effective in terms of achieving his farm objectives of improving the calving pattern and the genetic gain in his herd. The negative end of the component shows three construct labels which scored highly on the component: happy with the results, I achieve my objectives and improves my income. There were four elements which also scored highly on the component: artificial insemination, use of nitrogen fertiliser, dairy heifer grazing and herd testing. In other words, innovations which would produce good results would make the subject happy because he is able to achieve his farm objective of increasing his income.

Figure A1.12a: PrinCom analysis for subject 1

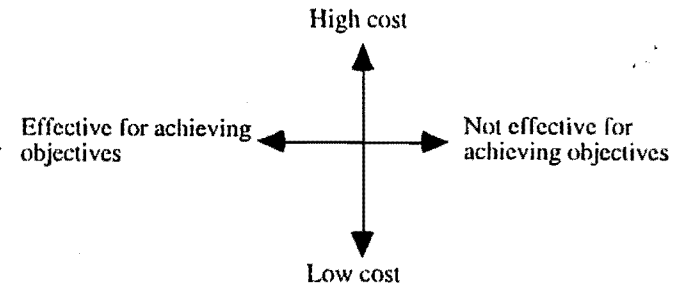
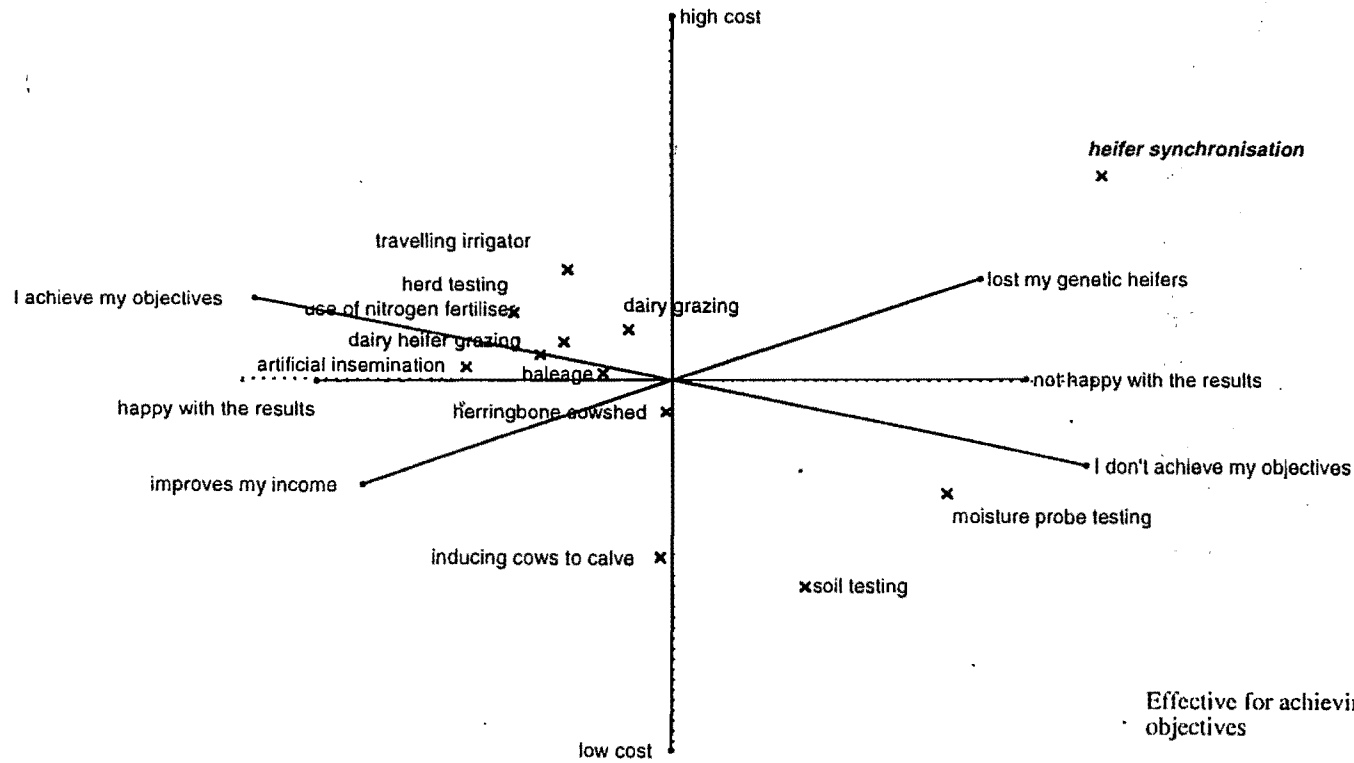


Figure A1.12b: Principal components for subject 1

In the second component, the percentage of variance in subject 1's grid attributable to the component is only 26 per cent. The positive end of the second component shows one construct, high cost, which scores highly on this component. The element which scores highly on this component is heifer synchronisation. This shows that the subject perceives heifer synchronisation as a high cost and is important in his decision to discontinue its use on his farm. The negative end of the component shows the construct label, low cost, which scored highly on this component. There are two elements which scored highly on this component: inducing cows to calve and soil testing. This shows that elements which are less expensive are readily adopted by the subject, compared to those which are more expensive.

A1.3.2 Subject 2's Constructs

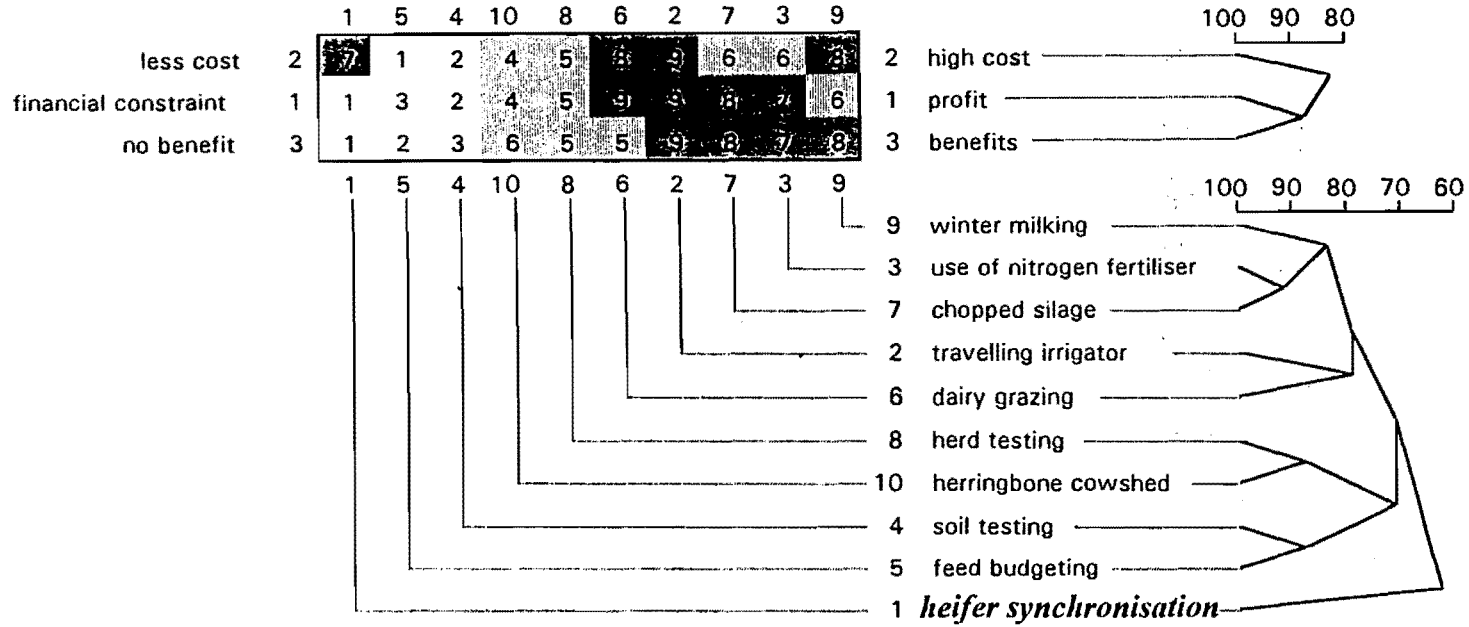
Subject 2, aged 46 years, has a high school certificate. He inherited their 132-hectare property from his father ten years ago. He has 250 milking cows of Friesian breed with their average production of 350 kg ms per cow. He indicated that he was an owner operator and also a town supplier of milk. His farming objective was to obtain a maximum milksolid production per cow with a minimum cost. The other objective was to be able to buy more farm land in order to make the present property a more economic unit. Hopefully, he said, he would be able to employ someone who would be able to do a majority of farm work and would release him to have a little bit more spare time.

Subject 2 adopted heifer synchronisation in 1994 with the objective of improving the genetic merit in his herds much more quickly, and also to condense the calving pattern for his heifers. Gathering from his experience using the technique, there seemed to be a reasonably good result in the spring. However, when he tried it again for the autumn mating he was very disappointed with the result. He did not want to try it again this year because he was not sure of the success and would prefer to spend the money to buy land for the extension of the family's farm.

Focus analysis

The focus analyses results of subject 2 are shown in Figure A1.13. It consists of 10 elements on the Element Tree and three construct dimensions on the Construct Tree.

Figure A1.13: Focused grid for subject 2



The subject was asked to give his interpretation of the Element Tree. He observed that use of nitrogen fertiliser and chopped silage are very tightly matched at 92 per cent and these are clustered with winter milking at 83 per cent. He experienced that use of nitrogen and chopped silage are concerned with the feeding regime for his stock. He said that in summer he uses nitrogen to boost the grass growth. Similarly, in winter the chopped silage is used to replace the grass.

Herd testing and the herringbone cowshed are tightly matched at 88 per cent, and these are clustered with soil testing and feed budgeting at 72 per cent. He indicated that these four elements are related to animal breeding, pasture management, feed supply and milk production and hence farm profitability and income. In his system, he said that they were all running at minimal cost.

He also observed that heifer synchronisation was located at the bottom of the Element Tree and is connected to other elements at a lower matching of about 65 per cent. He explained that he had tried heifer synchronisation for two seasons. However, he was not happy with his first trial and decided to discontinue with the programme. He said that he has some other priorities on his farm where his money could be spent wisely, such as for the purchase of the additional piece of land.

Figure A1.13 shows the focused grid of subject 2 displaying the three construct dimensions which he used to construe the elements. These three dimensions are: financial constraint, cost and results. The following sub-sections explain each of the three construct dimensions.

Financial constraint - profit

The first construct dimension used by subject 2 to construe the elements is financial constraint - profit. The subject gave a rating value of "1" to heifer synchronisation on this dimension, meaning that financial constraint is important in the decision to discontinue using the programme.

The subject indicated that he had two main reasons for adopting the programme previously. Firstly, he thought he would be able to improve the genetic material in the herd through higher conception rate. Secondly, he thought he would be able to improve the spread of calving in the herd through a concentrated calving pattern. However, after trying the programme for two seasons he experienced that the results were not satisfactory. He discovered that only about half of his heifers were in calf. He explained that because of the poor results he obtained he decided to be very cautious on how the family money was going to be spent. He decided to spend the money for expansion of the property by purchasing his neighbour's land. Subject 2 then argued that one of his main reasons on his decision to discontinue using heifer synchronisation was financial constraint.

Cost

The second construct dimension used is related to cost. Subject 2 gave a high rating of "7" to heifer synchronisation on this dimension, meaning that the programme involves high cost. The subject was concerned about the low conception rate and hence a higher cost. He argued that the programme involved a lot of money in terms of paying for the veterinary services and materials used for the programme such as CIDRs. He said when he synchronised 100 heifers he would only get 40 heifers that held to the first mating. From these 40 heifers he only managed to get 20 calves. He argued that these 20 calves or 50 per cent conception rate was very expensive considering the procedural costs involved in the programme. In terms of monetary value, he estimated the loss of about \$700 per heifer if it did not stay on calf.

Results

The third construct dimension used is related to results. Subject 2 gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that the programme produced poor results. As indicated earlier, one of his main reasons of trying the synchrony programme was to narrow the calving pattern of his heifers in such a way that all his heifers would calve at the same time. However, his experience of using such a programme in autumn showed

that it did not meet his objective. He claimed that the conception rate he obtained was less than 50 per cent, resulting in a wide calving spread in the herd. Such poor results, he said, was regarded as no financial benefit to him.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 2's grid attributable to the first component is 79.1 per cent. In Figure A1.14a, the positive end of the component shows two construct pole labels which load heavily on this component: no benefit and financial constraint. There are three elements which score highly on the component: heifer synchronisation, soil testing and feed budgeting. A possible theme that best describes this first component is "profits for benefits" (Figure A1.14b). In other words, the subject is more concerned about achieving financial benefits from heifer synchronisation. He regarded heifer synchronisation does not provide any financial benefits to him.

The negative end of the first component shows two construct labels which score highly on this component: profit and more benefits. The elements which score highly on the component are: the travelling irrigator, use of nitrogen fertiliser and chopped silage. These three elements were adopted by the subject because they were more beneficial to him in terms of profitability.

A1.3.3 Subject 4' Constructs

Subject 4, aged 47 years, has a school certificate. He has been on his 105-hectare property for about 23 years. At present he has 240 milking cows, mainly of Ayrshire breeds, with an average milk production of 350 kg ms per cow. He is involved both in seasonal and winter contract milk supply.

Subject 4 had used the synchrony programme for about four years. However, he decided to discontinue using the programme because of some reasons which will be presented as follows.

Figure A1.14a: PrinCom analysis for subject 2

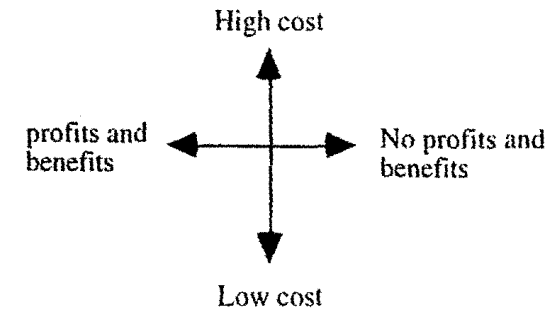
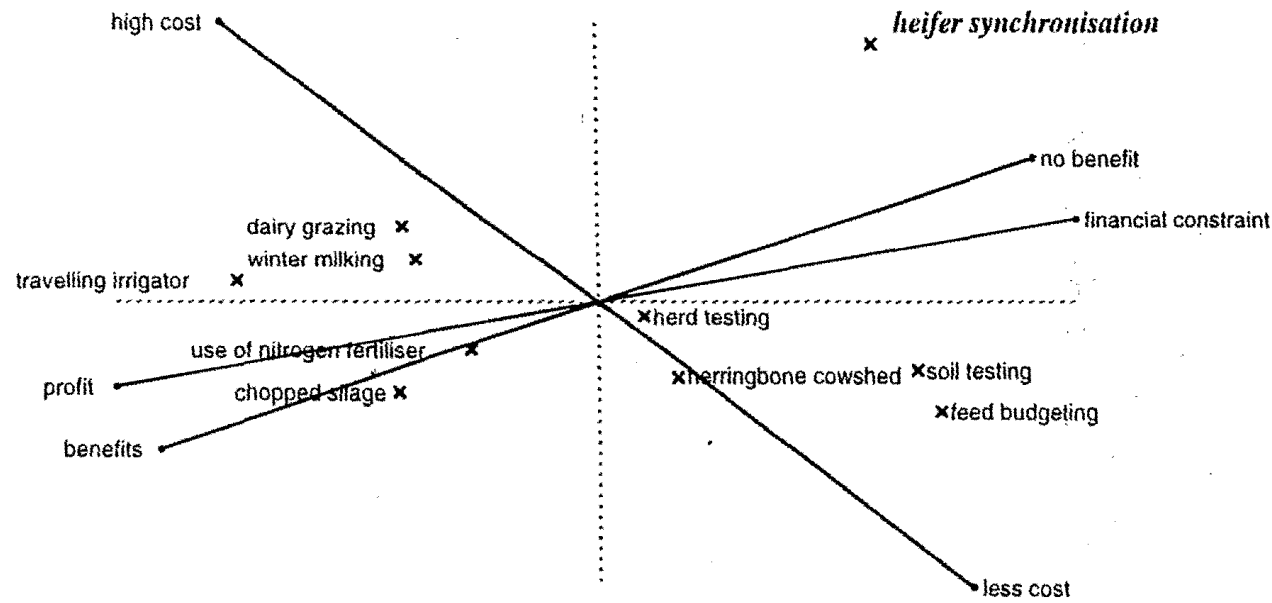


Figure A1.14b: Principal components for subject 2

Focus analysis

The focus analysis results (focused grid) of subject 4 are shown in Figure A1.15. It consists of 12 elements displayed on the Element Tree and three construct dimensions shown on the Construct Tree. His assessment of his grid is as follows.

His first comment was on his non-adopted innovations. He observed that heifer synchronisation and embryonic transfer are tightly matched at 96 per cent and that these are clustered with inducing cows to calve at 87 per cent. He said heifer synchronisation and embryonic transfer were tightly matched because both were concerned with breeding in terms of genetic improvement. However, he said they were not used on the property any more because he was not happy with their performance. He has stopped using the induction method of producing milk three years ago. One of the reasons, he said, was because it did not fit into his farming system any more. He considered it to be inhumane and unethical to allow the calves to die prematurely.

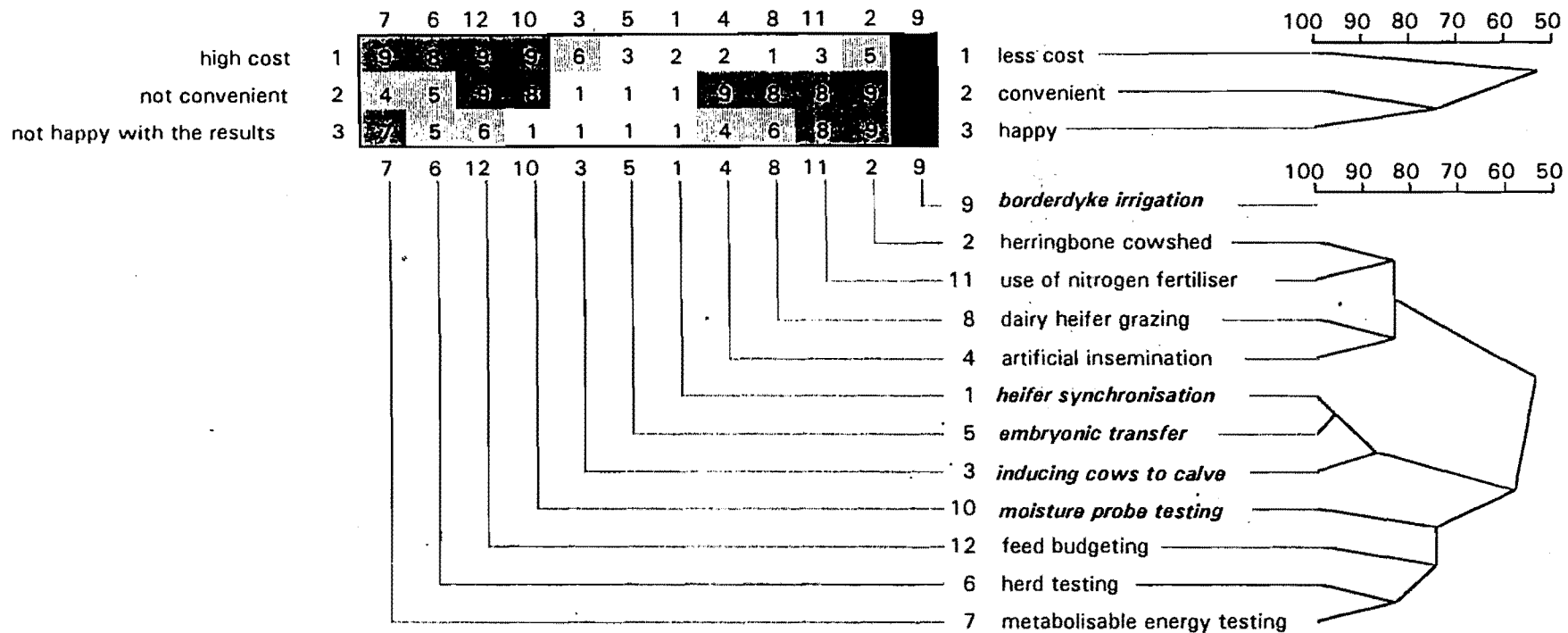
Moisture probe testing was not adopted but showed its direction towards the adopted innovations: feed budgeting, herd testing and ME testing. He said that he preferred to have a “wait-and-see” attitude towards the use of the probe because it might be useful in terms of further improving the pasture and feed quality in the future.

Borderdyke irrigation was not linked to other elements because he said he would never adopt such type of irrigation. The system was not available and practical in the area.

He observed that adopted innovations, such as the herringbone cowshed, use of nitrogen fertiliser, dairy heifer grazing and artificial insemination, were linked to each other because they were all important to him in increasing farm income and profitability.

Figure A1.15 shows the three construct dimensions which he used to construe the elements. These three dimensions are: cost, convenience and results. The following sub-sections explain each of these dimensions.

Figure A1.15: Focused grid for subject 4



Cost

The first construct dimension used to construe the elements is related to cost. The subject gave a strong rating of “2” to heifer synchronisation on this dimension, meaning that heifer synchronisation, in his experience, was an expensive exercise. He said the costs included the payment of the veterinary fees, drugs and CIDRs. However, he said that because he experienced a low conception rate from the programme the exercise was expensive. Moreover, he said he was not able to have a concentrated calving pattern or longer lactation days for the heifers as expected.

Convenience

The second construct dimension used by subject 4 to construe the innovations is the convenience of use. The subject gave a strong rating value of “1” to heifer synchronisation on this dimension, meaning that it is not convenient to use on his farm. He argued that heifer synchronisation was not convenient to use because his heifers were away at the grazier’s property. He had tried the programme. However, because of the inconvenience involved in being a distance away from his own property, and because he could not afford to provide additional labour unit to assist him he decided to stop using the programme. Instead, he preferred to put the bulls with the heifers.

Results

The third construct dimension used by subject 4 to construe the innovations is the results produced by using the programme. The subject gave a strong value of “1” to heifer synchronisation on this dimension, meaning that he was not happy with the results he obtained from the programme. He claimed that he was extremely unhappy with the results he achieved. Originally he had hoped to get a compact calving pattern and hence increase the lactation days or milk production of his heifers. He said that instead of having his heifers bred through within six weeks he still had them spread over more than six weeks. Therefore, he said the programme did not provide any change to the calving pattern as first expected.

PrinCom analysis

The percentage of variance in subject 4's grid attributable to the first principal component is 56.1 per cent (Table A3.1). In Figure A1.16a, the positive end of the component shows two construct labels which score highly on this component: not convenient and not happy with the results. There are three elements which score highly on the component: heifer synchronisation, embryonic transfer and inducing cows to calve. A possible theme that best describes this first component is "convenience, achievement and effectiveness" (Figure A1.16b). This subject is not happy with those innovations which cause inconvenience to his farm operation and which are also not effective in terms of increasing milk production.

In the second principal component the percentage of variance in subject 4's grid attributable to the component is 31.5 per cent. At the positive end of the pole, the component shows that one construct pole label, high cost, scores highly on this component, as do elements dairy heifer grazing, artificial insemination and use of nitrogen. These three innovations may involve higher initial costs for the subject, but are still important to him because they help increase farm income and profit.

A1.3.4 Subject 11's Constructs

Subject 11, aged 54 years, has completed his fifth form education. He has been on his 160-hectare property for about 11 years. Presently he has 300 milking cows of Friesian breed with an average milk production of 400 kg ms per cow. He is categorised as a seasonal supplier of milk. One of his main farm objectives is to increase farm income and profitability. His plan is to improve his pasture by putting in better types of grasses and upgrading the old borders. He would also like his children to share milk for the family in the near future, upon his retirement from the farm.

Subject 11 tried the synchronisation programme for one year. Because of certain reasons he decided to pull out of the programme.

Figure A1.16a: PrinCom analysis for subject 4

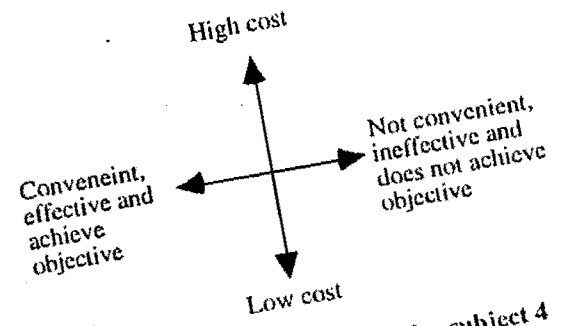
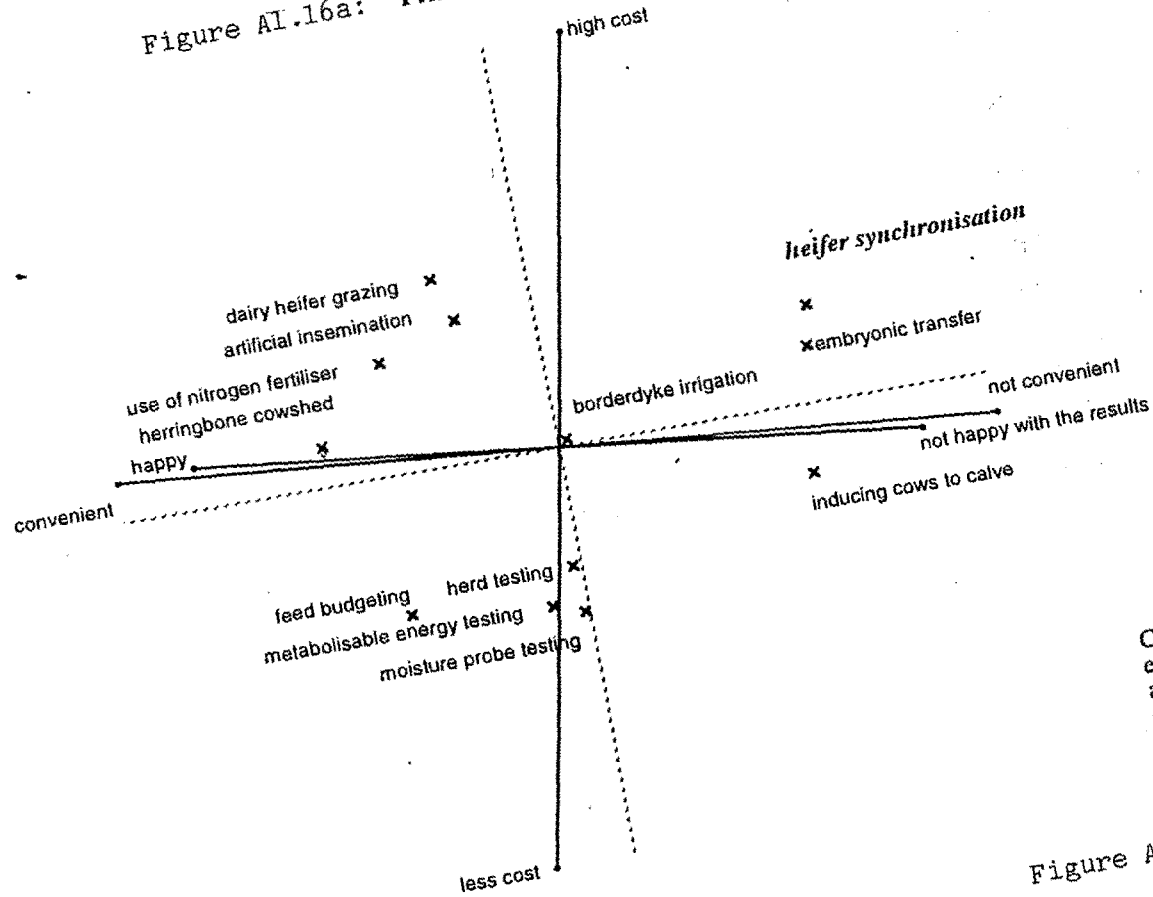


Figure A1.16b: Principal components for subject 4

Focus analysis

The focus analysis results of subject 11 are shown in Figure A1.17. The focused grid displays 12 elements and five construct dimensions. His interpretation of his grid is as follows. His first comment was on the non-adopted innovations which were located at the bottom of the Element Tree. He observed that herbage testing and ME testing were very tightly matched at 100 per cent. He said both of them were related to feed management. He had used herbage testing earlier upon the advice of one farm consultant. However, recently he was advised by another farm consultant that the testing was not necessary because his pasture was considered as satisfactory. He did not use the actual ME testing method to determine the feed quality. He said his own experience was sufficient to know the quality of his silage.

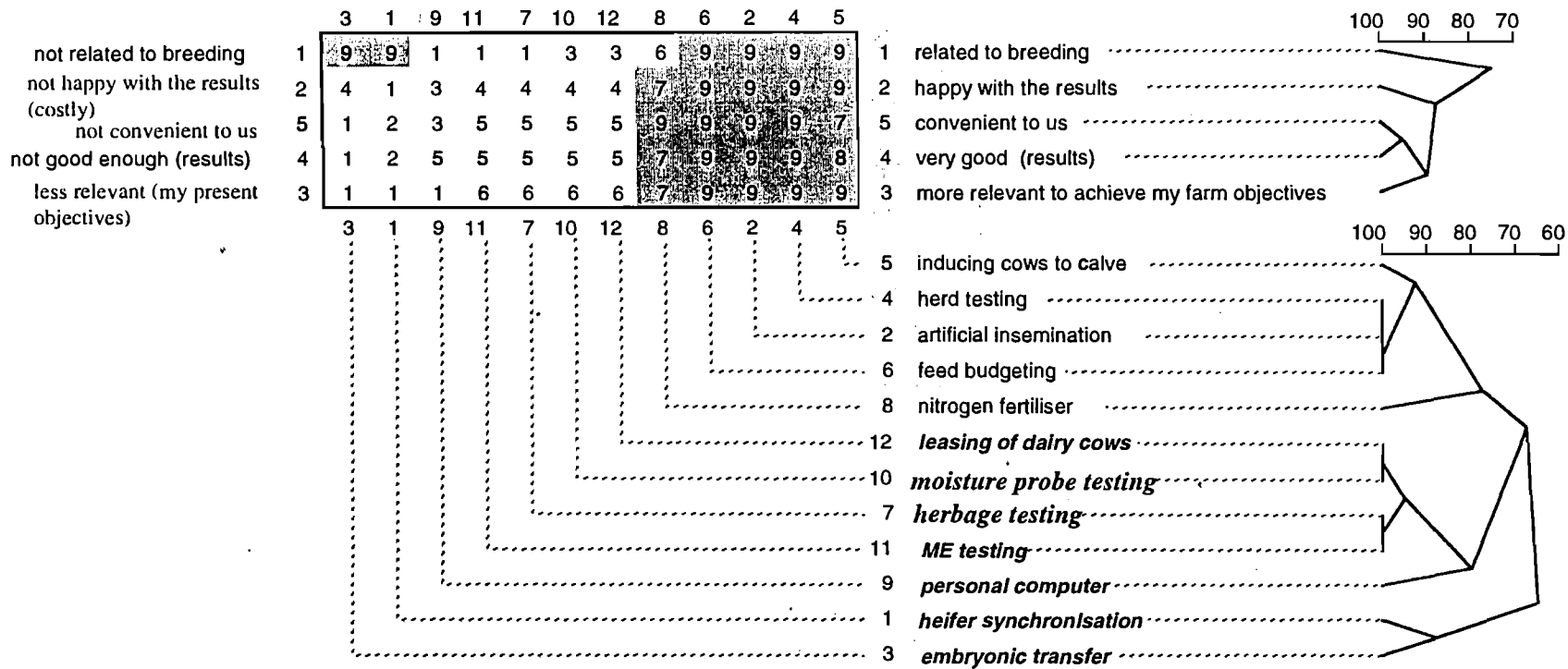
Leasing of dairy cows and moisture probe testing are tightly matched at 100 per cent. He said both of these innovations are not quite necessary in his system. He did not lease in cows because he said he has the quantity required. Similarly, he said he did not do the actual probe testing, but only listened to the radio to get the information.

Heifer synchronisation and embryonic transfer are tightly matched at 88 per cent. He said both of them are related to genetic improvement. However, he indicated that both were not needed because they were considered to be too expensive.

He observed that three elements consisting of herd testing, artificial insemination and feed budgeting are very tightly matched at 100 per cent. These are then clustered with inducing cows to calve at 92 per cent and then with nitrogen fertiliser at 80 per cent. He said all these elements were important tools for farm income and profitability. He said that although he did not like to do inducing cows to calve he was forced to do so because of economic reasons. He said: "It's our bank."

Figure A1.17 shows the focused grid of subject 11 displaying the five construct dimensions which he used to construe the elements. These five construct dimensions are: animal breeding, cost, farm objective, results and convenience. The following sub-sections explain each of the five construct dimensions.

Figure A1.17: Focused grid for subject 11



Breeding

The first construct dimension used to construe the innovations is related to animal breeding. The subject gave a very high rating of “9” to heifer synchronisation on this dimension, meaning that it is related to genetic improvement and ease of mating management in the herd. However, he said that because of the distance and location of where the heifers were grazed and mated, he decided to discontinue using the programme. He preferred to use natural mating and artificial insemination instead of using the synchronisation programme.

Cost

The second construct dimension used is related to cost. The subject gave a strong rating of “1” to heifer synchronisation on this dimension, meaning that he considered the programme as an expensive exercise. He said that his heifers were grazed at a distance from the main property. He indicated that he could not afford to share his time in two different places, and neither could he employ an additional labour unit to do the synchronisation. He said it would need at least seven trips going down to the grazing area to do the synchronisation. Because of the great distance between one farm and the other, the cost involved was therefore high. Hence he decided to discontinue using the programme.

Objectives

The third construct dimension used is related to farm objectives. The subject gave a strong rating of “1” to heifer synchronisation on this dimension, meaning that the subject sees the programme as less relevant in terms of achieving his farm objectives. One of his main farm objectives is related to increasing income and profitability. He was also concerned about improving pasture quality. Because of the high cost associated with heifer synchronisation he did not see any relevancy of such a programme of helping to attain his objectives.

Results

The fourth construct dimension used by subject 11 to construe the elements is related to the results obtained from the synchrony programme. The subject gave a rating of “2” to heifer synchronisation on this dimension, meaning that he was not happy with the results produced by heifer synchronisation. From his experience of the conception rate from heifer synchronisation, he regarded the result as not good enough, and not as good as natural mating. In fact, he said he had yet to see any farmer who would be able to get his heifers in calf within six weeks.

Convenience

The fifth construct dimension used is related to its convenience of use: The subject gave a rating of “2” to heifer synchronisation on this dimension, meaning that it is not convenient for him to use such programme in his system. As stated earlier, his heifers were grazed at a distance from the main property. In other words, he said he had to travel frequently to the place when he used the programme. He considered this to have created a lot of inconvenience to him, with a lot of time, energy and money being wasted.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 11’s grid attributable to the first principal component is 71.2 per cent. In Figure A1.18a, the positive end of the component shows four construct labels which score highly on this component: happy with the results, convenient to use, very good (results), and more relevant to achieve my objectives. Those elements which score highly on this component are: feed budgeting, herd testing, artificial insemination, inducing cows to calve and use of nitrogen fertiliser. One general theme that best describes this component is “effectiveness and convenience in achieving farm objectives” (Figure A1.18b). These innovations stated above are important to this subject because he is satisfied that they contribute to his farming objectives.

Figure A1.18a: PrinCom analysis for subject 11

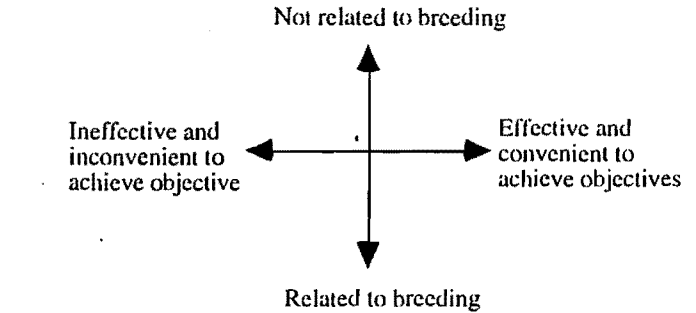
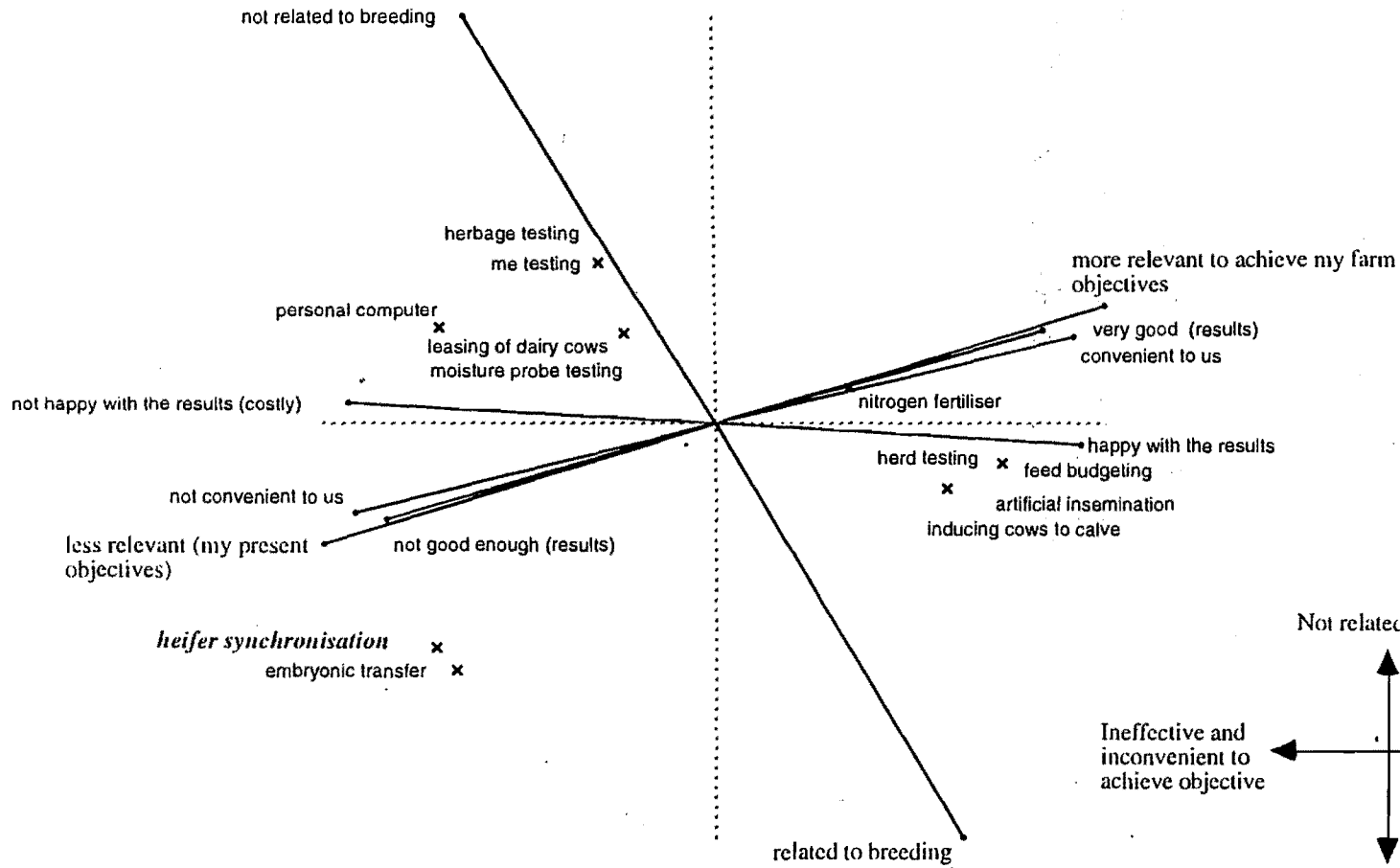


Figure A1.18b: Principal components for subject 11

The negative end of the component shows four construct labels which score highly on this component: not happy with the results (costly), not convenient to us, not good enough (results) and less relevant to my present objectives. There are two elements which score highly on this component: heifer synchronisation and embryonic transfer. The subject is not happy with heifer synchronisation. He considers it to be inconvenient and ineffective, and hence he is unable to achieve his farm objectives.

A1.3.5 Subject 12's Constructs

Subject 12, aged 46 years, has a two-year secondary education. He moved to this new 400-hectare property three years ago. He purchased the property from a sheep farmer and then converted to dairying. At the moment he has 450 milking cows, comprising of Jerseys and Friesians with an average milk production of 450 kg ms per cow. He is a seasonal supplier of milk. One of his farm objectives is to become wealthier or financially strong enough through the use of modern technology.

He said he has used heifer synchronisation for the past three years. This year he decided to discontinue because of some reasons. The following sub-sections will explain these reasons.

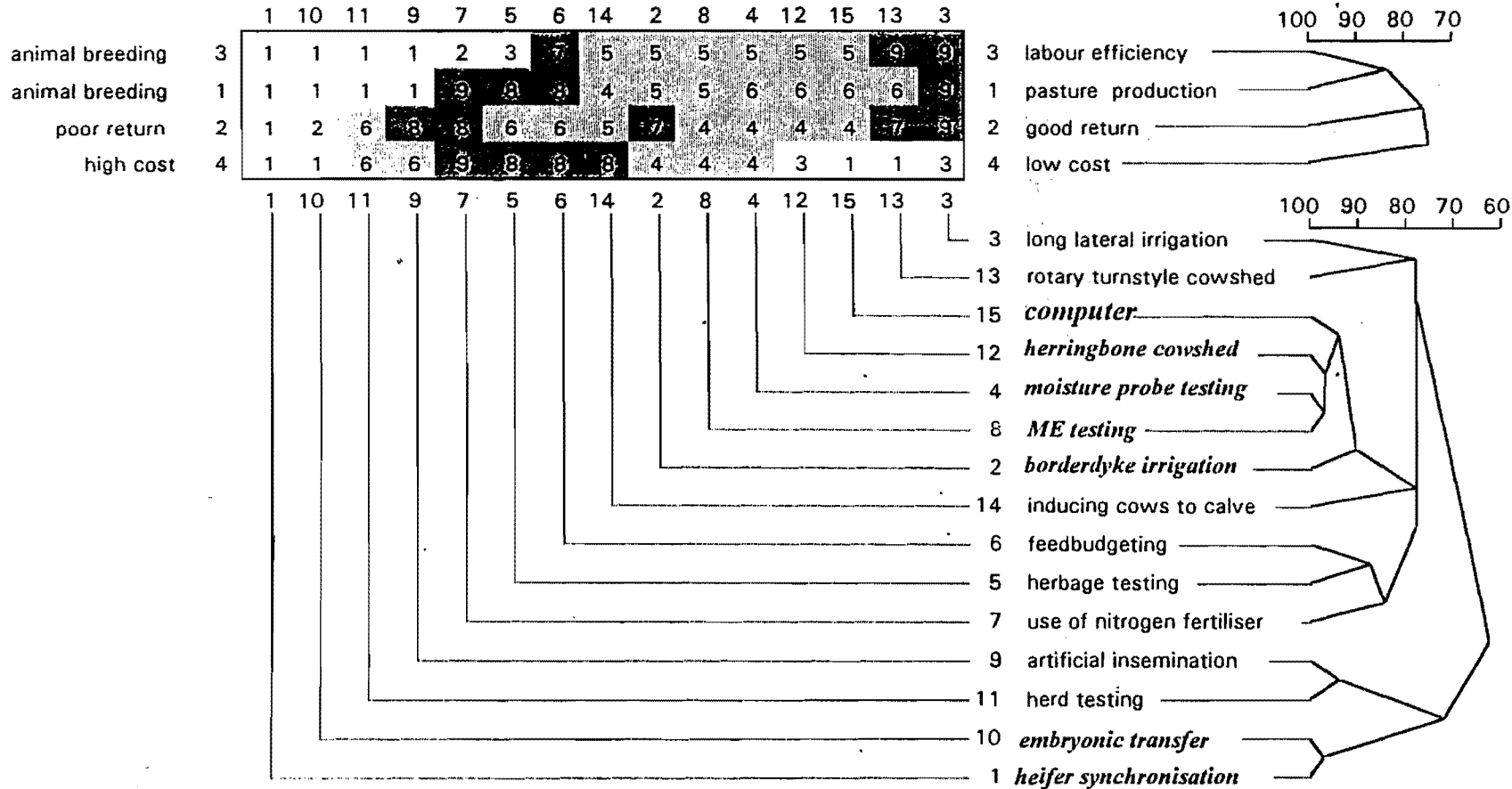
Focus analysis

The focus analysis results of subject 12 are shown in Figure A1.19. It consists of 14 elements on the Element Tree and four main construct dimensions on the construct Tree. His interpretation of the grid is as follows.

His first comment was on the location of the adopted and non-adopted innovations on the Element Tree. He pointed out that those non-adopted innovations were located at the top except for heifer synchronisation and embryonic transfer which are located at the bottom together with the adopted ones. Those adopted ones were located at the bottom except for the lateral irrigation and the rotary turnstyle cowshed which were located at the top.

Herbage testing and feed budgeting are tightly matched at 88 per cent and are then clustered with use of nitrogen at 85 per cent. He said that both of these elements were related to

Figure A1.19: Focused grid for subject 12



pasture management and hence animal feeding and milk production. Similarly, they are related to use of nitrogen fertiliser for pasture and milk production, and hence farm income.

Artificial insemination and herd testing are tightly matched at 94 per cent. He said these two elements are directly related to genetic improvement in the herd. Embryonic transfer and heifer synchronisation are matched at 97 per cent. He said these two innovations are related to genetic improvement. However, he indicated that both were not adopted or not used because of no financial reward to justify their use. He said all these four innovations are matched at 75 per cent because they were all related to genetic improvement.

Figure A1.19 shows the focused grid of subject 12 displaying the four construct dimensions which he used to construe the elements. These four dimensions are: animal breeding, financial returns, labour and cost. The following sub-sections explain each of the four dimensions.

Animal breeding - pasture production

The first construct dimensions used to construe the innovations is related to milk production. The subject gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that heifer synchronisation is related to animal breeding in connection with genetic improvement and milk production. He said that by inseminating those synchronised heifers, he thought it would help make life easier through an increase in milk production and genetic improvement. However, he indicated that he was not particularly concerned about how heifer synchronisation could help improve the genetic gain. He said he decided to move away from the programme because he was not getting good returns from it as he thought he should.

Financial returns

The second construct dimension used is related to the financial return he would expect from the programme. The subject gave a strong rating of "1" to heifer synchronisation on this

dimension, meaning that he was getting poor returns from the programme. For example, he said that he mated 60 of the synchronised heifers. From synchronising 60 heifers he should get about 18 replacement heifer calves. However, he indicated that for the last two years he only got 12, and he argued that this was not a good enough return to justify spending the money on such a programme. He said he could possibly use the normal heat detection method and then artificially inseminate them to achieve the same result, if not better, with minimal cost.

Animal breeding - labour efficiency

The third construct dimension used to construe the innovations is animal breeding - labour efficiency. Subject 12 gave a strong rating of "1" to heifer synchronisation on this dimension, meaning that heifer synchronisation is related to animal breeding. He said the programme was related to calving management and genetic improvement. However, he said these factors were not important to him, and he considered that heifer synchronisation could not be used to achieve his farm objectives.

Cost

The fourth construct dimension used to construe the innovations is related to cost. Subject 12 gave a strong rating of "1" to heifer synchronisation on this dimension, meaning that the programme involves higher cost. The subject explained that if he could get reasonable results from such programme the cost would have been worthwhile. In other words, he said it was not justified for him to proceed using the programme because there were alternative ways to achieve similar results, such as using his own bulls.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 12's grid attributable to the first principal components is 55.2 per cent. In Figure A1.20a, the positive end of the dimension shows three construct labels which score highly on this component: good returns, pasture production and low cost. Those elements which score highly on this component

Figure A1.20a: PrinCom analysis for subject 12

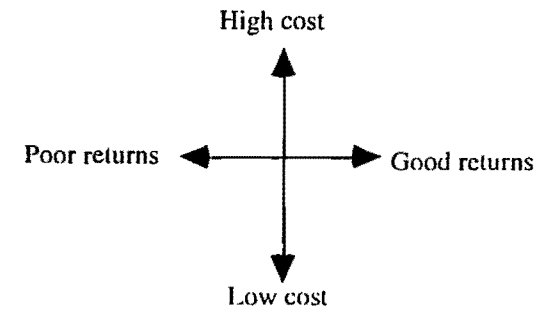
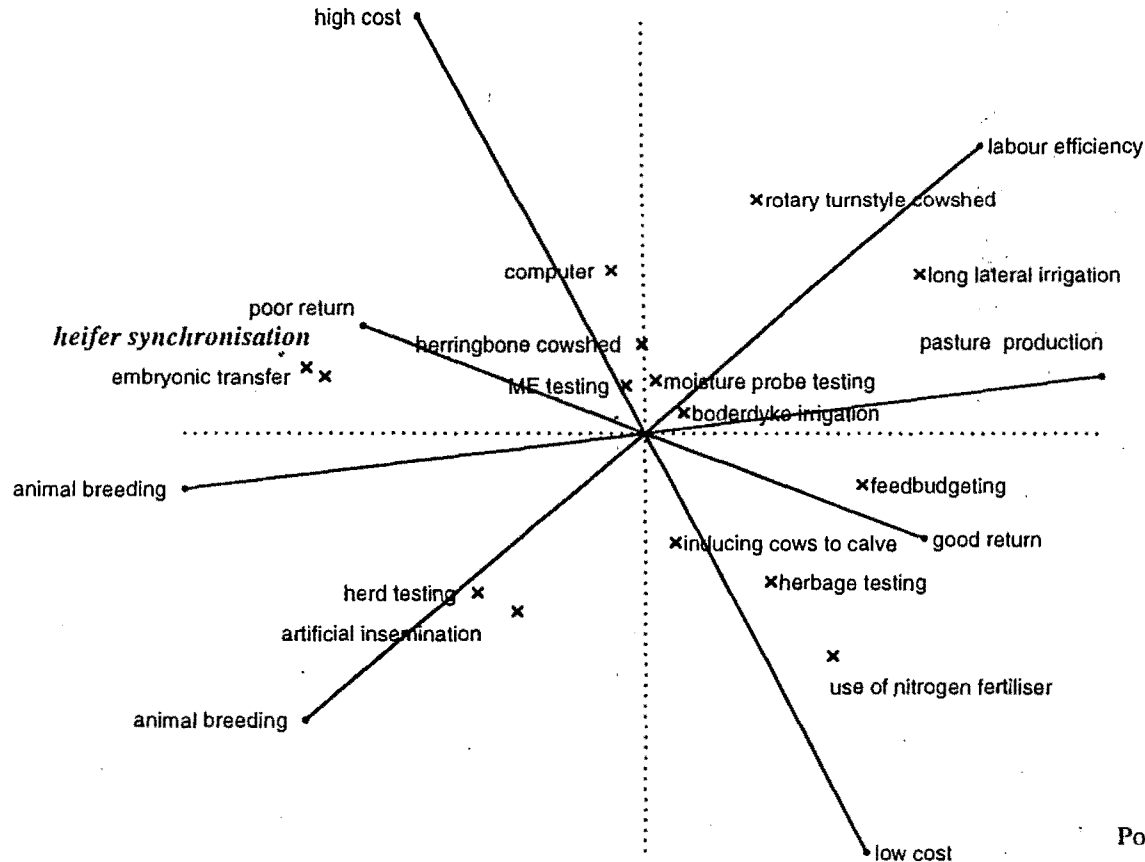


Figure A1.20b: Principal components for subject 12

include, the rotary turnstyle cowshed, long lateral irrigation, inducing cows to calve and use of nitrogen fertiliser. One general theme that best describes this component is “achievement from good returns” (Figure A1.20b). The innovations stated above are important to this subject because they all contribute to good returns through efficient pasture production.

The negative end of the component shows two construct pole labels which load heavily on this component: poor return and animal production. The elements which score highly on this component are: heifer synchronisation and embryonic transfer. Although this subject believes that heifer synchronisation is related to genetic improvement and calving management, he does not consider that it gives him good return.

The second principal component gives a percentage variance of 32.6 per cent. The positive end of this component shows one construct label which scores highly on this component: high cost. The elements which score highly on this component are: moisture probe testing and computer. The subject considers that those innovations which are costly will not be adopted. At the negative end of the component the construct which scores highly on the component is low cost. The elements which are associated with this construct are: artificial insemination, herbage testing and feed budgeting. This shows that those innovations which have less cost will be taken up easily by the subject.

A1.4.1 Subject 10's Constructs

Subject 10, aged 26 years, has a Diploma in Farm Management. He has been on the 154-hectare property for three years, in partnership with his parents. He has 300 milking cows of Holstein-Friesian breed, with an average milk production of 333 kg ms per cow. The property was converted to a dairy farm 20 years ago. The plan is for him to buy this property in stages while preparing for his parents to retire from the farm.

Subject 10 has mentioned that his main farm objective was to keep the operation on a low cost basis. He would not like to use a lot of supplements or concentrates. He would go for the lowest stocking rate in trying to get maximum production from the cows. He would try to keep the cost down and similarly keep the profit high, which he believed was easier for

risk management. He believed that the use of a high rate of concentrates would be highly susceptible to price changes, and hence would not be profitable in his system.

He also mentioned that he was developing an irrigation system. He operates his own water pump for the wells and therefore does not rely on any water supply from the county council. This is one of the strengths of his farm, apart from the heavy and fertile soils. In terms of utilisation of new ideas on his farm, he said that he has tried and is still using a number of them. With regard to heifer synchronisation he said he has not adopted it yet. He was aware of the innovation but would prefer to have a “wait-and-see” attitude towards it.

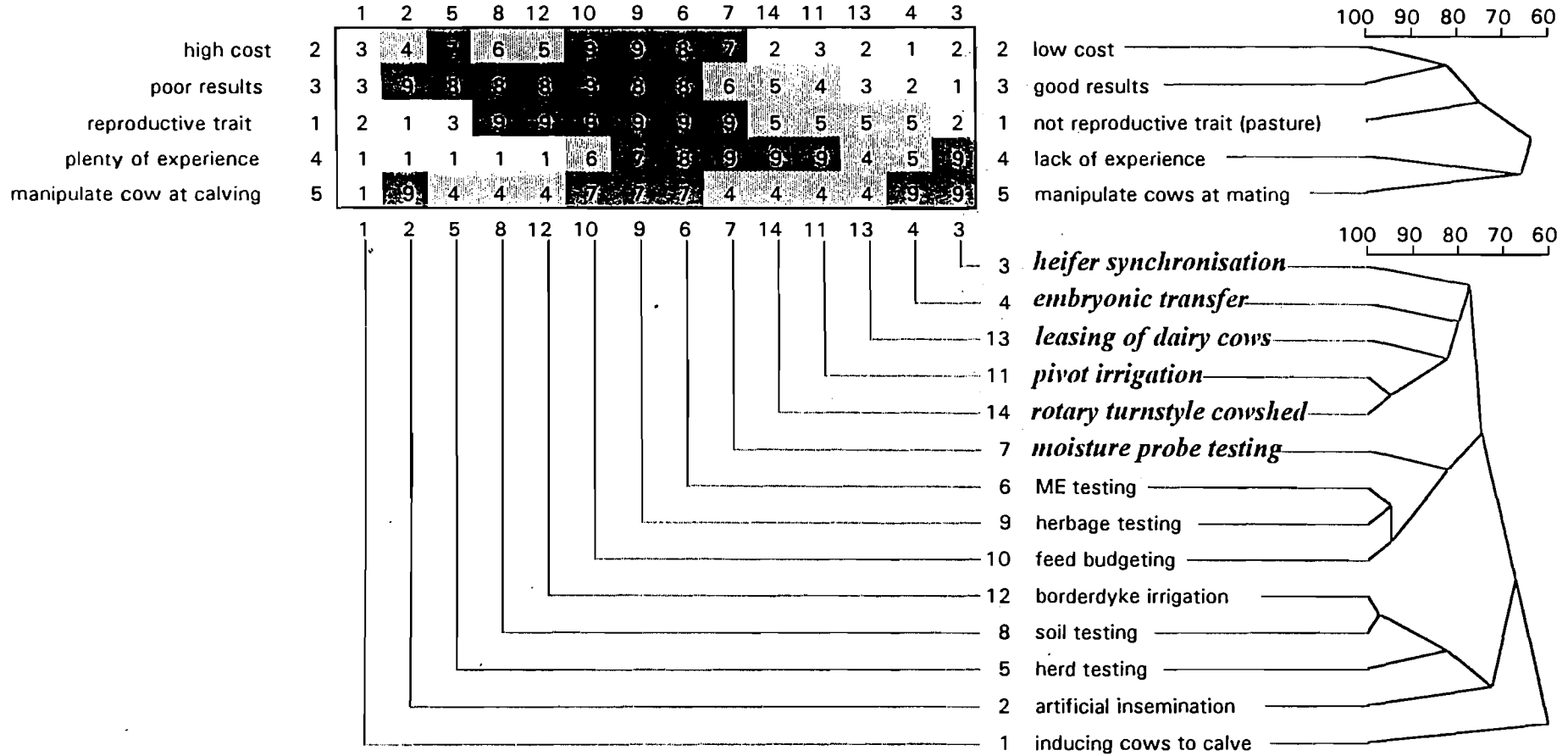
Focus analysis

The focus analysis results (focused grid) of subject 10 are shown in Figure A1.21. It consists of 14 elements displayed on the Element Tree and five construct dimensions on the Construct Tree.

Subject 10 observed that the non-adopted innovations were clustered together at the top of the tree and that the adopted ones formed another cluster at the bottom. He observed that moisture probe testing was not adopted but was clustered with the adopted innovations at 80 per cent. He said although he has not adopted the moisture probe testing he would prefer to have a “wait-and-see” attitude. His understanding was that there were not many dairy farmers using the technology and would like to obtain more information about it. He said he decided to discontinue using embryonic transfer because it was too expensive, too technical and produced mixed results. Moreover, they could not always guarantee what they wanted to get, he said. They have also tried using the idea of leasing of dairy cows but because of disagreement on the terms and conditions of lease they decided to discontinue using it, and would prefer to increase their own herd size.

Borderdyke irrigation and soil testing are tightly matched at 97 per cent. He said the results from soil testing provided him with some information on the time to irrigate the farm and the amount of fertiliser to be used. They are equally important, he said because both are management decision tools, and would allow him to make sure that his operation was not depleting the natural resources.

Figure A1.21: Focused grid for subject 10



He said herd testing and artificial insemination were close to each other because both were related to genetic improvement of the herd. He observed that inducing cows to calve was located at the bottom of the tree. This type of innovation has been used in the property for about 20 years. He said that, being a seasonal supplier of milk, it is the only good option available at present in terms of farm profitability. However, it has been drawn to his attention that one day he might stop doing this induction method of producing milk. One of the main reasons, he said, was that the environmental group was putting some pressure on the farmers and the government to stop using what they regarded as a very “inhumane” method of increasing farm production. With this situation in mind, he said he was still keeping his mind open on the importance of heifer synchronisation on his farm.

Figure A1.21 shows the five construct dimensions used to construe the elements: reproductive trait, cost, results, experience and calving management. The following subsections explain each of these dimensions.

Reproductive trait

The first construct dimension used to construe the innovations is reproductive trait. The subject gave a strong rating of “2” to heifer synchronisation on this dimension. He said that the programme is a good management tool in terms of improving the genetic gain and in the early calving of the herd. He indicated that he was still concerned with other aspects related to its usage, such as the cost, results and lack of experience.

Cost

The second construct dimension used is related to the cost involved. The subject gave a strong value of “2” to heifer synchronisation on this dimension, meaning that it is an expensive exercise. The subject said that the costs include the purchase of drugs and the veterinary fees. He indicated that there were some new and very good drugs on the market that would cost \$30-\$40 per cow. He believed that this price was too expensive.

He claimed that his existing method of breeding programme by identifying visually those animals on heat, artificially inseminating them and then putting the bulls over them, has provided him with a high conception rate. For example, he said he has 80 replacement heifers, and by putting six bulls over them only 2 or 3 of his heifers did not calf on time. He argued that as long as they were fed and well looked after, they could be expected to cycle properly and in time.

If he were to use the synchrony programme, he said, he would have to have the veterinary technicians there to inseminate those heifers on heat. His understanding from other farmers was that the result would only give a conception of about 46 per cent. By including the costs of the drugs and the veterinary fees, he believed that this synchrony programme was very expensive. Basically, he said he wanted to try the synchrony programme but would like to wait for the cost of drugs and the results to improve. He perceived that the results he would expect to get from the programme would not seem to warrant the amount of money he would spend.

Results

The third construct dimension used is related to the results obtained from heifer synchronisation. Subject 10 gave a very strong rating value of "1" to heifer synchronisation, meaning that the results were construed as poor. The subject said that he had attended meetings, seminars, field days and discussion groups, and had talked to farm consultants and other farmers who have used the technique. Other sources of information, such as farming magazines and The Press, also provided good information on the results related to the use of heifer synchronisation. He claimed that the results obtained from the programme were mixed. Some farmers did produce good and acceptable results with a 60 per cent conception rate, while some produced a calving rate as low as 46 per cent. He believed that he would probably have spent a lot of money if he were to use the programme unless he could achieve a 70-80 per cent in calf through artificial insemination.

From his perspective the principle of heifer synchronisation was good in terms of achieving early calving for the cows and providing them with plenty of time to calve again. However, he pointed out that his concern with the results and the costs seemed to outweigh the expected early calving and longer lactation period for the cows.

Experience

The fourth construct dimension used is related to his own experience. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that he has a lack of experience regarding heifer synchronisation. He said he has only been on the farm for about three years and therefore did not have enough practical experience in terms of managing the farm or the synchrony programme itself. Further, his father was not interested in the programme. Subject 10 had talked to other farmers who have bigger herds and have stopped using the programme because of the poor results achieved. He said that his father was a good source of information for him because he has a wider scope of contact with other farmers. He therefore believed that lack of experience also plays some influence in his decision not to use the synchrony programme in his system. The result from lack of experience suggests that it might be possible that he considers adopting the innovation when he has gathered more practical experience on his farm.

Calving management

The fifth construct dimension used is related to calving management. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that the programme is concerned with the mating management of heifers. He said the programme allows the heifers to calve as early as possible so that they do not have to calve throughout the calving season. However, at this stage, he said he preferred to put less priority on this arrangement. He indicated that he had some other pressing factors which he considered more important and caused some concern to him. He therefore preferred to have a “wait-and-see” attitude towards the synchrony programme.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 10's grid attributable to the first principal component is 44 per cent. In Figure A1.22a, the positive end of the component shows three construct labels which score highly on this component: high cost, poor results and reproductive trait. There are two elements which score highly on the component: heifer synchronisation and embryonic transfer. One general theme that best describes this component is "high cost and ineffective" (Figure A1.22b and Table 3). Heifer synchronisation has caused some concern to this subject because of high cost involved. It was also ineffective in terms of increasing the conception rate in the heifers.

The percentage of variance attributable to the second component is 32.7 per cent. The positive end of the component shows one construct label which scores highly on the component: lack of experience. The element which scores highly on this component is heifer synchronisation. This element, heifer synchronisation, is not important to the subject because he has no practical experience and hence no confidence of using the innovation.

A1.4.2 Subject 13's Constructs

Subject 13, aged 28 years, has completed his two years secondary education. He is a sharemilker and has been in this 80-hectare property for about three years. He also mentioned that the property was very traditional with not much work having been done on it in the past. He was sharemilking for about four years before coming to the present place. At present he is milking 200 Friesian cows. He is a seasonal supplier of milk. His main objective is to achieve the production level of 330 kg ms per cow. He is married with one child. His wife is also helping with the daily operation of their farm, especially with milking.

Focus analysis

The focus analyses results for subject 13 are shown in Figure A1.23. The Element Tree shows 13 elements of which seven are adopted and six are not adopted by the subject. The Construct Tree displays four construct dimensions used to construe the elements. His interpretation of his grid is as follows.

Figure A1.22a: PrinCom analysis for subject 10

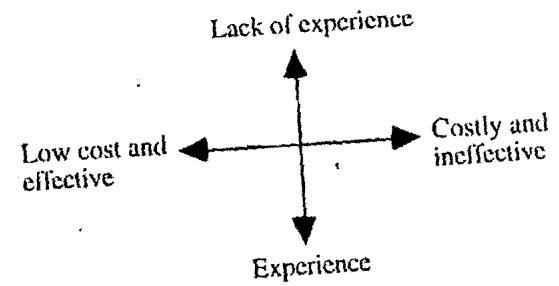
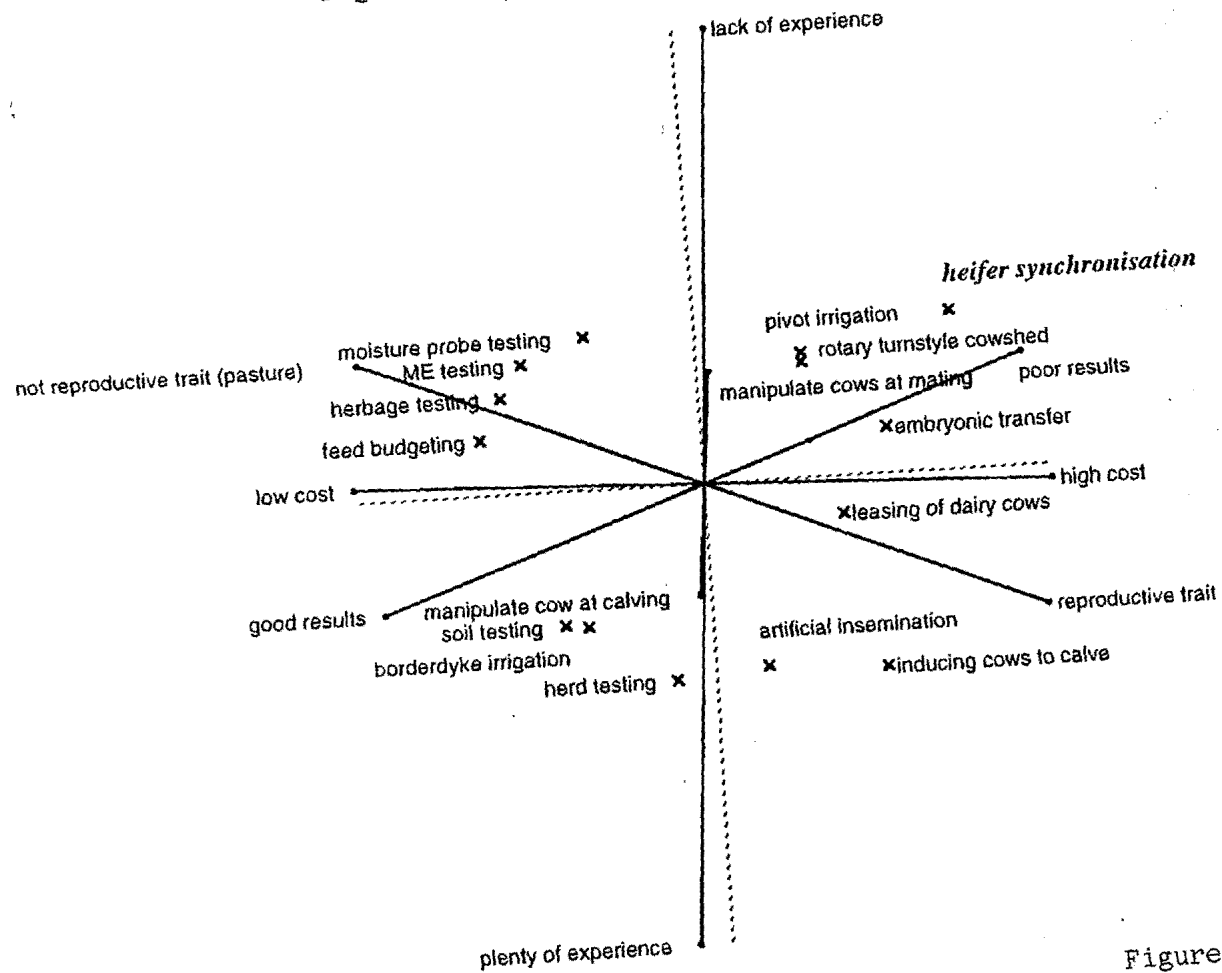
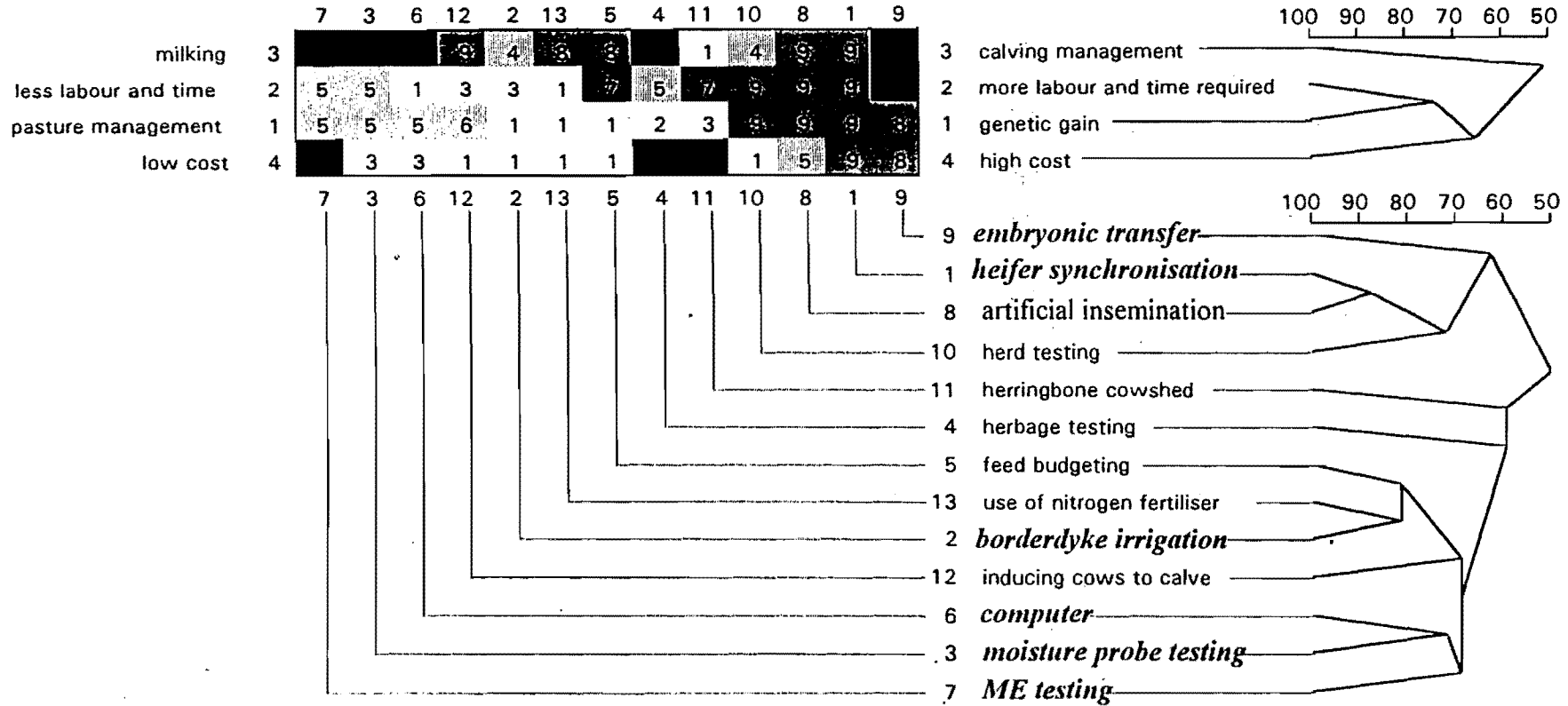


Figure A1.22b: Principal components for subject 10

Figure A1.23: Focused grid for subject 13



The subject gave his comments on the non-adopted innovations. One of the innovations which he has not adopted was moisture probe testing. While the adopters of the moisture probe testing believed that it was useful and beneficial on their farms, subject 13 construed otherwise. He said he has never used it before and did not believe there was a need to find out how much water was available and how much was to be used. However, he said it might be useful in the future and preferred to have a “wait-and-see” attitude towards it. The same applies to ME testing which he has not adopted, and preferred to keep his mind open.

Subject 13 indicated that he has some knowledge of heifer synchronisation. He said it was a technique used to get a better genetic gain, and to get the heifers calve at the right time. However, at the time of the interview he has not adopted such programme.

He observed that heifer synchronisation and artificial insemination are tightly matched at 88 per cent and are clustered with herd testing at 72 per cent. He said heifer synchronisation, artificial insemination and herd testing were directly related to genetic improvement in the herd. Although he was using artificial insemination and herd testing, he said he has not used the synchronisation programme because he still has some concern about the cost and the labour needed.

He indicated that the herringbone cowshed, herbage testing, feed budgeting and use of nitrogen fertiliser were all directly related to pasture management and were important in his system. They were linked to inducing cows to calve because he was a seasonal supplier of milk and hence were directly related to farm productivity, he said. He reiterated that those innovations which he has adopted are either directly or indirectly linked to each other in terms of farm productivity.

Figure A1.23 shows the focused grid of subject 13. It displays the four construct dimensions he used to construe the innovations: genetic gain, labour, calving management and cost. The following sub-sections explain each of the construct dimensions.

Pasture management - genetic gain

The first construct dimension used by subject 13 to construe the innovations is pasture management - genetic gain. Subject 13 gave a high rating value of "9" to heifer synchronisation on this dimension, meaning the programme is related to genetic gain in the herd. The subject said that one important aspect of using the programme was that it would help increase the genetic gain in the herd. He regarded this aspect as one of the long term benefits of using the technique. He agreed on the usefulness of this aspect in terms of increasing farm profitability. However, he said he was a bit concerned about the uncertainty of the results obtained. He said some farmers had good results while some had unsatisfactory results with respect to improving the genetic gain in the herd.

Labour/time

The second construct dimensions he used is related to labour/time. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that it requires more time and labour. Subject 13 indicated that his heifers were all grazing off-farm, about 40 km away from the main property. He said he could not afford to have additional labour or workers to do the synchrony programme, or to use some of his time to be at the grazier's property in order to do the programme. He considered this type work as a hassle for him. However, he indicated that if all his heifers were all at his own farm he would agree that such programme would be beneficial to him. He reiterated that his farm was just the milking platform for his cows or young stocks. He said he would prefer to keep his mind open about heifer synchronisation.

Milking - calving management

The third construct dimension used is milking - calving management. The subject gave a rating value of "9" to heifer synchronisation on this dimension, meaning that it is directly related to calving management. He said heifer synchronisation allowed farmers to synchronise their heifers so that they would calve earlier and at the right time. It would also

allow the calving period to be manipulated to coincide with the growth of the grass. However, he said that although he agreed that such a programme is believed to improve the genetic gain in the herd and also to ease the calving management, he was concerned about the uncertainty of the results produced and the time and labour involved.

Cost

The fourth construct dimension used is related to cost. The subject gave a rating value of "9" to heifer synchronisation on this dimension, meaning that the exercise is costly. The subject indicated that there were two main aspects of the cost involved in the synchrony programme: (1) transportation, and (2) unexpected poor results. His heifers were grazed off-farm at another grazier's property, about 40 km away from the main property. He considered that if he were to use such programme he would have to pay for the additional cost of transport and labour used in the programme. He said that at present he was putting the bulls over these heifers after they had been artificially inseminated, and he did not have to worry about going to the place frequently. He said he was very pleased with the present arrangement because it was less hassle and therefore less cost involved.

Secondly, he also expressed some concern about the results from the synchrony programme. He said some technicians and consultants have mentioned all the good information on background of these heifers, or presumably they were good milkers. However, he said these heifers could turn out to give a different result when using the synchrony programme. He believed this phenomenon could happen occasionally. If this would happen he said, he would be spending more money on animals which were not good as he thought, as a result of using the synchrony programme. In other words, he argued the whole programme would be very expensive to run.

PrinCom analysis

The percentage of variance in subject 13's grid attributable to the first principal component is 54.2 per cent (Table A3.1). The positive end of the first component shows three construct labels which score highly on this component: more labour, high cost and genetic gain (Figure A1.24a).

Figure A1.24a: PrinCom analysis for subject 13

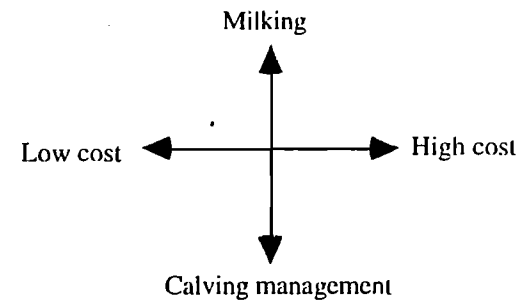
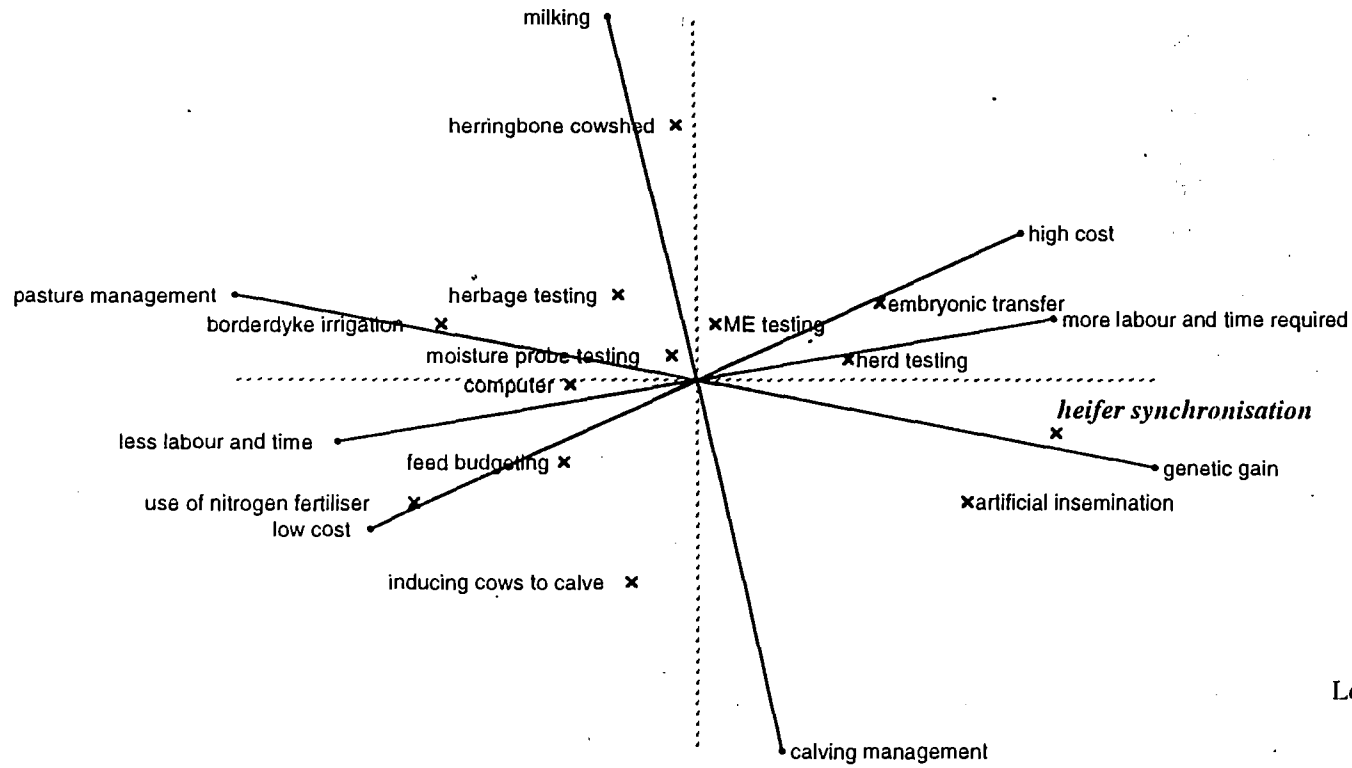


Figure A1.24b: Principal components for subject 13

There are two elements which score highly on the component: embryonic transfer and heifer synchronisation. One general theme that best describes this component is “genetic gain but expensive” (Figure A1.24b and Table 3). This subject has some concern about the high cost involved in heifer synchronisation, although he believes that it could improve the genetic gain in the herd.

A1.4.3 Subject 17's Constructs

Subject 17, aged 40 years, has completed his fifth form certificate. He is a seasonal supplier of milk and operates his own 270-hectare property. One of his main objectives is to be able to increase his number of milking cows from the present 130 to 250 cows, and to lift the production level to 450 kg ms per cow. His plan is to be efficient in the use of fertiliser and to be receptive to the use of new ideas. At present dairy farming provides more than 90 per cent of his income. The other portions of his income are from beef and sheep. He is also working towards improvement of the place all the time. He hopes to have a good lifestyle, sufficient spare time and enough money to retire comfortably in the future.

Focus analysis

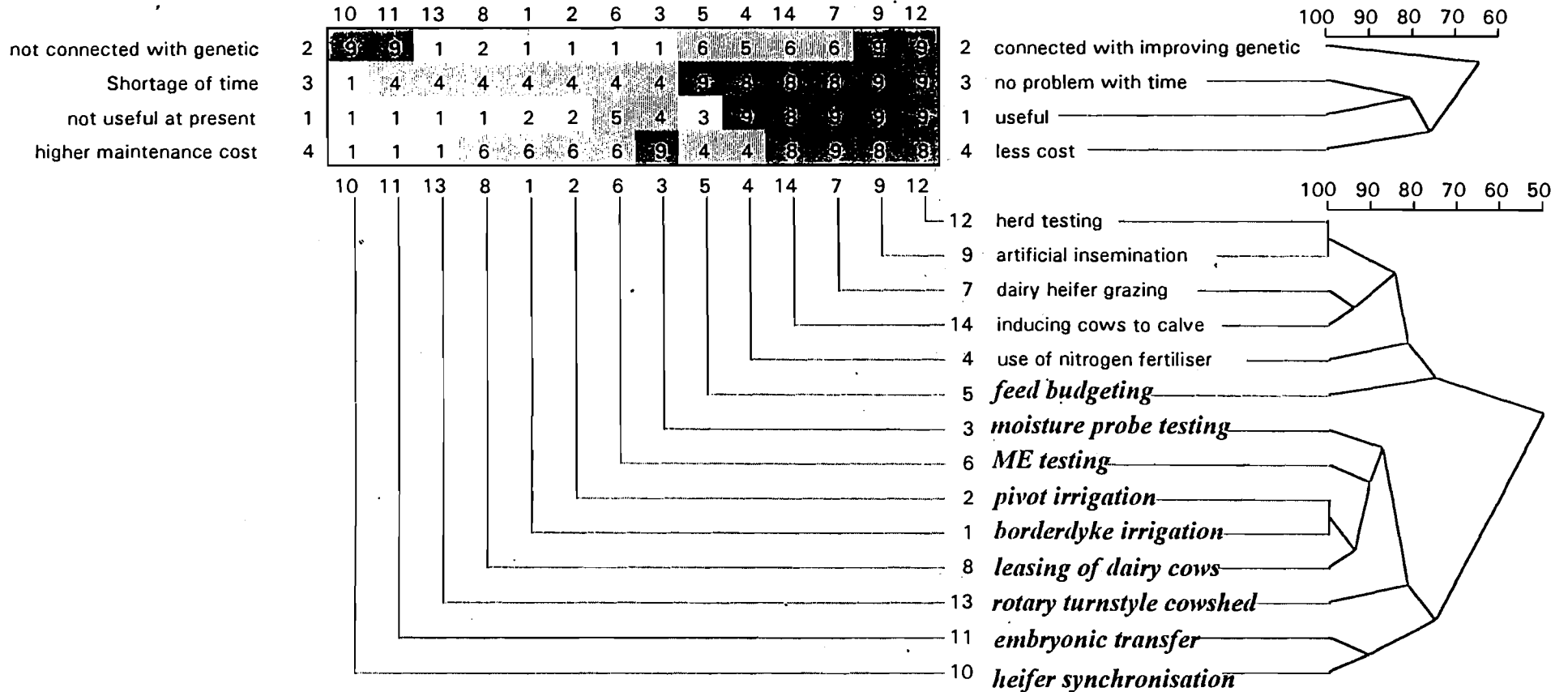
The focus analyses results of subject 17 are shown in Figure A1.25. The Element Tree shows 14 elements with four construct dimensions on the Construct Tree.

The subject observed that the five adopted innovations were located and clustered at the top of the tree, and the nine non-adopted ones were also located and clustered at the bottom of the tree.

Herd testing and artificial insemination were tightly matched at 100 per cent. The subject said that these two were directly related to breeding and genetic improvement in his herd. He indicated that he has been using artificial insemination in the past for many years, and has also carried out herd testing at least two or three times a year.

Dairy heifer grazing and inducing cows to calve are matched at 94 per cent. The subject said both of them were related to milk production. In winter, he said, there was not much pasture

Figure A1.25: Focused grid for subject 17



available and considered he was better off feeding his animals off the farm or on someone else's grass. He said that when the animals are well fed more milk is produced. Similarly, he said, inducing cows to calve was also related to milk production for better income. He said all these five innovations were clustered together at 81 per cent because they were all related to farm income. He also said that feed budgeting was leaning toward the adopted innovations because he might consider it in the future. He indicated this topic was discussed in his discussion group and he was quite happy with the benefit he has obtained from it.

He observed that all those non-adopted innovations were not practical to be used on his farm. He was not confident enough to deal with them. He preferred to stick to the basic and select those which he considered more worthwhile to do.

Figure A1.25 is the focused grid of subject 17 showing the four construct dimensions he used to construe the elements: usefulness, genetic, time and cost.

Usefulness

The first construct dimension used by subject 17 to construe the innovations is usefulness. The subject gave a rating value of "1" to heifer synchronisation on this dimension, meaning that it is not useful to him at this stage. He said heifer synchronisation was a hassle to him because he would have to bring all the heifers down to the property to be mated all the time. He said during the time of the year when they were supposed to be mated he was very busy with other type of farm work. Therefore, at this stage, because of his tight schedule of work, he considered it was not useful to him.

Genetics

The second construct dimension used by subject 17 is related to genetics. The subject gave a high rating of "9" to heifer synchronisation on this dimension, meaning that it is related to genetic improvement and ease of mating in the herd. He said that under the new Livestock Improvement policy, breeding worth (BW) and production worth (PW) are important with a

dollar value attached to the life weight. He indicated that younger heifers produce better genetics than the cows. In other words, he said, synchronising the heifers would improve the breeding worth and breeding production in the new herd because a good quality semen was used. At this stage, he said he was not ready to use it.

Time

The third construct dimension used by subject 17 is related to time. He gave a very strong rating of "1" to heifer synchronisation on this dimension, meaning that time is an important factor in his decision not to use heifer synchronisation. He said the main issue was that he has shortage of time. The mating time for the heifers was in November. However, during this time he was very busy making his hay while at the same time mating his heifers.

He also said that his property was divided into three blocks: dairy, beef and sheep. The dairy block was an hour's distance from the yard. Because of this distance, it was difficult to do the synchronisation exercise, as it would involve a lot of his time.

Cost

The fourth construct dimension used is related to cost. The subject gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that it is an expensive exercise. The subject indicated that synchronisation programme was a costly exercise because he would have to pay for the veterinarian fees, drugs and CIDRs. He said that the injection might be needed two or three times, and that would involve a lot of money and time. He explained that if he did not get them in calf, he considered it a waste of time and money for him. Secondly, he said if he were to get some bull calves instead of heifers, all that money was wasted because he was not getting that genetic improvement. Therefore he said heifer synchronisation was an expensive exercise.

PrinCom analysis

The percentage of variance in subject 17's grid attributable to the first principal component is 59.6 per cent (Table A3.1). In Figure A1.26a, the positive end of the component shows two construct labels which score highly on this component: not useful at present and shortage of time. The elements which score highly on the component are: the rotary turnstyle cowshed, leasing of cows and heifer synchronisation. A possible theme that best describes this first component is "usefulness of time" (Figure A1.26b and Table 3). If the innovations were not useful to the subject he would not consider adopting them because of the constraint of time.

In the second principal component, the percentage of variance in subject 17's grid attributable to the component is 30.1 per cent. The negative end of the component shows two construct labels which score highly on this component: higher maintenance cost and connected with improving genetics. The elements which score highly on the component are: heifer synchronisation and embryonic transfer. Although the subject believes that heifer synchronisation is related to genetic improvement he still considers cost a major concern to him.

A1.4.4 Subject 19's Constructs

Subject 19, aged 43 years, has his civil engineering certificate. He has been on his 106-hectare property for about 15 years. He has 185 milking cows of Friesian and Jersey breeds, with an average milk production of 330 kg ms per cow. He is a seasonal supplier of milk. His main goals are for his farm to be profitable and to listen to new ideas if he thinks that they could be cost effective.

Focus analysis

The focus analyses results for subject 19 are shown in Figure A1.27. It displays 14 elements and three construct dimensions used to construe the innovations.

Subject 19 observed that the six adopted innovations were clustered and located at the bottom of the Element Tree. The eight non-adopted ones were also clustered and located at the top of the tree. Herd testing and artificial insemination are very tightly matched at 100

Figure A1.26a: PrinCom analysis for subject 17

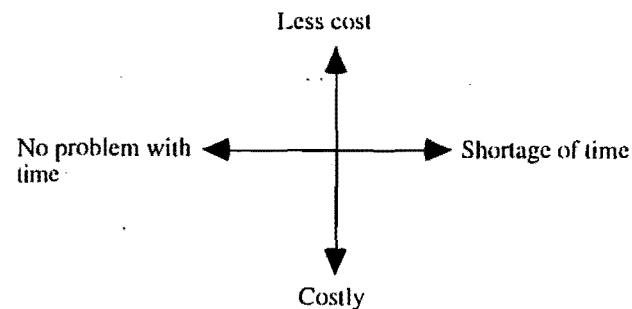
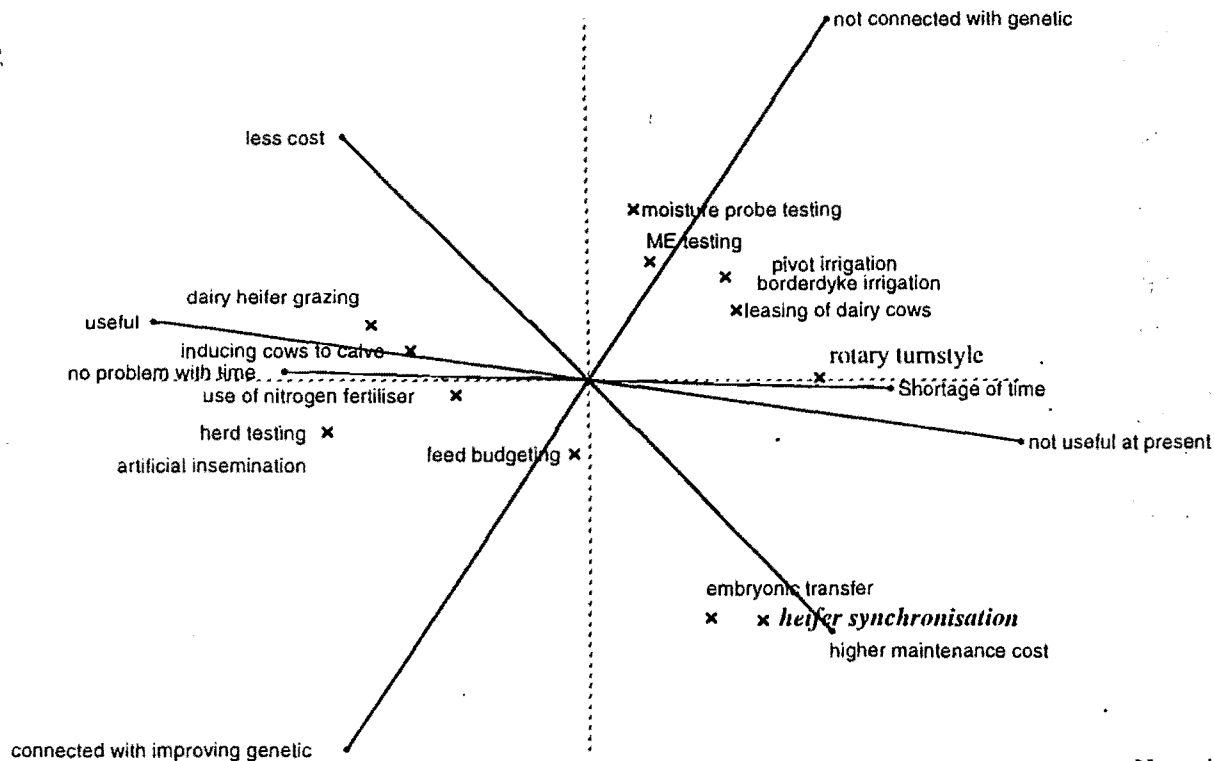
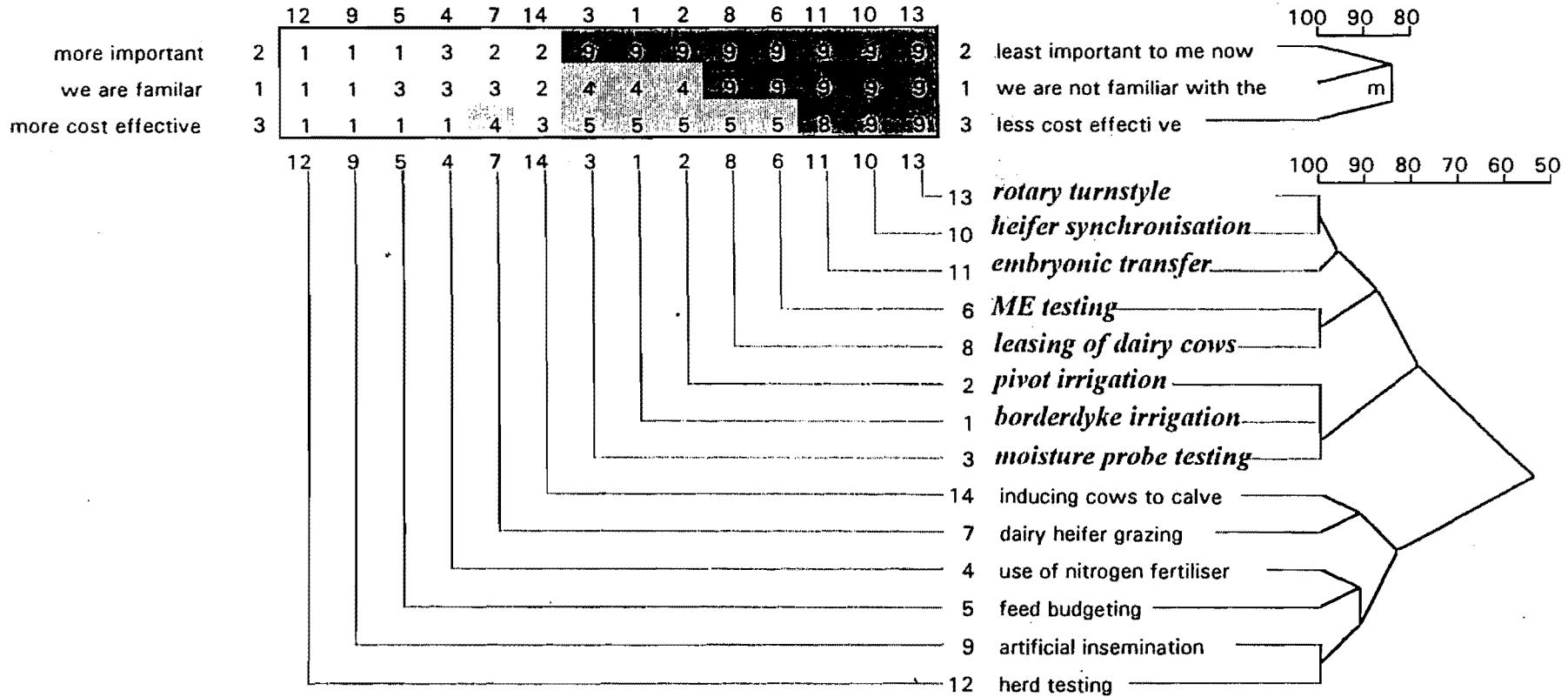


Figure A1.26b: Principal components for subject 17

Figure A1.27: Focused grid for subject 19



per cent. These two elements, he said, are closely related because both are used to improve genetics in the herd. Subject 19 said that he has been using artificial insemination and herd testing for sometime.

Feed budgeting and use of nitrogen fertiliser are tightly matched at 92 per cent. He said that these two elements were also directly related to each other. He said he needed to have feed budgeting to make sure that he has the quantity and quality of feed available throughout the year. He said if there was not sufficient feed available he would put in more nitrogen fertiliser to boost the pasture production.

Dairy heifer grazing and inducing cows to calve are tightly matched at 92 per cent. He said that both of them were related to farm income. His animals were grazed out to make sure that they were fed well to increase milk production. Similarly, he said he has to induce his cows for their early calving and hence milk production. All the above innovations, he said, were related to his farm objectives and hence profitability.

He indicated that all those non-adopted innovations were either not practical or not applicable in his farming operation. However, he indicated that although heifer synchronisation was not adopted now and grouped at the top of the Element Tree, together with the non-adopted innovations he was still evaluating the future benefits of that innovation on his farm. He indicated that he might consider it in the next couple of years if the programme could guarantee that it would be able to produce genetically good quality heifer calves.

Figure A1.27 shows the focused grid of subject 19 displaying the three construct dimensions which he used to construe the elements: familiarity, importance and cost. The following subsections explain each of the three construct dimensions.

Familiarity

The first construct dimension used by subject 19 to construe the elements is related to his familiarity with the elements. The subject gave a very high rating value of “9” to heifer synchronisation on this dimension, meaning that the subject is not familiar with heifer synchronisation. The subject said that he has heard about the programme through the Livestock Improvement and other farmers who have used it. He said he was aware that the programme was linked to genetics and synchronised mating of heifers. He has also heard some negative information about the programme. He said some people who had used it later decided to move away from it because of some negative impact on its use. For example, he said, people moved away from it because they did not consider that it was desirable for the young heifers to be artificially manipulated by having them calving earlier than their normal cycles. He said he would prefer to have his animals to grow, to let them calve easily and have their natural life span.

Importance

The second construct dimension is related to how important it is to the subject. The subject also gave a high rating of “9” to heifer synchronisation on this dimension, meaning that the programme is least important to him. He indicated that the programme required good facilities for handling the animals at the right time. He has to have sufficient labour available after the insemination. He indicated the possible hassle at calving time because he would be dealing with large number of heifers at once. He said at this stage he could not afford to have all these facilities or labour made available. He agreed that heifer synchronisation is related to genetic improvement. However, he said, he had some doubt that the animals which have been mated with heifer synchronisation were unproven animals. He said it would be possible that he might be keeping replacement stocks out of unproven animals that might not meet his expectation.

Cost

The third construct dimension is related to cost. The subject gave a very high rating value of “9” to heifer synchronisation on this dimension, meaning that it is an expensive exercise. The subject said that there were a lot of costs attached to the programme. These include the payment of veterinary fees, CIDRs and drugs. He said it would cost about \$30 for one heifer to be injected. He argued that if he were to have a conception rate of only 60 per cent the cost would still be very expensive.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 19’s grid attributable to the first principal component is 88.0 per cent. In Figure A1.28a, the positive end of the component shows two construct labels which score highly on this component: more cost effective and we are familiar. The elements which score highly on the component are: artificial insemination, herd testing, inducing cows to calve, use of nitrogen and feed budgeting. One general theme that best describes this component is “familiarity, cost effectiveness and importance” (Figure A1.28b and Table 3). In other words, the subject would adopt innovations which are more cost effective and important to him and about which he has more knowledge.

A1.4.5 Subject 22’s Constructs

Subject 22, aged 32 years, has attained his school certificate education. He is a sharemilker and has been sharemilking at his parents’ 170-hectare property for about five years. Prior to this he was in partnership with his brother on the same property. He is milking 395 Jersey cows with the average milk production of 290 kg ms per cow. One of his farm objectives is to achieve a production level of 330 kg ms per cow.

Focus analysis

The focus analyses results for subject 22 are shown in Figure A1.29. The Element Tree has 14 elements of which eight are adopted and six are not adopted by the subject. His interpretation of his Element Tree is as follows.

Figure A1.28a: PrinCom analysis for subject 19

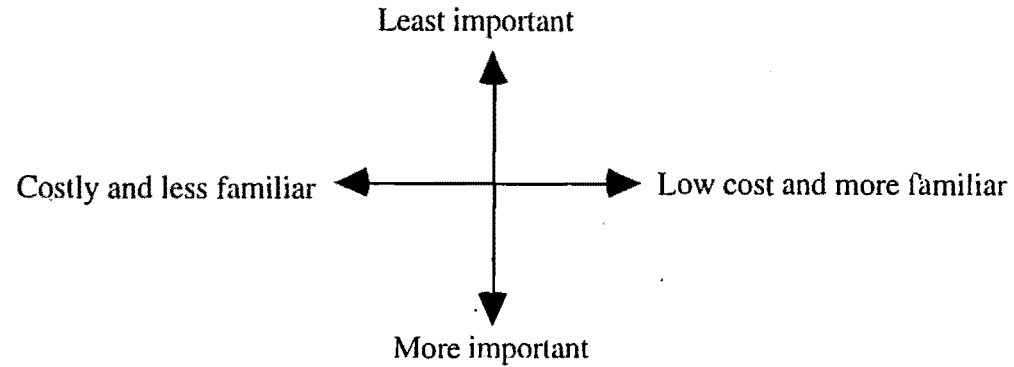
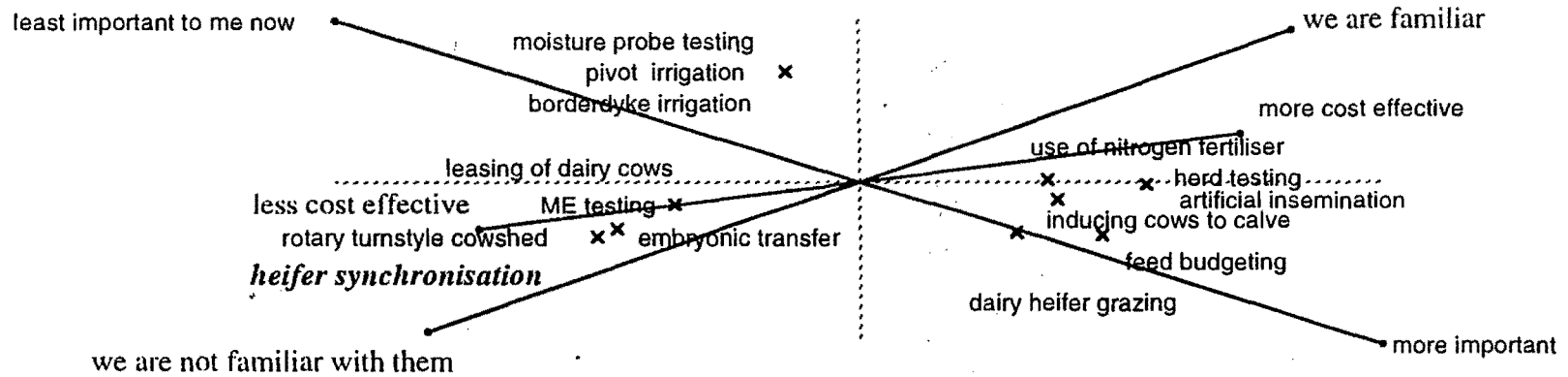
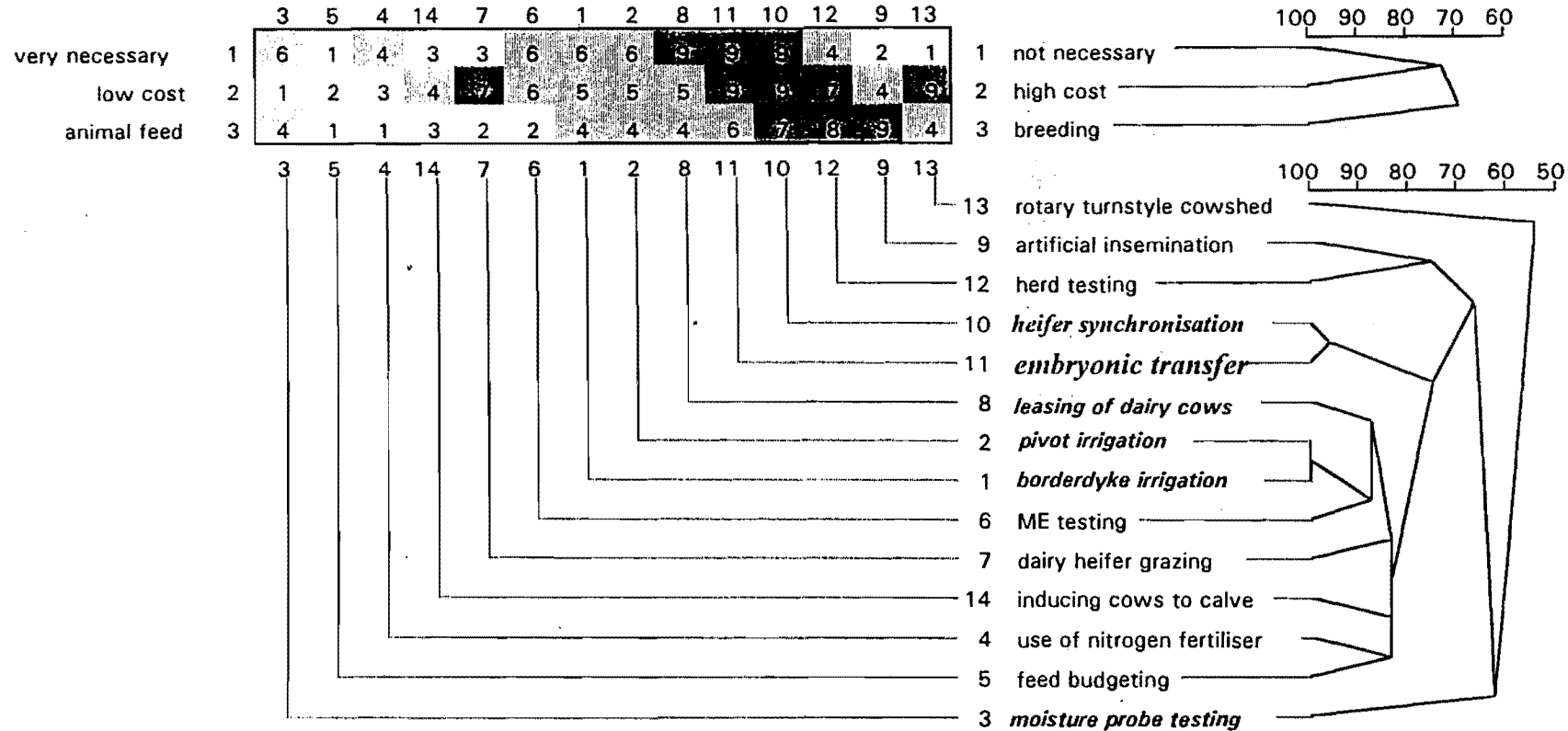


Figure A1.28b: Principal components for subject 19

Figure A1.29: Focused grid for subject 22



Heifer synchronisation and embryonic transfer are tightly matched at 96 per cent. Subject 22 said that both of these were related to genetics. However, they were not needed at this stage. He said they were better ways of spending his money.

Pivot irrigation and borderdyke irrigation are tightly matched at 100 per cent. According to the subject, these two irrigation systems were essentials for farming but were not used on his farm because there was no water available.

Artificial insemination and herd testing are matched at 75 per cent. He indicated that both of these elements were important to him because they helped to improve genetics in the herd.

Use of nitrogen and feed budgeting are matched at 83 per cent. He said both of these elements were directly related to each other because they were both connected to the feeding regime. He said that he used a lot of nitrogen on his pasture. He indicated all these adopted innovations, such as artificial insemination, dairy heifer grazing, inducing cows to calve, use of nitrogen and feed budgeting, were considered as being important to him in achieving his farming objective of increasing profitability.

Figure A1.29 shows the focused grid of subject 22 displaying the three construct dimensions used to construe the elements. These dimensions are: necessity, cost and breeding. The following sub-sections explain each of the dimensions.

Necessity

The first construct dimension used by subject 22 to construe the elements is whether there is a need for these elements. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the subject does not need the programme at this stage. He said all his heifers were on his run-off, which was near and convenient for him. He observes and identifies those on cycle and has them tail-painted before artificially inseminating them. The heifers which have been mated are then sent to another farmer's

property for grazing. He said that because of the convenience of his present set-up, he considered it unnecessary to change to heifer synchronisation.

However, he said, although he did not synchronise at this stage, the need might arise in the future when there might be bad seasons.

Cost

The second construct dimension he used is the cost. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the exercise is very expensive. The subject explained that the cheaper option for breeding was available to him. This was done by inseminating his heifers at his own run-off and sending those already mated to other farmers' grass. He indicated that heifer synchronisation was expensive because he would have to pay for the veterinarian fees, the drugs and CIDRs. He said that, because he has his own run-off near the main property, it was therefore much easier and less expensive to mate the heifers without synchronising them. However, he said, if he did not have the run-off, he could possibly have done the synchrony programme.

Animal feed - breeding

The third construct dimension is related to breeding. The subject gave a rating value of "7" to heifer synchronisation on this dimension, meaning that the programme is related to breeding. The subject explained that he was aware that the programme was related to genetic gain and calving management. However, he said, at this stage he was not ready yet to use the programme in his system. He said there was another cheaper option available, i.e., he has his own run-off, and that the programme was not needed at present.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 22's grid attributable to the first principal component is 53 per cent. In Figure A1.30a, the positive end of the component shows three construct pole labels which score highly on this component: very costly,

Figure A1.30a: PrinCom analysis for subject 22

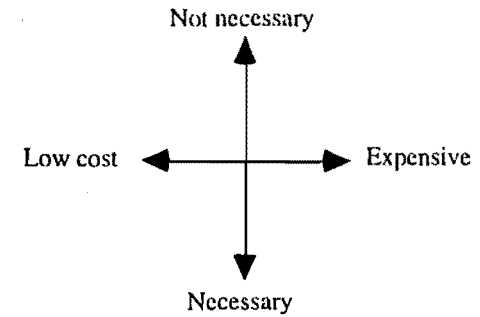
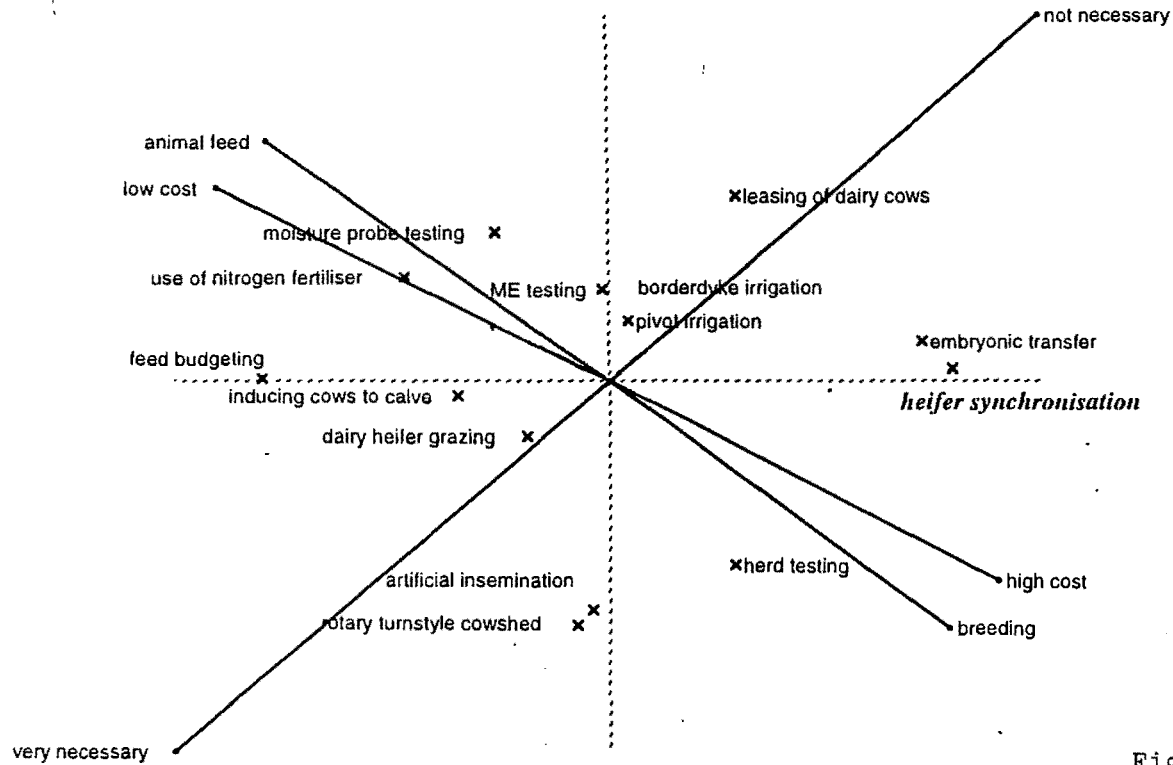


Figure A1.30b: Principal components for subject 22

breeding and not necessary. There are two elements which score highly on this component: heifer synchronisation and embryonic transfer. A general theme that best describes this component is “expensive and unnecessary” (Figure A1.30b and Table 3). This subject is aware of the benefit through genetic gain in the herd. However, because of the high cost involved, and that the need was not there, he considered it to be unimportant to him.

A1.5.1 Subject 15’s Construct

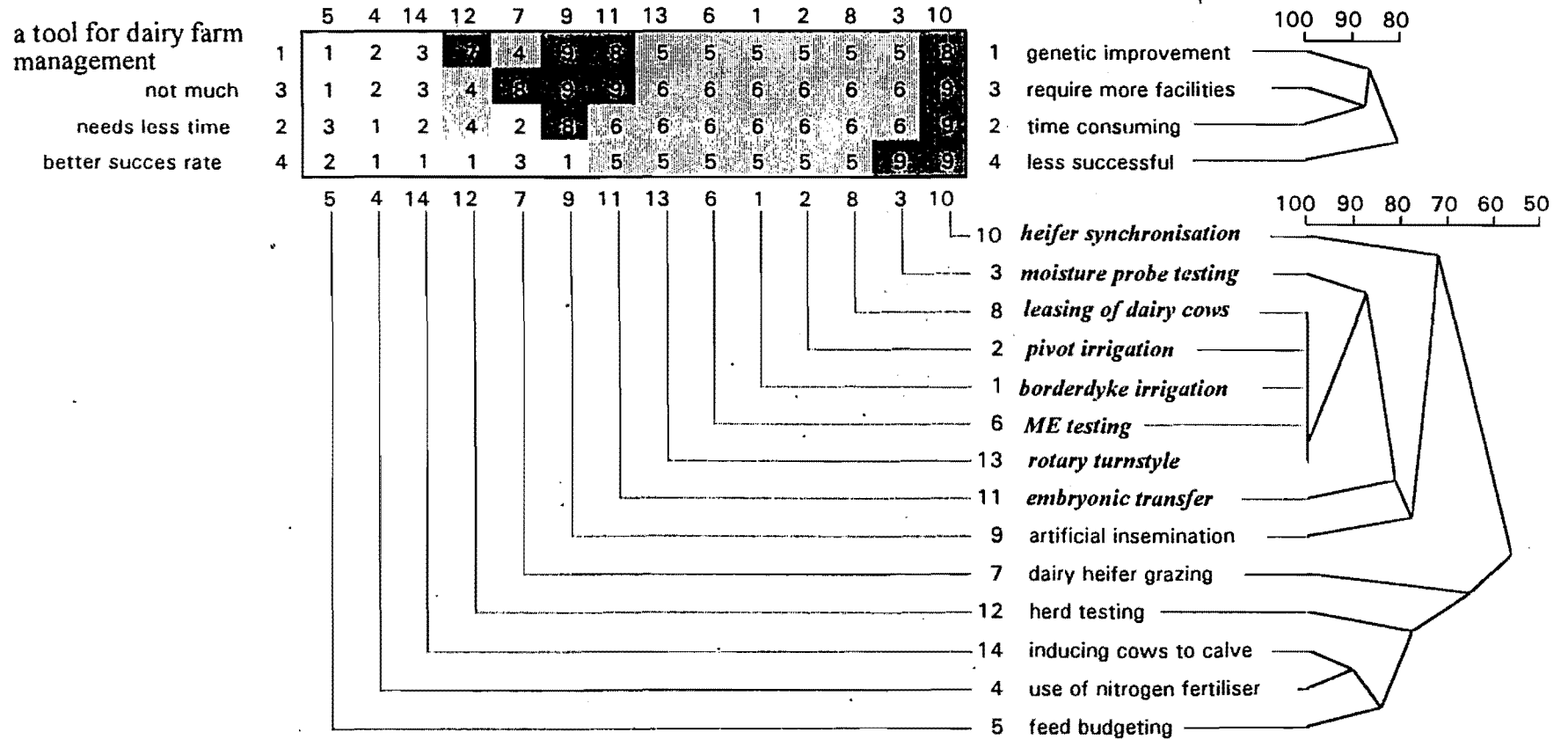
Subject 15, aged 32 years, has attained school certificate education. He is a sharemilker on his parents’ 96-hectare property. He is milking 293 Ayrshire cows with an average production of 360 kg ms per cow. He has both seasonal and winter contracts and a milk quota of 1,000 litres per day. One of his main goals is to own his own farm within the next four years.

Focus analysis

The focus analyses results of subject 15 are shown in Figure A1.31. The Element Tree displays 14 elements of which six are adopted and eight are non-adopted. The subject observed that adopted innovations were clustered and located at the bottom of the Element Tree. The non-adopted ones are located at the top of the Tree. The subject mentioned that those non-adopted innovations were clustered together because they were not needed or not practical on his farm. For example, heifer synchronisation and rotary tuymstyle cowshed were not needed because of some constraints. Pivot irrigation and borderdyke irrigations were not practical on his property.

The subject mentioned that inducing cows to calve and use of nitrogen fertiliser are tightly matched at 91 per cent and then clustered with feed budgeting at 82 per cent. He said that inducing cows to calve and use of nitrogen fertiliser are very important tools on his farm. He said he would induce his cows when he could see enough feed on hand or feed was coming. If there was a deficit in the feed supply he would apply more nitrogen to his pasture. Feed budgeting, he said, was therefore very important because he has to make sure a certain amount of feed is available at certain time of the year. Dairy heifer grazing and herd testing are also important because they are related to income. He grazed his animals out to make

Figure A1.31: Focused grid for subject 15



sure that they are given sufficient feed. Herd testing was also important because it was related to genetic improvement. He said all these adopted innovations were clustered together because they were all directly related to his farm income and profitability.

Figure A1.31 is the focused grid of subject 15 showing the four construct dimensions he used to construe the elements: genetics, time, facilities and result. The following sub-sections explain each of these dimensions.

Genetics

The first construct dimension used by subject 15 to construe the elements is genetic improvement. The subject gave a rating of "8" to heifer synchronisation on this dimension. Subject 15 said that he was aware that heifer synchronisation was related to genetic improvement and calving management in the herd. However, he said, these two factors were not important to him.

Time

The second construct dimension used is related to time. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that it is a time-consuming exercise. The subject said that an important factor related to heifer synchronisation was time constraint. His heifers were grazed off the farm of about 1½ hours drive from the main property. He said that if he were to use the programme he would have to get ready all the CIDRs, drugs and arrange with the technician and would have to come back again to the same place and do the same things again. All these procedures, he said, would need a lot of his time. The second factor was related to the conception rate. For example, he said he has observed his neighbours doing the synchronisation programme. The result was that when he artificially inseminated them it only gave a 30 per cent holding to calf. However, when he naturally mated them it gave him 40 per cent hold to the bull. Therefore, he said using the bull was much better than the synchronisation programme because it gave him a 30 per cent better conception rate. He argued that he would lose 30 days on that 30 per cent conception

rate. Subject 15, therefore, concluded that time was one of the major constraints that prevented him from using heifer synchronisation.

Facilities

The third construct dimension is related to availability of facilities needed for the programme. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that it requires more facilities. He said heifer synchronisation would need good facilities because it deals with a large number of animals. These facilities include the provision of bigger stock yard for these animals. He said he did not have these facilities and he could not afford to make them available. He argued that provision of good facilities was also a major constraint in using the programme.

Result

The fourth construct dimension used is related to the result obtained from heifer synchronisation. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that the results are less successful.

The subject has learned from other farmers that the result was not successful. He said that they did not hold in calf in the first synchrony programme. They were only in calf after the second insemination. He said if the heifers were not in calf within the three-week period they were regarded as six weeks behind the normal calving date. However, from his experience of using the bull he was very happy with the success rate that he obtained and would prefer to stick to his rule. Therefore, the other major constraint in his use of heifer synchronisation was his perception that the success rate was very poor.

PrinCom analysis

The percentage of variance in subject 15's grid attributable to the first principal component is 71.0 per cent (Table A3.1). In Figure A1.32a, the positive end of the component shows four construct pole labels which score highly on this component: time consuming, require more

Figure A1.32a: PrinCom analysis for subject 15

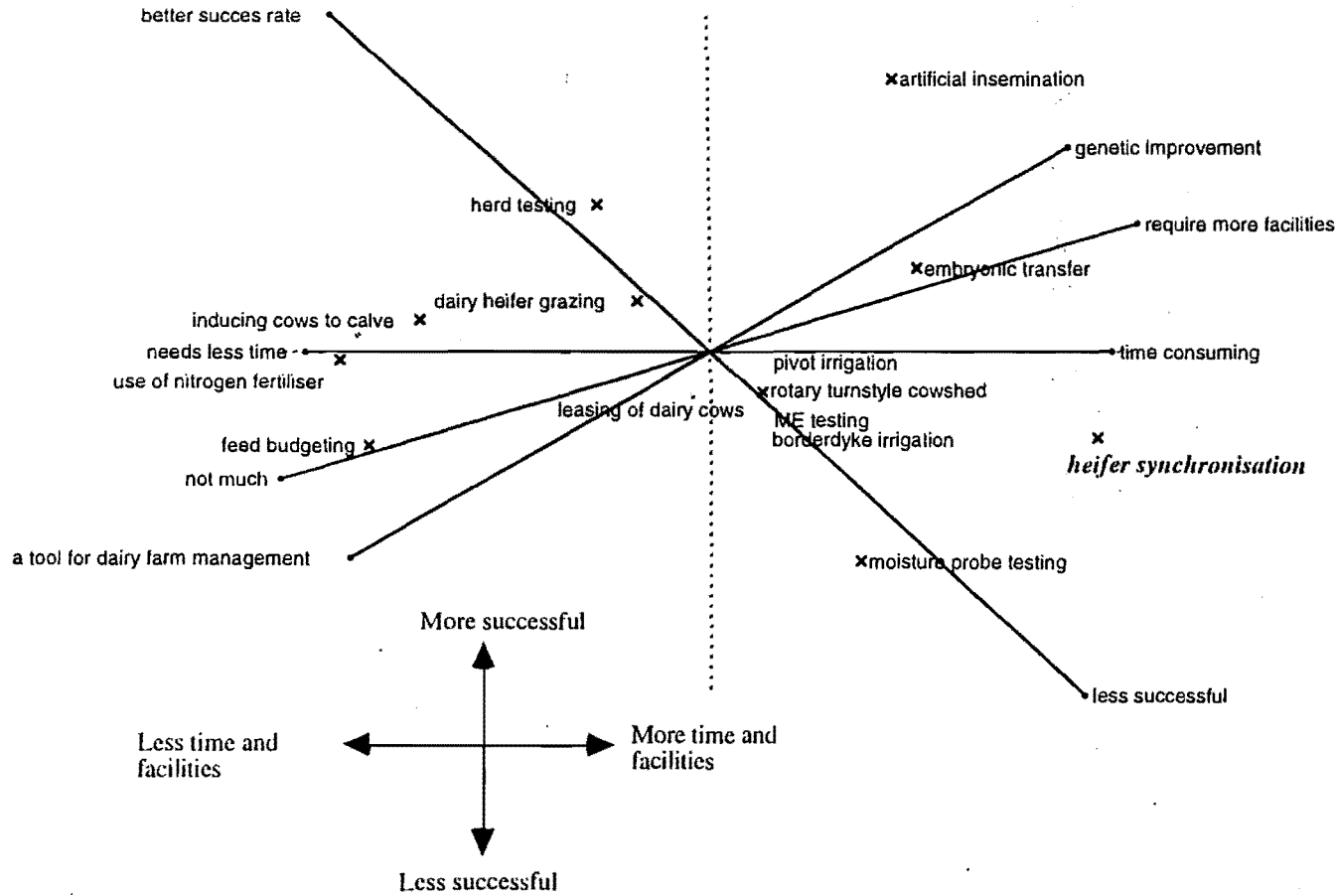


Figure A1.32b: Principal components for subject 15

facilities, genetic improvement and less successful. The elements which score highly on this component are: heifer synchronisation and embryonic transfer. One general theme that best describes this component is “use of time and facilities for success in farming” (Figure A1.32b and Table 3). Availability of time and facilities are important resources in terms of using certain types of innovations on the farm or to make farming a great success. This subject does not have sufficient time and facilities needed to adopt heifer synchronisation. He considers these factors as major constraints in the decision to adopt the innovation.

A1.5.2 Subject 16’s Constructs

Subject 16, aged 54 years, has attained his school certificate education. He has been on his 92-hectare property for about 24 years. He is milking 240 Friesian cows with an average milk production of 335 kg ms per cow. One of his objectives is to increase farm profitability through better usage of farm innovations.

Focus analysis

The focus analyses results for subject 16 are shown in Figure A1.33. It consists of 14 elements on the Element Tree and five construct dimensions on the Construct Tree. Subject 16 observed that four non-adopted innovations located at the top of the Element Tree were clustered together and were not connected to other innovations. He said these innovations at this stage were not practical and relevant to his farm situation. Similarly, the other group of four non-adopted innovations was also clustered but are located below the Element Tree. He said these innovations were also not needed because they were not relevant in his situation due to some constraints. For example, he said, borderdyke irrigation and pivot irrigation were not used because there was not enough water available for their operation.

The adopted innovations were clustered together, he said, because they were all needed in his system. He mentioned that these innovations were tools to achieve his farming objectives to increase his income and to make profits.

Figure A1.33: Focused grid for subject 16

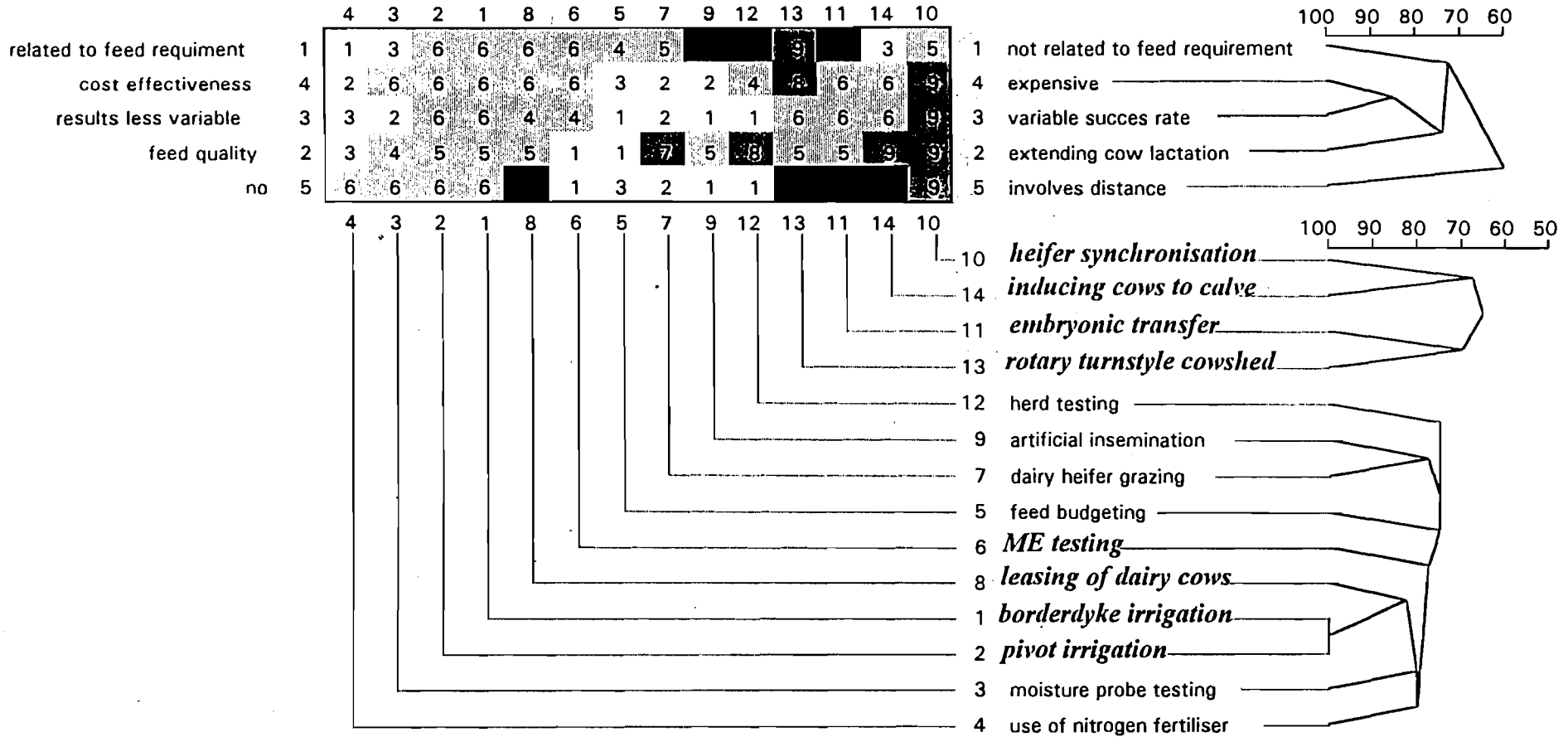


Figure A1.33 shows the focused grid of subject 16. It displays the five construct dimensions he used to construe the innovations: feeding, calving management, results, cost and distance. The following sub-sections explain each of these dimensions in respect of heifer synchronisation.

Feed requirement

The first construct dimension used to construe the innovations is related to feed requirement. The subject gave a rating value of “5” to heifer synchronisation on this dimension, meaning that it is not related to feed requirement. The subject, however, mentioned that the programme was connected to calving management and genetic improvement. He said that he was fully aware of the programme but decided not to use it at this stage because of some constraints which he considered important.

Calving management

The second construct dimension used is related to calving management. The subject gave a high rating value of “9” to heifer synchronisation on this dimension. The subject was fully aware of this programme. He said that the programme would enable farmers to have all their heifers calve earlier in the season or over a short period of time. It would, therefore, allow them to milk longer or have a greater number of milking days. He said the veterinary technicians told him that all those later calvers could be brought forward in the programme. However, he indicated that this procedure was not necessary at this stage.

Success rate

The third construct dimension used is related to the success rate produced by the programme. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that there are some variables on the success rate produced by the programme. The subject claimed that from his discussion with the veterinary technicians, there were some variable results. Some farmers had produced good results, as high as 80 per

cent conception rate, while others had very poor results, as low as 30 per cent. He said that there was no clear explanation given for the low conception rate because these heifers were in good health and had adequate feed supplies. The subject explained that with the high cost involved in using the programme and the unreliable results produced he considered there was no justification to use it.

He argued that the results produced from the existing method that he used were considered satisfactory. He used three young bulls with these heifers. He left the bulls with these heifers during the mating period. He said he was very happy with the results because most of them calved in the first three weeks with a conception rate of 75 per cent. He said that he was very happy with this result.

Cost

The fourth construct dimension used is related to cost. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that this is an expensive exercise. The subject said that the programme could be expensive if it did not work well. He said the cost included the purchase of drugs, CIDRs and the payment of veterinary fees. He considered this was more expensive than running the young bulls with the heifers. He indicated that the great advantage of using the programme was that it would produce an animal of much higher breeding worth or better quality heifer calves. However, he said, he did not need extra heifer calves and, therefore, heifer synchronisation was not required. Furthermore, he said that a lot of extra time and work were required. He said this would involve putting in the CIDRs, injecting the heifers, and pulling out the CIDRs. Therefore, he considered all these activities associated with this programme were very time-consuming and laborious and hence costly.

Distance

The fifth construct dimension used to construe these innovations is related to distance. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning

that the distance of these heifers from the main property is also relevant when considering whether to use the programme. The subject said that his heifers were away from the property. He considered it was extremely difficult to use the programme because it would mean more labour and time required of him.

PrinCom analysis

The percentage of variance in subject 16's grid attributable to the first principal component is 57 per cent (Table A3.1). The positive end of the component shows three construct pole labels which score highly on this component: involves distance, variable success rate and expensive (Figure A1.34a). There are two elements which score highly on the component: heifer synchronisation and embryonic transfer. One general theme that best describes this component is "cost and certainty of results" (Figure A1.34b and Table 3). This shows that cost and certainty of results are important factors in the decision to adopt a new technology. This subject considers that high cost and uncertainty of the results from heifer synchronisation are the major constraints in his decision not to adopt the programme.

A1.5.3 Subject 18's Constructs

Subject 18, aged 39 years, has attained his school certificate education. He has been on his 145-hectare property for about eight years. He is milking 230 Jersey and Jersey-Friesian cows. One of his farming objectives is to replace the pasture and genetically improve the herd as quickly and economically as possible. He also plans to raise the present level of milk production from 300 to 360 kg ms per cow.

Focus analysis

The focus analysis results for subject 18 are shown in Figure A1.35. The Element Tree displays 14 elements of which eight are adopted and another six are not adopted. The Construct Tree shows five construct dimensions by the subject used to construe the innovations.

His first observation was on the non-adopted innovations. He said nearly all the non-adopted innovations were clustered together and located at the top of the Element Tree. Heifer synchronisation and embryonic transfer are matched at 88 per cent. He said both of them

Figure A1.34a: PrinCom analysis for subject 16

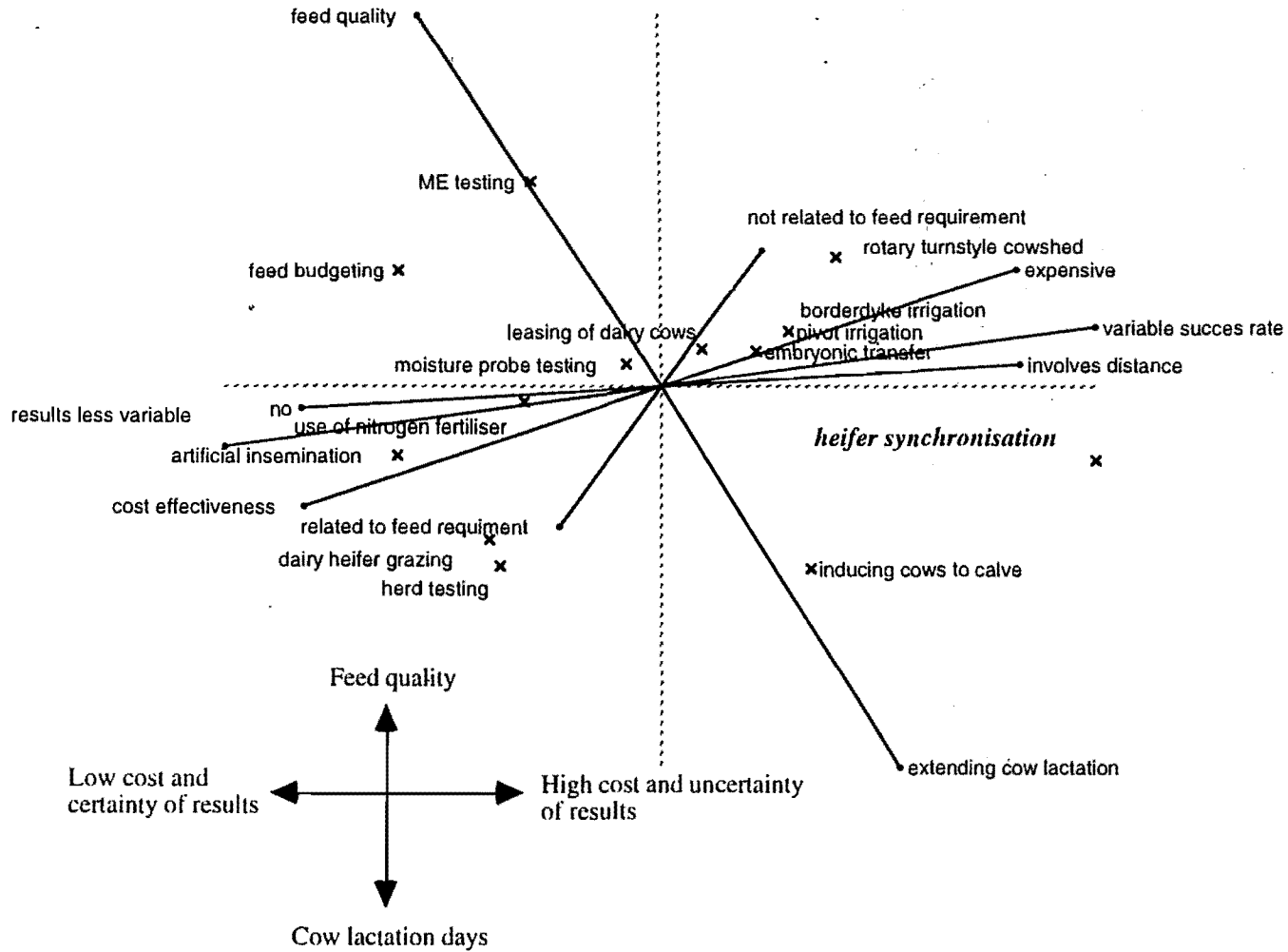
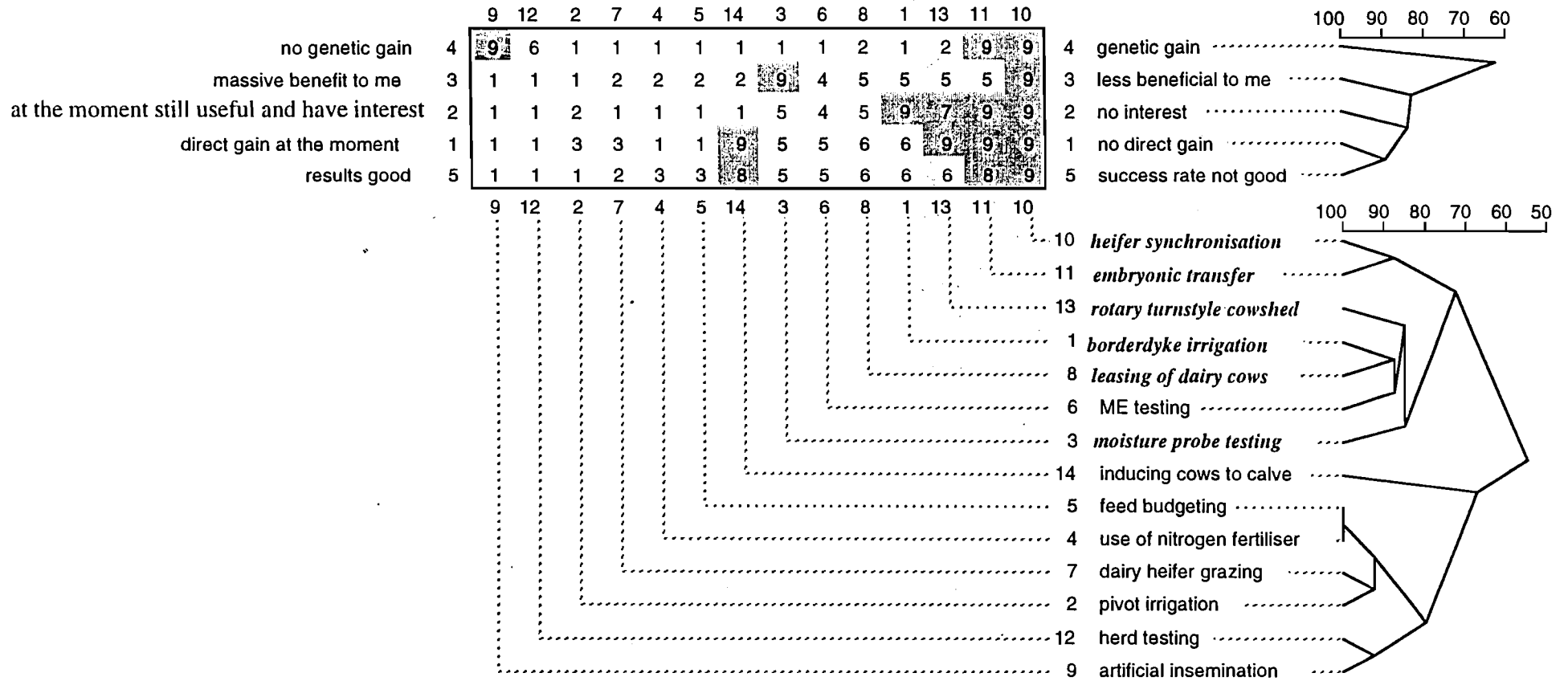


Figure A1.34b: Principal components for subject 16

Figure A1.35: Focused grid for subject 18



were related to genetically superior animals, better milking and hence better profit. However, he said, because of constraints both of them were not applicable on his farm. Similarly, all the other innovations, he said, were either not relevant or not practical in his present farming set up. For example, he said, the rotary turnstyle cowshed and the leasing of dairy cows were not needed. It was also not practical to use borderdyke irrigation in the area. He also indicated that, at the moment he has not used the moisture probe testing. He said he might use it after completing the installation of the pivot irrigation on his farm.

He also observed that nearly all the adopted innovations were clustered and located at the bottom of the Element Tree. Feed budgeting and use of nitrogen fertiliser are tightly matched at 100 per cent. The subject said that these two elements were working hand in hand. He used nitrogen fertiliser to enhance grass growth and that feed was made available both in quality and quantity through feed budgeting.

Dairy heifer grazing and pivot irrigation were tightly matched at 92 per cent. He said he experienced a summer feed shortage in his area and the best option to help solve the problem of feed supply was to graze his animals on another farmer's farm. He was in the process of installing the pipe for his pivot irrigation. He said both of these arrangements help solve the problem of feed supply and were therefore closely linked to each other.

Herd testing and artificial insemination are also tightly matched at 92 per cent. The subject indicated that he has experienced a high success rate in artificial insemination. He said he only kept 45-50 heifer calves and through herd testing he was then able to identify which calves he was going to keep in the herd.

Figure A1.35 shows the focused grid of subject 18. It displays the five construct dimensions he used to construe the innovations: gain, interest, benefits, genetic gain and result. The following sub-sections explain each of these dimensions in respect of heifer synchronisation.

Gain

The first construct dimension used by subject 18 to construe the innovations is related to gain. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that synchronisation does not give any direct gain to the subject.

The subject said that at the moment he was more concerned about the immediate or direct financial gain from the activities he was doing or the innovations he was going to use. He said his priorities were to renew his pasture through improvement of his soil fertility by using more nitrogen fertiliser and by installing the pivot irrigation. He felt that, genetically, his herd was reasonably good and considered the highest fertility in the area with a conception rate of 76-80 per cent. He indicated that in his present operation, the time, effort and money involved in doing the synchronisation could well be utilised in other important activities on the farm.

Interest

The second construct dimension used by the subject is related to his interest. He gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that he has no interest on this programme. The subject said that at this moment he was not set up for heifer synchronisation. He was not interested in getting aside any major expenditure for the activities which he considered not a priority. He was more interested in spending his money and labour on those activities which he believed could give him a lot better financial gain, such as on the improvement of the grass and soil fertility. He considered his herd at the moment was exceptionally good in terms of the conception rate through artificial insemination, and replacement was not a problem for him. Therefore, at this moment, he said he has no interest in trying to improve the calving management or change the calving pattern of his cows. He was happy with the existing results of getting his replacement calves.

Benefit

The third construct dimension is related to benefit. The subject gave a high rating of “9” to heifer synchronisation on this dimension, meaning that heifer synchronisation is less beneficial for him. The subject indicated that he was very happy with his present breeding programme. He said he has put a lot of effort and time into his artificial insemination breeding programme, and was very happy with the good conception rate that he was getting. Therefore, he said, there was no benefit for him to do such synchronisation on his farm. He believed, at this stage, there would be more financial gain for him if he were to upgrade his soil fertility and pasture, instead of doing the synchronisation.

Genetic gain

The fourth construct dimension used is genetic gain. The subject gave a high rating value of “9” to heifer synchronisation on this dimension. The subject said that he was fully aware of the procedure and uses of heifer synchronisation. However, he said those activities related to genetic improvement, getting the replacements or changing the calving pattern in the herd for milk production, were not his priority at this stage. He said he was happy with his present achievement or activities that he was doing.

Results

The fifth construct dimension used is related to the results produced from the synchrony programme. The subject gave a high rating of “9” to heifer synchronisation on this dimension, meaning that the success rate was not good. The subject indicated that the programme was very expensive because it had to absorb the veterinary fees and cost of the drugs and CIDRs. Moreover, he said he was not happy to see the small and young animal being artificially inseminated especially the Jersey and the smaller Jersey crosses. He considered it was not good in terms of increasing the milk production. With all this trauma, he considered the success rate through synchronisation was not good. He also learned that a

number of farmers who have done the synchronisation had stopped doing it, because they were not happy with the results.

PrinCom analysis

The percentage of variance in subject 18's grid attributable to the first principal component is 63.9 per cent (Table A3.1). The positive end of the component shows four construct labels which score highly on this component: at the moment still useful and have interest, massive benefit to me, results good no direct gain at the moment (Figure A1.36a). There are five elements which score highly on this component: pivot irrigation, feed budgeting, use of nitrogen fertiliser, dairy heifer grazing and herd testing. A possible theme that best describes this component is "cost, gain and benefits" (Figure A1.36b and Table 3). This implies that innovations which have potential gain and benefits would be considered readily by the subject and that he has the interest and desire to use such innovations. At the negative end of this first component, the four construct labels which score highly on the component are: no interest, less beneficial to me, success rate not good and no direct gain. The elements which score highly on this component are: heifer synchronisation and embryonic transfer. This subject has no interest in heifer synchronisation because he considers it has no potential benefits to him.

A1.5.4 Subject 21's Constructs

Subject 21, aged 66 years, has attained his Form One education. He has been living on his 120-hectare property for about 40 years. He is milking 200 Friesian cows with an average milk production of 313 kg ms per cow. One of his main objectives is to achieve the production level of 348 kg ms per cow.

Focus analysis

The focus analysis results for subject 21 are shown in Figure A1.37. It consists of 14 elements of which eight are adopted and six are not adopted. The Construct Tree displays four construct dimensions. His interpretation of the Element Tree is as follows. He observed that the non-adopted innovations were clustered and located at the bottom and the adopted innovations

Figure A1.36a: PrinCom analysis for subject 18

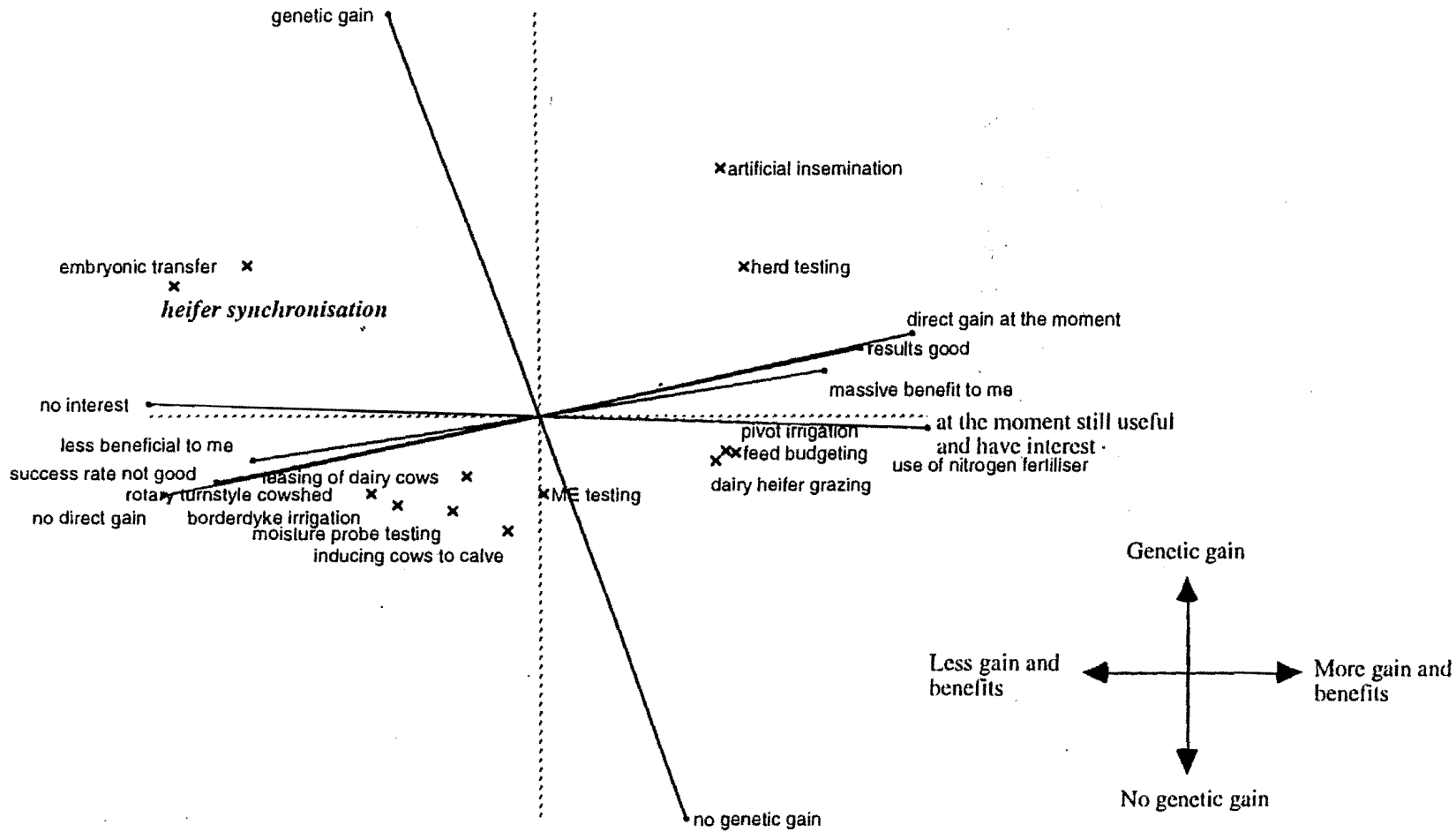
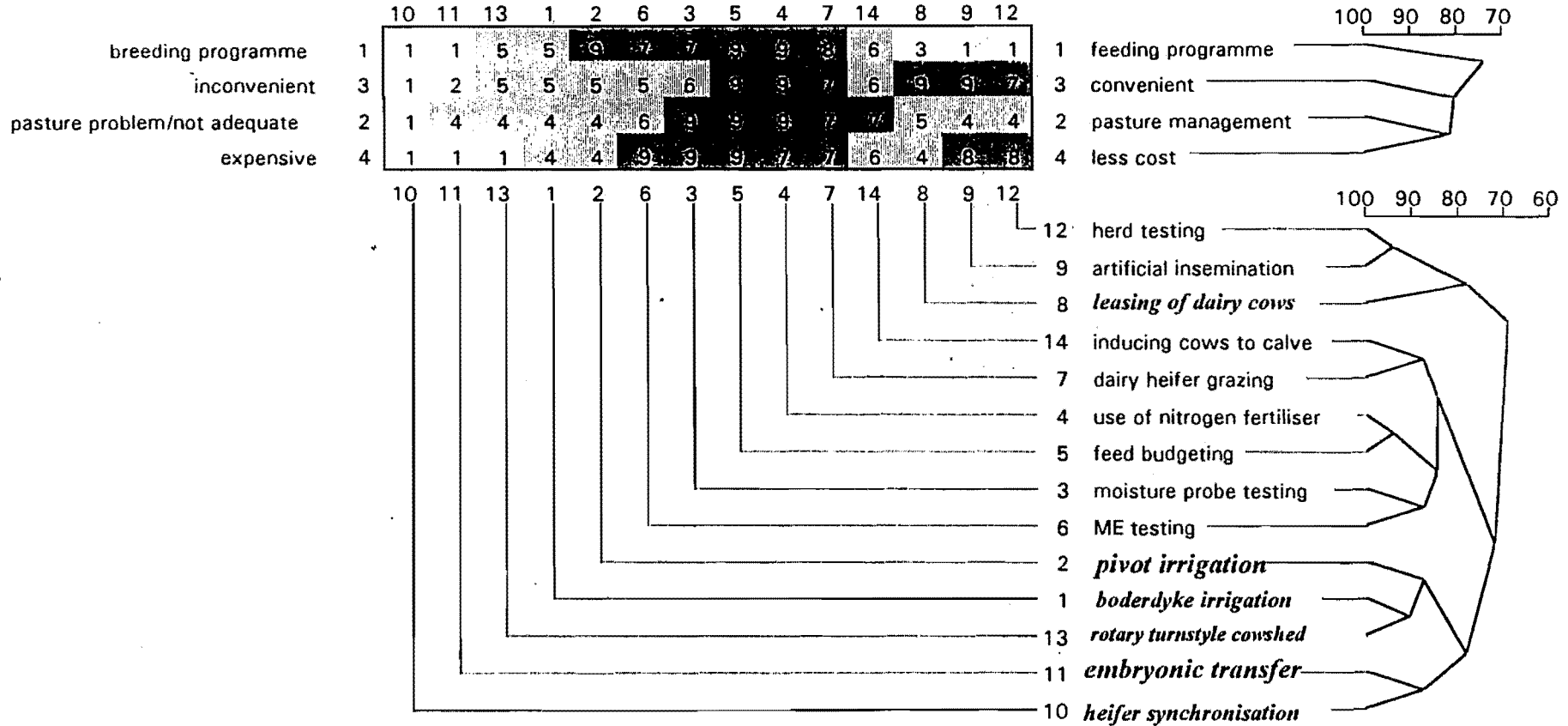


Figure A1.36b: Principal components for subject 18

Figure A1.37: Focused grid for subject 21



were at the top of the Elements Tree. The subject mentioned that the non-adopted innovations were clustered together because they were not needed in his system.

Herd testing and artificial insemination are tightly matched at 94 per cent. The subject indicated that both were related to upgrading the genetic quality of the cows.

Use of nitrogen fertiliser and feed budgeting are tightly matched at 94 per cent. The subject indicated that these two elements were very close because both were related to animal feed. He said that he used a lot of nitrogen to increase the grass production. Feed budgeting allows him to determine the amount of feed available for the animals.

Inducing cows to calve and dairy heifer grazing are tightly matched at 88 per cent. The subject said that both of them were related to increased milk production from better utilisation of feed. Inducing cows to calve allows him to calve earlier and hence produce milk earlier than normal. He said these heifers also needed a lot of feed before they can be induced. Therefore, he said, the only way he could milk the cows was to graze off his heifers on another farmer's property. The subject observed that all those adopted innovations listed above were related to his animal breeding and feed and hence income and profitability.

Figure A1.37 shows the focused grid of subject 21 displaying the four construct dimensions he used to construe the elements: breeding, pasture management, convenient and cost. The following sub-sections explain each of the four construct dimensions.

Breeding programme - feeding programme

The first construct dimension is building programme - feeding programme. The subject gave a strong rating of "1" to heifer synchronisation on this dimension; meaning that it is related to breeding programme. The subject indicated that heifer synchronisation was a management tool for genetic improvement. He said it would be possible to do the insemination using the top bull with the most valuable stock having the highest breeding worth (BW). Heifer synchronisation, he said, was the quickest way of raising the BW in the herd. However, the

subject said that at present he has not adopted it because of certain constraints available on his farm.

Feed

The second construct dimension is related to feed. The subject gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that feed is a problem or a major constraint related to heifer synchronisation.

Subject 21 explained that feed was very strongly associated with synchronisation. The heifers had to be well fed in order to reach a certain body weight. The subject was concerned about the quality and the quantity of feed available for his heifers in order to make them reach the correct body weight before considering using the programme.

Convenience

The third construct dimension used is related to convenience of its use. The subject gave a strong rating value of "1" to heifer synchronisation on this dimension, meaning that the programme is not convenient for the subject. The subject indicated that his heifers were grazing 50 km away from the main property. He considered this was a geographical constraint. He said it would be very inconvenient for him to do the programme because that would mean he had to go very frequently to the place. Consequently he said that would incur a lot of expenses.

He also said that the programme involved handling many heifers calving at the same time. This would mean putting a lot of pressure and a hassle to him. He said he would not prefer this sort of work. He would still prefer handling the animals in a small group and in stages.

Cost

The fourth construct dimension is related to cost. The subject gave a strong rating value of “1” to heifer synchronisation on this dimension, meaning that the programme is very costly. In other words, cost is a major constraint for subject 21 in his decision not to use the programme.

He said the general procedures of the programme involved a lot of costs. This would include the cost of drugs and CIDRs, injection, and veterinarian visits. He said the initial costs, including the inconvenience of doing such a programme, were therefore, very high especially if the end results were very poor.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 21’s grid attributable to the first principal component is 66.9 per cent. In Figure A1.37a, the positive end of the component shows three construct pole labels which score highly on this component: pasture problem/not adequate, inconvenient and costly. The elements which score highly on the component are: embryonic transfer and heifer synchronisation. One general theme that best describes this component is “cost and convenience relevant to pasture management and animal breeding” (Figure A1.37b and Table 3). This means that innovations which are expensive and not convenient to use will not be adopted. This subject considers that cost and inconvenience of use are the major constraints in the decision not to adopt heifer synchronisation, although it is related to genetic improvement and calving management. The negative end of the component shows three construct labels which score highly on the component: pasture management, convenient and less cost. The elements which score highly on the component are: feed budgeting, use of nitrogen fertiliser, ME testing and moisture probe testing. The subject considers that these innovations are important because they are less expensive and more convenient for pasture management.

A1.5.5 Subject 25’s Constructs

Subject 25, aged 38 years, has attained his high school education. He is the second

Figure A1.37a: PrinCom analysis for subject 21

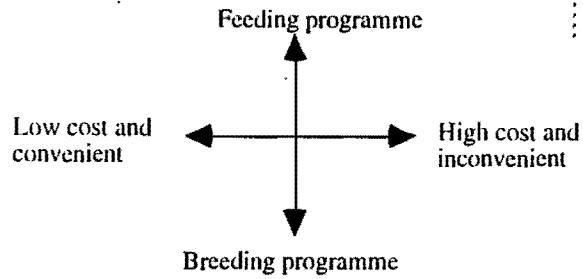
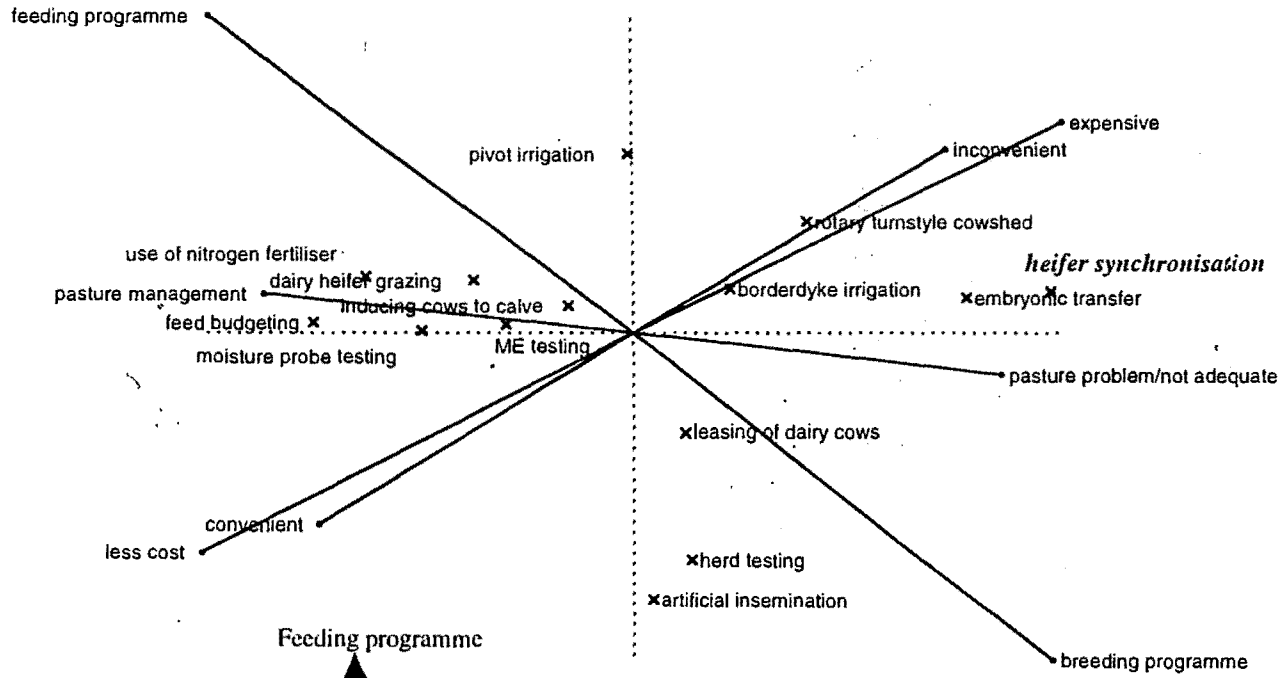


Figure A1.37b: Principal components for subject 21

generation on the farm of 75 hectares. He is a town milk and also a winter contract milk supplier. He is milking 200 Holstein-Friesian cows with the average milk production of 500 kg ms per cow. One of his farm objectives is to achieve the production level of 1800 litres a day in order to meet the milk quota allocated to him.

Focus analysis

The focus analysis results for subject 25 are shown in Figure A1.38. The Element Tree consists of 14 elements of which six are adopted and eight are not adopted. The Construct Tree displays four construct dimensions. His interpretation of the Element Tree is as follows.

Subject 25 commented that the non-adopted innovations were clustered to each other although they were split into two groups: one group consisting of four elements was located at the top and the other group of the same number was at the bottom of the tree. He explained that these innovations were not adopted because of some constraints and that the subjects preferred to have a “wait-and-see” attitude towards them.

The subject also observed that the six adopted innovations were clustered and located at the centre of the Element Tree. He said all these elements were important to him in achieving his farm objective of increasing farm income. He observed that the use of nitrogen fertiliser and ME testing are tightly matched at 88 per cent and are clustered with dairy heifer grazing at 78 per cent. He said these two elements were closely related. Nitrogen fertiliser was used in order to create a “bank of feed” and ME testing was needed to test the quality of this feed in relation to its nutrient content. He was grazing off his heifers and he would also have to know that the animals were getting good pasture.

Feed budgeting and herd testing are tightly matched at 88 per cent and are then clustered with artificial insemination at 83 per cent. He said these two elements were also tied to each other because the production records or genetic worth from his animals would also relate to the amount of feed they are eating and hence feed budgeting.

Figure A1.38: Focused grid for subject 25

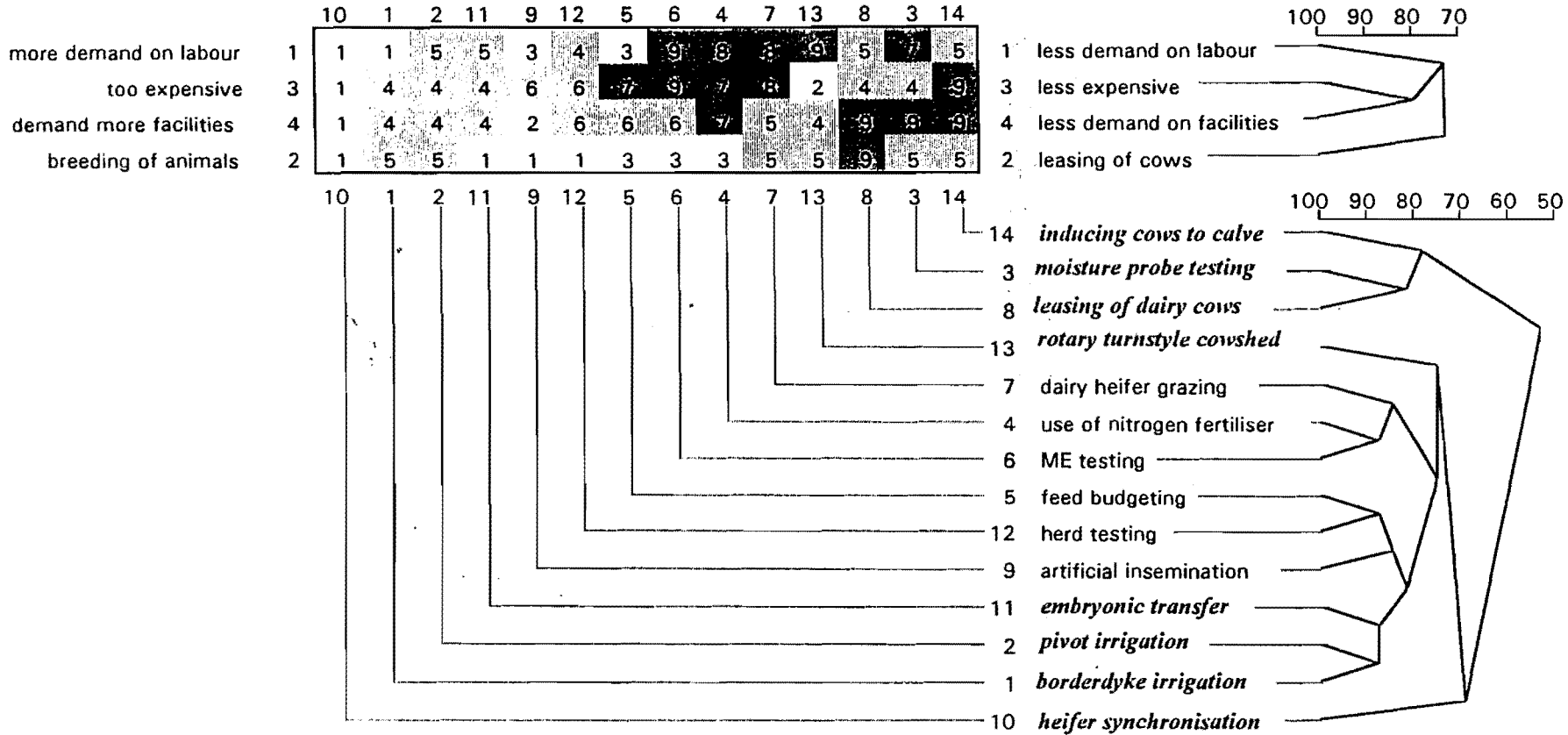


Figure A1.38 shows the focused grid of subject 25 displaying the four construct dimensions he used to construe the elements: labour, breeding, cost and facilities. The following subsections explain each of these dimensions.

Labour

The first construct dimension used by subject 25 to construe the elements is connected to labour requirement. The subject gave a very strong rating of “1” to heifer synchronisation on this dimension, meaning that the programme is labour intensive. The subject said his major constraint was related to labour. He mentioned that heifer synchronisation (the subject also called it as a “CIDR system”) was labour intensive because it would involve handling of a large number of animals at one time and also putting the CIDRs into the animals. He said that it would create a lot of hassle because all these heifers would calve on the same day.

He said the existing system that he was using was less hassle and cheap. He only brought back home 30 heifers at one time and kept them here for 5-6 days. He said he did the artificial insemination by himself to those animals on heat. He said he was very happy with the existing method he used.

Animal breeding - leasing of cows

The second construct dimension used is related to animal breeding - leasing of cows. The subject gave a strong rating value of “1” to heifer synchronisation on this dimension, meaning that it is related to animal breeding. The subject said that he was fully aware of the use of heifer synchronisation. He was informed that it was used to synchronise the cycles of all these heifers so that they would calve at a certain period. He also mentioned that it could also be used to improve the rate of genetic gain in the herd. However, he said he preferred not to use the programme because of some constraints or other priorities on his farm.

Cost

The third construct dimension he used is related to cost. Subject 25 gave a rating value of "1" to heifer synchronisation on this dimension, meaning that it is very expensive. The subject mentioned that the programme was too expensive. He said he would have to pay for the technicians, buy the drugs and CIDRs. He would also have to pay for an additional labour to help in the programme. The other important factor was that the heifers were grazed off the property. Therefore, he said, this would make it a very expensive exercise and considered finance as the major constraint in doing this exercise.

Facilities

The fourth construct dimension used is related to facilities. The subject gave a rating value of "1" to heifer synchronisation on this dimension, meaning that the programme has more demand on facilities. The subject mentioned that it would need a good cattle yard, such as raisers so that he could inseminate a lot of cows in a very short period of time. The subject said that he could not afford to make these facilities available. He would prefer to handle a small number of animals at a time.

PrinCom analysis

As shown in Table A3.1, the percentage of variance in subject 25's grid attributable to the first principal component is 51.9 per cent. In Figure A1.39a, the positive end of the component has three construct labels which score highly on this component: less demand on labour, less demand on facilities and less expensive. The innovations which score highly on this component are: inducing cows to calve, dairy heifer grazing, use of nitrogen fertiliser. The innovations above require less labour and less cost and are considered as efficient with regard to farm profitability. One general theme that best describes this component is "cost and facilities"

Figure A1.39a: PrinCom analysis for subject 25

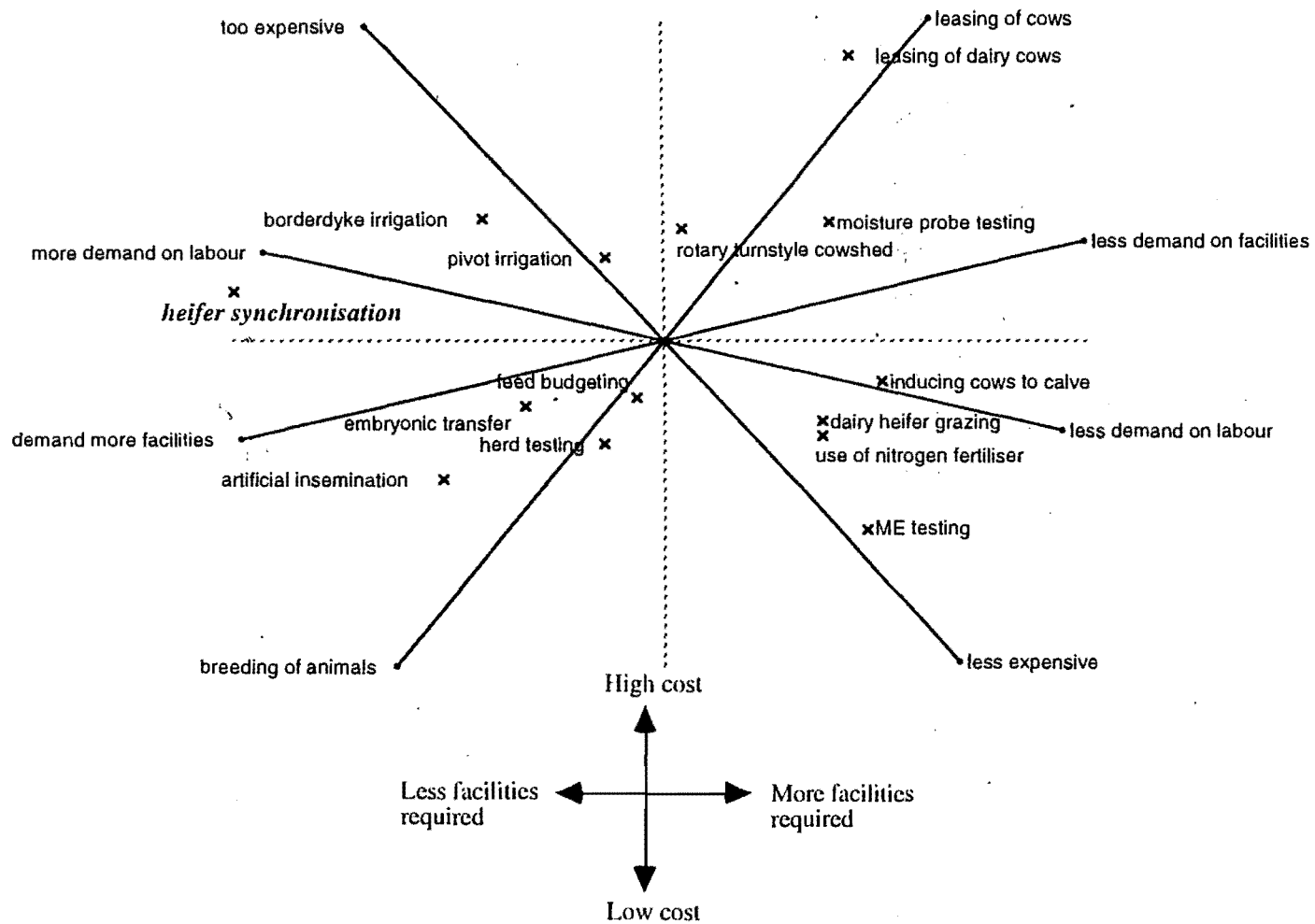


Figure A1.39b: Principal components for subject 25

A1.6.1 Subject 7's Constructs

Subject 7, aged 37 years, has a Bachelor's Degree in Agricultural Science. He is a sharemilker of a dairy company and has been on this 200-hectare property for about three years. At present he has 580 breeding cows and 150 yearling heifers. His dairy breed consists of Jersey-Friesian, Holstein and Jersey with an average milk production of about 360 kg ms per cow. His farming objective is centred around high performance through efficient use of all resources. With regard to sharemilking, subject 7 indicated that it would allow him to put together a good capital base quickly for future business investment. He pointed out that once he has sufficient capital he might opt for a change in occupation, preferably, in commercial property.

Focus analysis

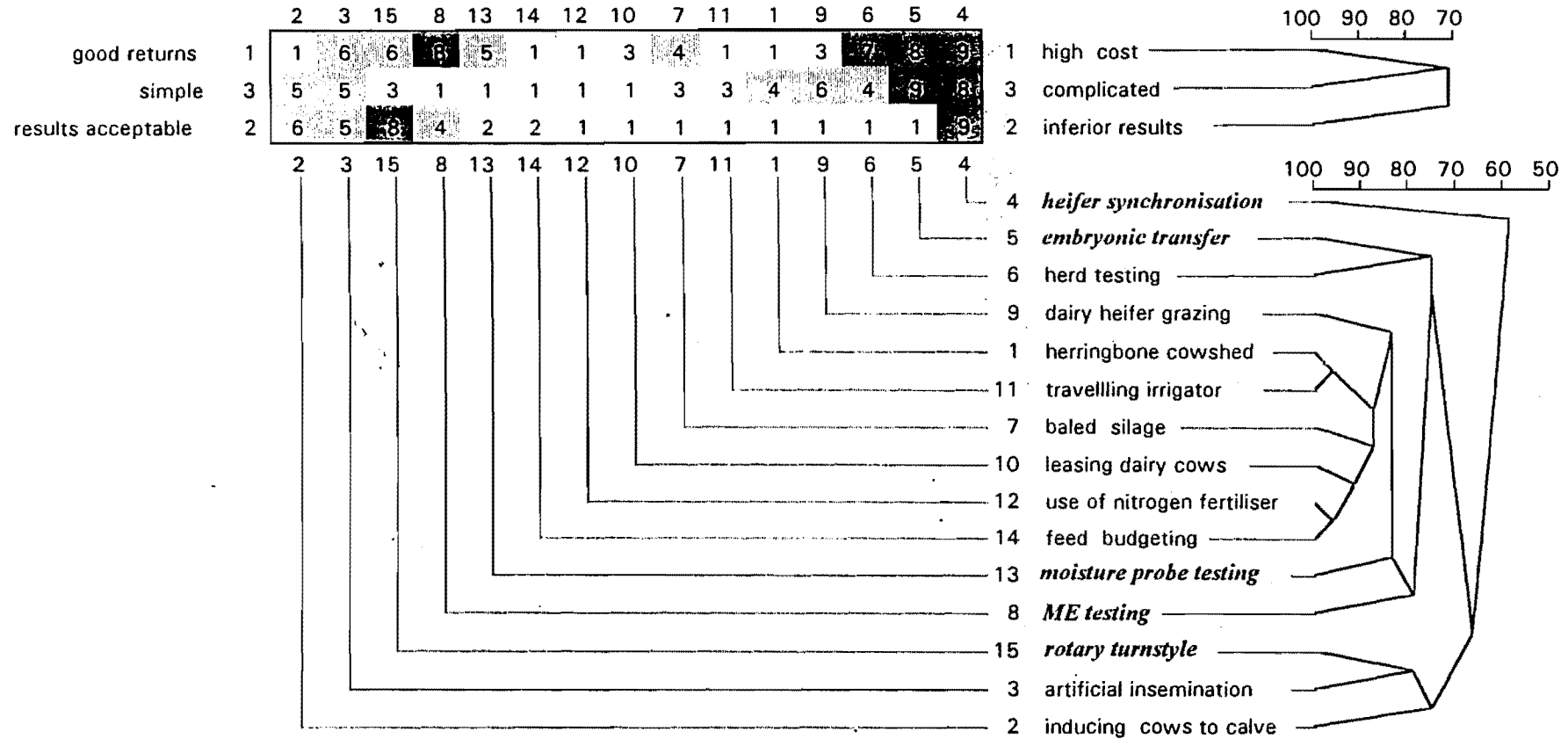
The focus analysis results for subject 7 are shown in Figure A1.40. The Element Tree consists of 15 elements of which 11 have already been adopted and four are not adopted. The Construct Tree displays three construct dimensions which he used to construe the innovations. His interpretation of his Element Tree is as follows.

The subject commented that he would never adopt heifer synchronisation, rotary cowshed and moisture probe testing in his system because he believed they were complicated, expensive and not applicable, respectively. However, he would like to evaluate the usefulness and to have a wait and see attitude towards other elements: embryonic transfer and ME testing.

Subject 7 observed that the adopted innovations, such as the herringbone cowshed and the travelling irrigator are tightly matched at 96 per cent. He mentioned that he has been using these innovations for about three years on this property. He said they were linked not in terms of farm performance but of their efficiency and simplicity.

Use of nitrogen fertiliser and feed budgeting are tightly matched at 96 per cent. Subject 7 stated that he has been using the two innovations for the past three years. He said they were closely linked. Feed budgeting allowed him to predict the feed requirement of his herd

Figure A1.40: Focused grid for subject 7



through the use of historic trends in terms of determining what has happened in the past few weeks, such as with regard to the animals growth rate and the feed or pasture supply. He said that if there was a short fall in the feed or pasture supply he would have to determine the amount of nitrogen required for the optimum feeding of his cows. In other words, he claimed that he would have to do feed budgeting prior to his decision to use nitrogen fertiliser.

Other adopted innovations, such as dairy heifer grazing, herringbone cowshed, travelling irrigator, baleage, leasing of dairy cows, use of nitrogen fertiliser and feed budgeting all use simple farm techniques or systems. He said they were all very simple to work with. They were simple to organise because they required minimal input of energy and money. They could achieve good results and provide a high economic return.

Figure A1.40 is the focused grid of subject 7 showing the three construct dimensions used to construe the innovations: returns, results and complexity. The following sub-sections explain each of these construct dimensions.

Cost

The first construct dimension used by subject 7 to construe the elements is related to the cost. The subject gave a very high rating value of "9" to heifer synchronisation on this dimension, meaning that it is very costly. As stated earlier subject 7's farming objective revolves around two important factors: high performance and cost effectiveness. In terms of his breeding programme he has been using artificial insemination for about three years. He said the main objective of artificial insemination was to get high quality replacement heifer calves. While some farmers preferred to use heifer synchronisation which they believe could be used to improve the genetic gain, subject 7 thought otherwise. He indicated that one of the most constraining factors associated with heifer synchronisation was the high cost involved: This cost involved the purchase of the drugs, CIDRs and the payment of the veterinary fees. He estimated the cost to be about \$30 per cow. He claimed that the cost of each heifer calf from a synchronisation programme was higher than getting a similar animal from the normal use of detecting those on heat on a daily basis. He said that he might just

obtain a fraction less genetically than those calves already in the herd in he did not use the synchronisation programme. Therefore, he said he could not see any justification in spending extra money for a relatively small number of heifer calves.

Results

The second construct dimension used is related to the result produced by the programme. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the result is very poor.

Subject 7 was also grazing his heifers off-farm but they are returned to his own property a week before the artificial insemination programme was carried out. He did not use the synchrony programme but instead used the "kamar heatamount" detector to detect those animals on heat followed by artificial insemination. The whole mob of heifers was run through his dairy shed and those found in season were drafted off and then inseminated. He did this for a duration of 21 days. He agreed that using the detection method was very time-consuming. However, he still claimed that the conception rate he obtained from the detection method was still superior to that obtained from the synchronisation programme. He said: "My natural cycling detection programme is giving me up to 60 per cent in calving rate. The response through synchronisation programme is extremely variable. There have been some good results achieved and bad results too and the national average was only about 60 per cent."

Based on the information he received from other farmers and other sources of information subject 7 did not consider heifer synchronisation would offer him any benefit over his own method in terms of achieving a high conception rate.

Ease of use

The third construct dimension used is whether heifer synchronisation is easy or difficult to use. As shown in the Construct Tree the subject gave a rating value of "8" to heifer

synchronisation on this dimension, meaning that it is very complicated. He construed that such a technique was complicated because of three main factors: (1) organisation, (2) facilities, and (3) weather conditions. The subject claimed that heifer synchronisation was complicated to use because it would require some organisation, such as making arrangement or appointment with other people including the veterinary technicians. He did not intend to spend time organising some activities involving heifer synchronisation. Secondly, he said the synchrony programme required him to have some good facilities

available, such as yard and grazing facilities which he could not afford. He also expressed his concern about the effect of adverse weather condition on the effectiveness of heifer synchronisation. He argued that when the heifers were synchronised for the insemination programme very bad weather conditions could affect the results of the insemination programme. This, he believed, would consequently make the insemination programme less effective.

PrinCom analysis

The percentage of variance in subject 7's grid attributable to the first principal component is 59.7 per cent (Table A3.1). In Figure A1.41a, the positive end of the component shows two construct pole labels which score highly on this component: high cost and complicated. There are two elements which score highly on the component: heifer synchronisation and embryonic transfer. One general theme that best describes this component is "cost effectiveness and simplicity" (Figure A1.41b and Table 3). The subject considers that an innovation, such as heifer synchronisation which is not cost effective and complicated to use, will not be adopted. However, innovations which are more cost effective and simple to use, such as nitrogen fertiliser and a travelling irrigator are easily adopted and could ensure better returns.

A1.6.2 Subject 14's Constructs

Subject 14, aged 40 years, has completed his fifth form education. He is a town milk supplier dairy farmer and has been on his 170-hectare property for about 12 years. He is milking 200 Friesian cows with an average milk production of 406 kg ms per cow. He said six years ago

Figure A1.41a: PrinCom analysis for subject 7

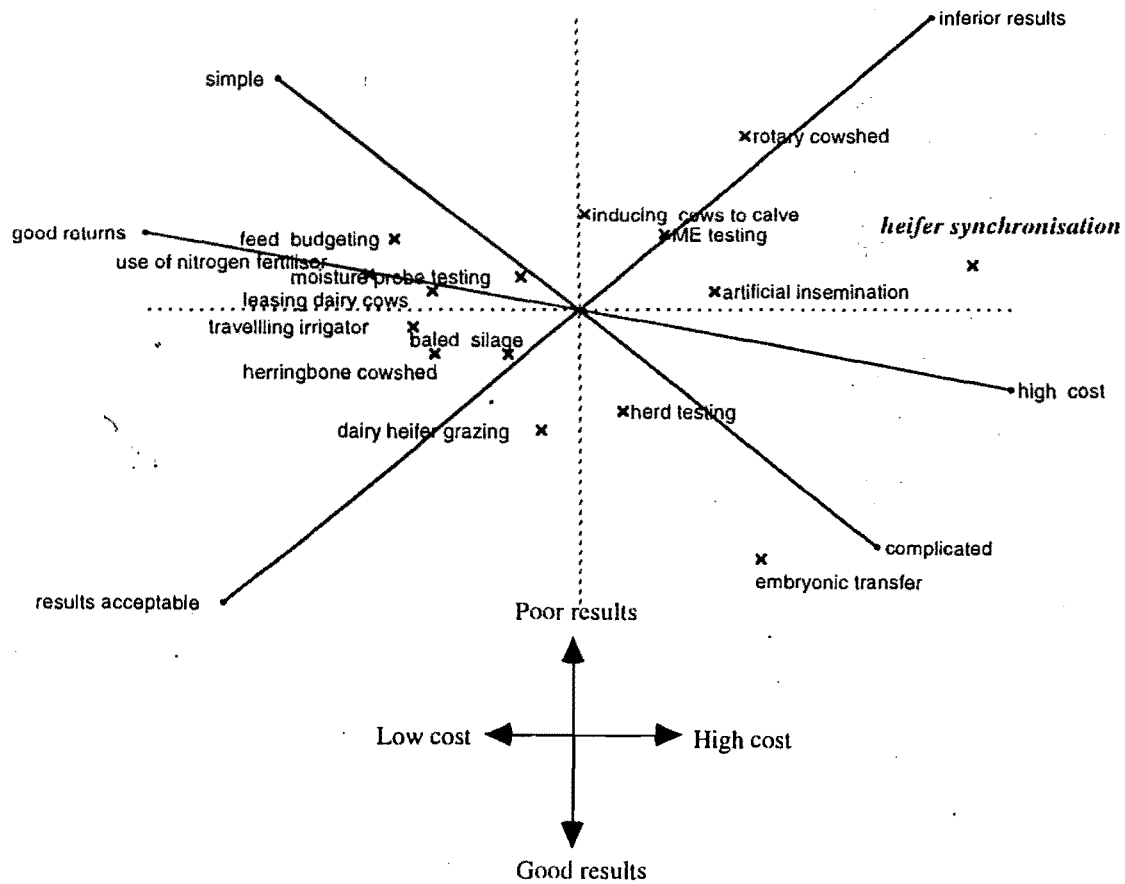


Figure A1.41b: Principal components for subject 7

he used the hand-shift pipe to irrigate his land. With the use of his travelling irrigator (rotorainer) he is now able to irrigate his land more effectively and efficiently covering 4-5 hectares per day.

Focus analysis

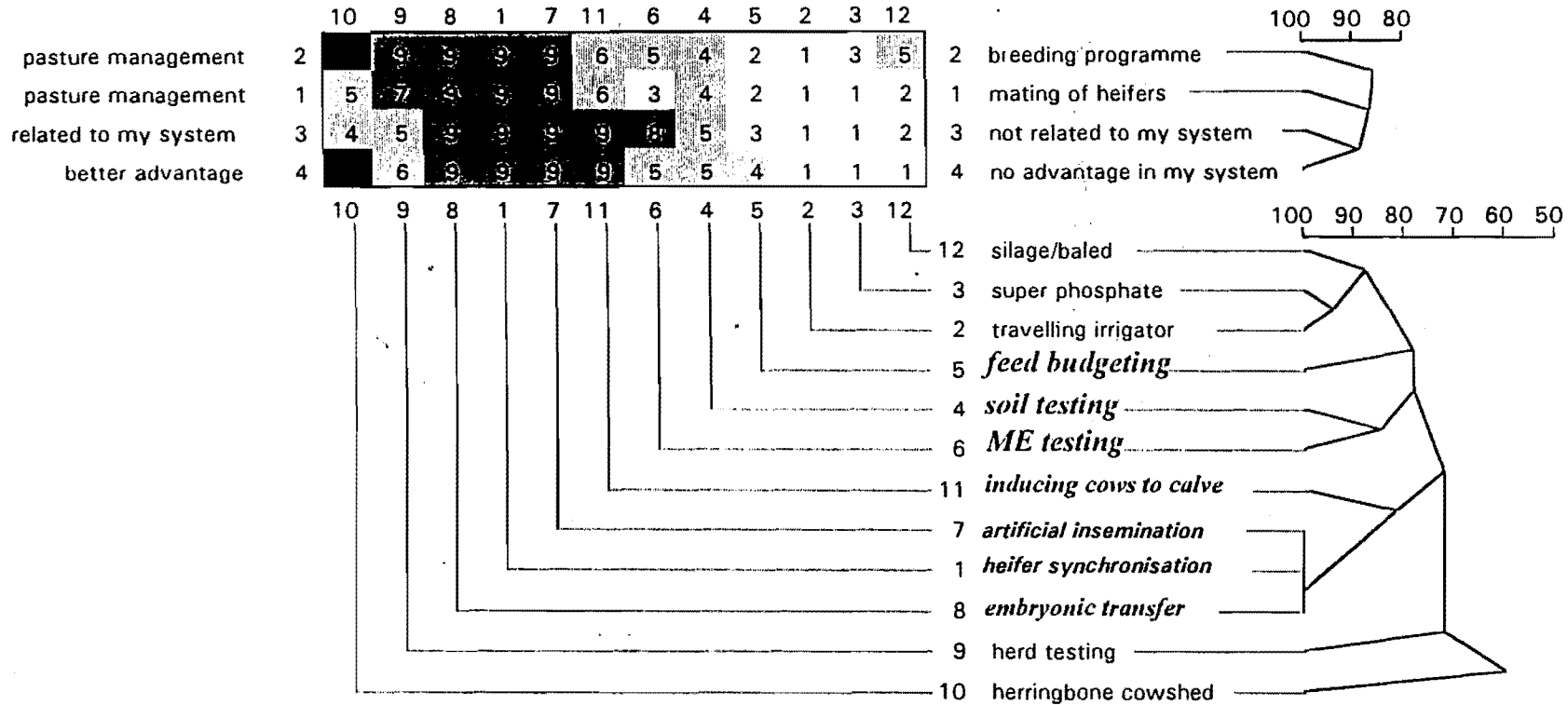
The results of focus analysis for subject 14 are shown in Figure A1.42. The Element Tree consists of 12 elements of which five are adopted and seven are not adopted. The Construct Tree shows four construct dimensions used to construe these elements. His interpretation of this element tree is as follows.

Subject 14 observed that those innovations which he did not adopt are clustered and located at the centre of the Element Tree. The reason for this, he said, was because they were not needed or not necessary in his system. For example, artificial insemination, heifer synchronisation and embryonic transfer were tightly matched at 100 per cent and clustered with inducing cows to calve at 85 per cent. He indicated that these three innovations were not needed although they were all related to breeding.

He also observed that three adopted innovations, silage, super phosphate and travelling irrigator were clustered and located at the top of the Element Tree. Similarly, two adopted innovations, herd testing and herringbone cowshed are clustered at the bottom of the tree. Super phosphate and travelling irrigator are tightly matched at 96 per cent and clustered with silage at 87 per cent. He said that all these elements were related to pasture management and stock feeding. They were all directly related to his farm income and considered very important in his system.

Figure A1.42 is the focused grid of subject 14 showing the four construct dimensions he used to construe the elements: mating of heifers, breeding programme, relevancy and advantage. The following sub-sections describe each of the four construct dimensions.

Figure A1.42: Focused grid for subject 14



Pasture management - mating of heifers

The first construct dimension used by subject 14 to construe the innovations is pasture management - mating of heifers. Subject 14 gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that it is related to mating of heifers. He was aware of the uses of heifer synchronisation. He said the basic thing about the programme was to have the heifers calve earlier and at the same time. His idea was that this programme only benefited seasonal suppliers of milk. He argued that this method of mating management was not needed because it did not suit his system. He said he was a town milk supplier and required to produce or supply milk throughout the year.

Pasture management - breeding programme

The second construct dimension used is related to pasture management - breeding programme. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that it is related to the breeding programme. According to him, while he agreed that it was related to breeding in terms of improving the genetic quality in the herd, he also believed that his present system of using his good bulls was as good. Therefore, he said, there was no justification for him to use heifer synchronisation.

Relevancy

The third construct dimension is concerned with the relevance of such innovations to his farming system. Subject 14 gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the programme is not relevant to his farming system. He said that the programme was not applicable to his system. He reiterated that he was a town milk supplier and has to supply milk the whole year. Therefore, he said, such a programme could not be used on his farm. He claimed that under his present objective he would never adopt such a programme in his system.

Advantage

The fourth construct dimension used is whether the programme has an advantage in his system. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that such a programme has no advantage in his system. According to him, the programme has no advantage at all in his system. He could not see any use to him in terms of achieving his farming objectives. He said that it was only applicable to seasonal milk suppliers. He indicated that town milk suppliers have their cows calve twice a year. They were given certain milk quota to produce. In other words, they have fixed number of cows to milk in spring and winter. Therefore, under his present system he said that heifer synchronisation was not applicable or no advantage to him.

PrinCom analysis

The percentage of variance in subject 14’s grid attributable to the first principal components is 90.3 per cent (Table A3.1). In Figure A1.44a, the positive end of the component shows four construct pole labels which score highly on this component: no advantage in my system, mating of heifers, not related to my system and breeding programme. There are three elements which score highly on the component: artificial insemination, embryonic transfer and heifer synchronisation. A possible theme that best describes this component is “relevance and applicability of use” (Figure A1.44b and Table 3). This shows that innovations which are relevant and applicable are easily adopted, whereas those not relevant and not applicable, such as heifer synchronisation, will not be adopted by the subject.

A1.6.3 Subject 20’s Constructs

Subject 20, aged 70 years, has attained his Standard Six education. He is the fourth generation on the family farm of about 50 hectares. He is milking 130 Friesian cows with an average production of 330 kg ms per cow. One of his farming objectives is to maximise profit based on what he is doing now. He said that he is very happy with what he is doing at the moment.

Figure A1.43a: PrinCom analysis for subject 14

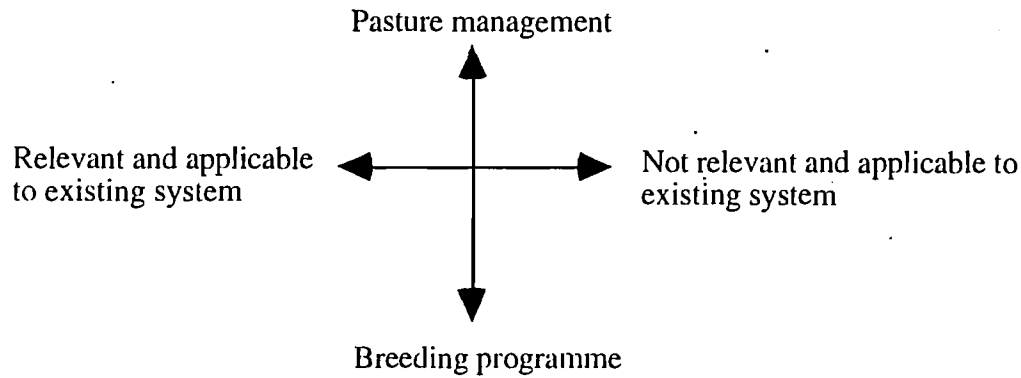
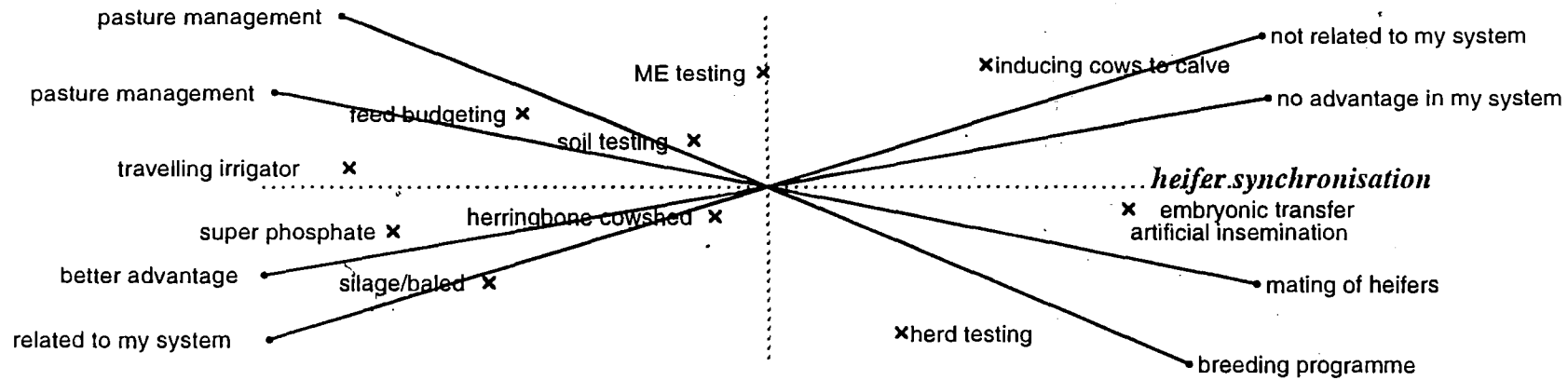


Figure A1.43b: Principal components for subject 14

Focus analysis

The focus analysis results of subject 20 were shown in Figure A1.44. The Element Tree displays 14 elements of which five are adopted and nine are not adopted. There are three construct dimensions shown on the Construct Tree. The subject observed that all those nine non-adopted innovations were clustered and located at the top of the Element Tree and the five adopted ones are also clustered and located at the bottom of the tree.

Those non-adopted innovations, he said, were not useful to him. He said that he did not bother about them and would never use them because they did not offer any benefit to him. He claimed that he did not use them to achieve his farming objective or to increase farm profit.

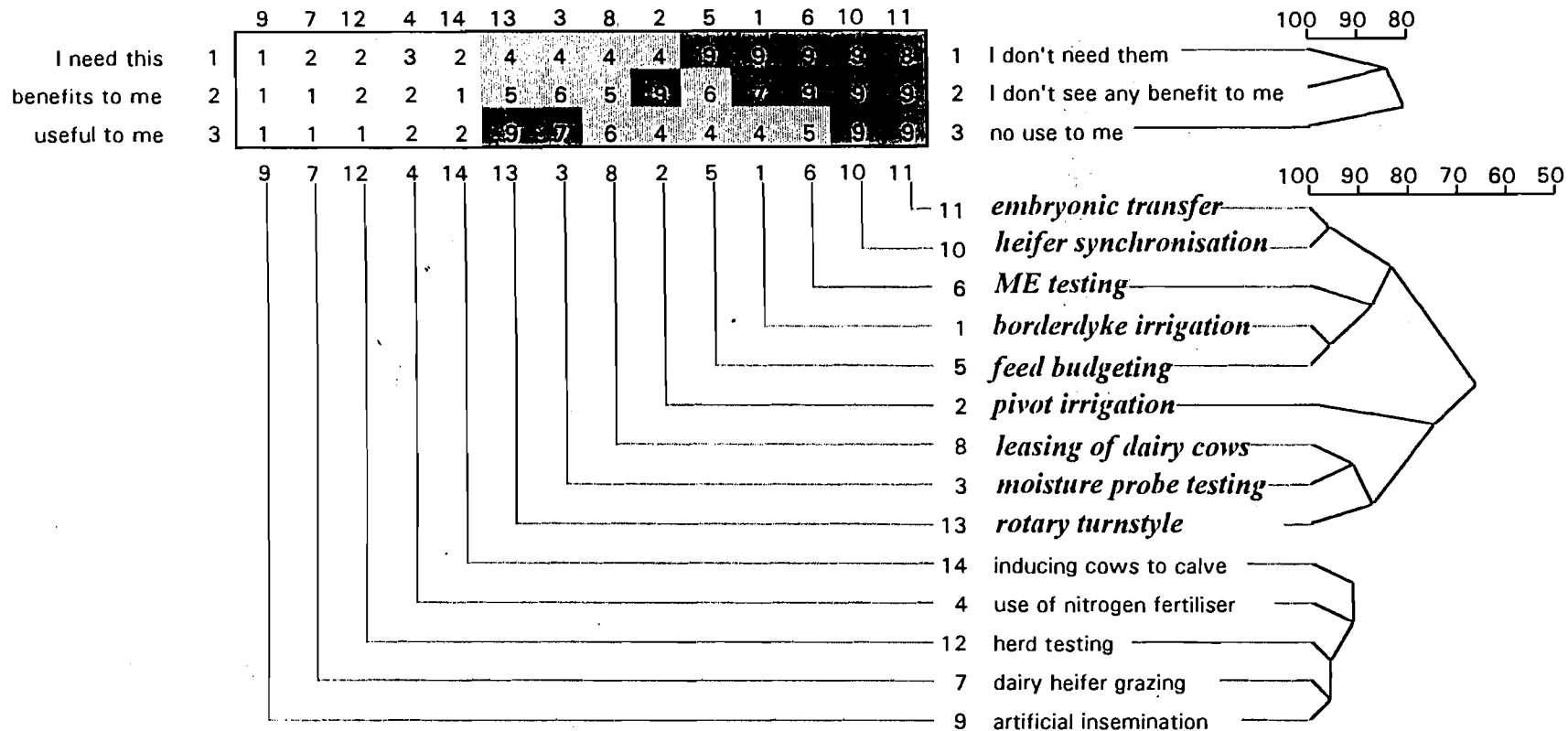
The five adopted innovations are clustered together. He said that he derived most of his “dollars” from using these innovations. For example, dairy heifer grazing and artificial insemination are highly matched at 96 per cent and then clustered with herd testing also at 96 per cent. All his heifers were normally grazed on his own property although some were grazed off the farm. He was using artificial insemination and herd testing for genetic improvement in his herd. These three innovations were then clustered with the use of nitrogen fertiliser and inducing cows to calve at 94 per cent. He said that he used these innovations because they were important management tools to him for increasing profit.

Figure A1.44 is the focused grid of subject 20 displaying the three construct dimensions he used to construe the elements: need, benefit and usefulness. The following sub-sections explain each of these dimensions:

Need

The first construct dimension used by subject 20 to construe the elements is related to the need of the elements in his farming system. He gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that the subject does not need heifer synchronisation in his farming system. The subject said that he was aware of the programme.

Figure A1.44: Focused grid for subject 20



He said the programme was used to synchronise the cycling of heifers so that they would calve earlier and at the same time increase the genetic gain. However, he argued that he would prefer his cows to have their own natural cycles rather than through artificial manipulation. He said that from his experience, his cows got in calf within three weeks and therefore earlier than through a synchronisation programme. He argued that if his heifers could get in calf within three weeks this was fast enough for him. Therefore, he said, since the synchrony programme was no better than his existing one he could not see any need for a change.

Benefit

The second construct dimension used is whether the programme has any benefit to him. He gave a rating value of "9" to heifer synchronisation on this dimension, meaning that it has no benefit for him. The subject argued that if all the heifers would calve at the same time that would mean extra work or labour for him. He said he would not like to have any extra work or pressure on him. He would prefer to handle a small number of animals at one time. He argued that his whole farming set up would be changed, if he were to use the programme. At this moment, he said that he was very happy with the existing system and hence did not prefer to have any change. In other words, he said, heifer synchronisation has no benefit for him.

Usefulness

The third construct dimension used is whether the programme is useful to him. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the programme is not useful to him. The subject said that he would prefer to work slowly and quietly without having too much pressure. He said that his existing method of identifying those animals in season, artificially inseminating them and following up with a bull, was good enough for him. He said that he did not want to change his pattern of work. Because heifer synchronisation would force him to change his working style, he said such programme was not useful to him and would never adopt it.

PrinCom analysis

The percentage of variance in subject 20's grid attributable to the first principal components is 80.9 per cent (Table A3.1). In Figure A1.45a, the positive end of the component shows three construct labels which score highly on the component: benefits to me, I need this and useful to me. There are few elements associated with this component: artificial insemination, use of nitrogen fertiliser, inducing cows to calve, dairy heifer grazing and herd testing. A possible theme that best describes this component is "utility and benefits" (Figure A1.45a and Table 3). In other words, the subject considers that those innovations above are useful, applicable and beneficial to him.

At the negative end of the component the three construct labels are: I don't see any benefit to me, I don't need them and no use to me. The elements which score highly on the component are: heifer synchronisation and embryonic transfer. The subject considers that heifer synchronisation is not useful and inapplicable on his farm and hence of no benefit to him. He feels very happy with his existing working style and change is not appropriate.

A1.6.4 Subject 23's Constructs

Subject 23, aged 61 years, has his school certificate education. He has been farming on his 80-hectare property for about 23 years. He is milking 187 Friesian cows with an average production of 360 kg ms per cow. His future plan is to have a herd manager or a sharemilker on the property although he would prefer to be on the farm as long as he can.

Focus analysis

The results of subject 23's focus analyses were shown in Figure A1.46. The Element Tree displays 14 elements of which 10 are not adopted and four are adopted. The Construct Tree shows three construct dimensions:

Subject 20 observed that the non-adopted innovations were clustered and located at the top of the tree. Similarly, the adopted innovations were also clustered but located at the bottom of the tree. The subject commented that these non-adopted were clustered together because

Figure Al.45a: PrinCom analysis for subject 20

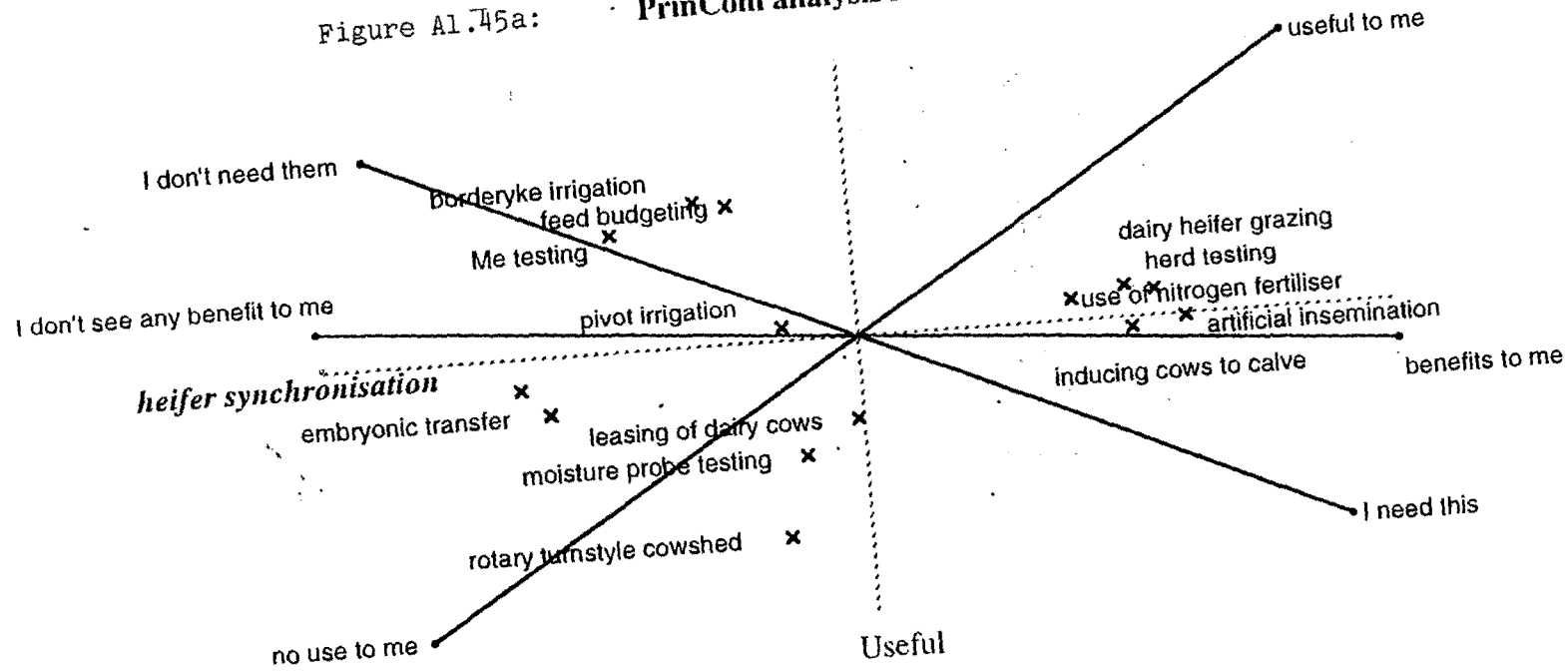


Figure Al.45b Principal components for subject 20

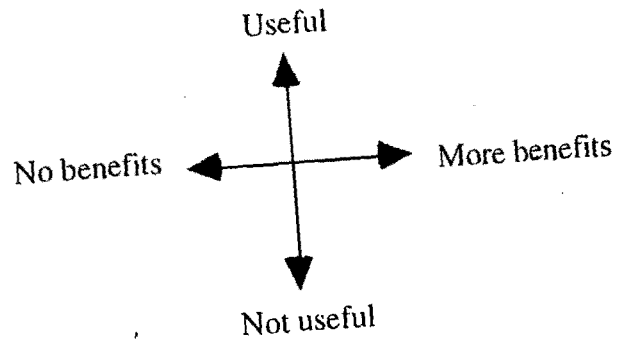
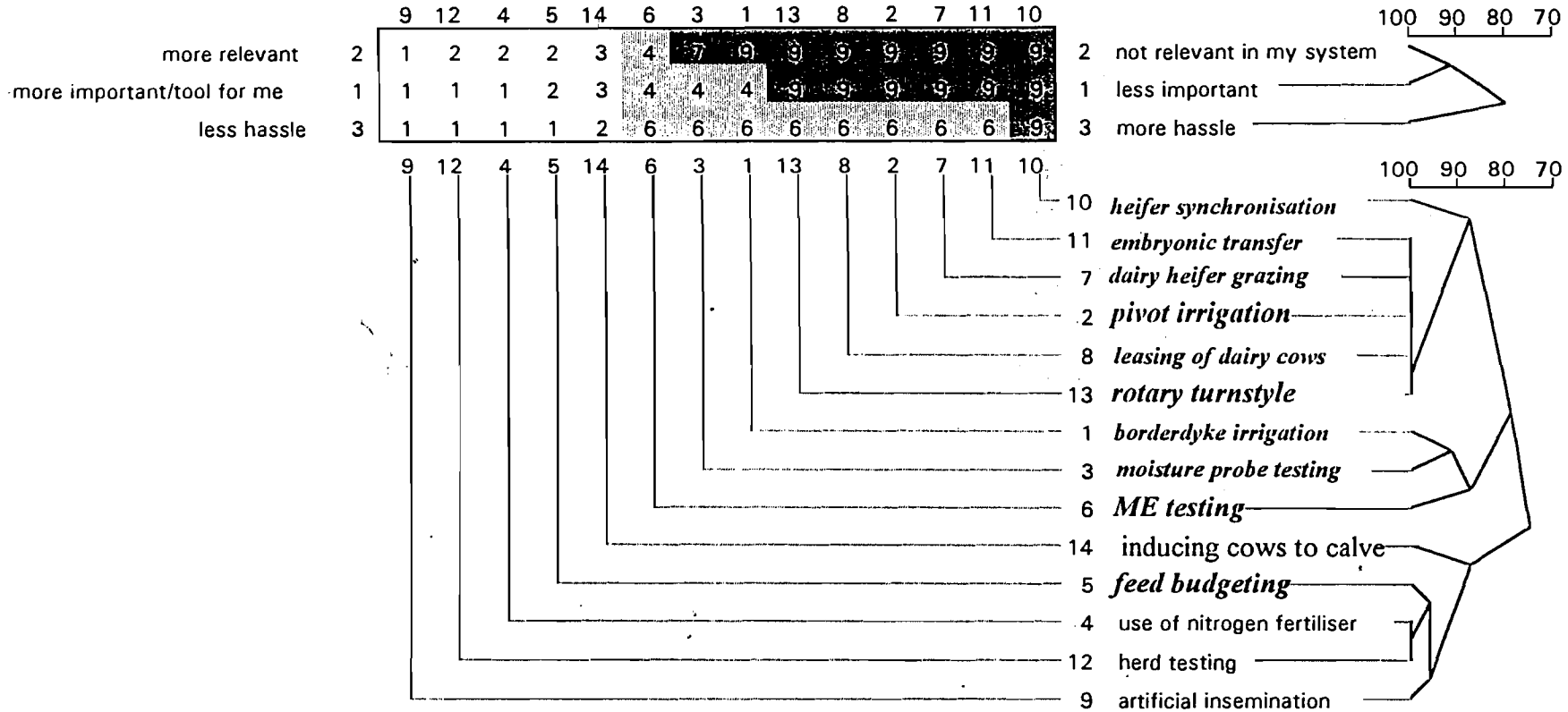


Figure A1.46: Focused grid for subject 23



they were not applicable or not important on his farm. He said that he did not bother about them because they could not be used to operate his farm. He would like to maintain his farm cost structure at a reasonably low level.

He observed that those four adopted innovations, inducing cows to calve, use of nitrogen fertiliser, herd testing and artificial insemination, were clustered together because they were important to him in making his farm business more profitable.

Use of nitrogen fertiliser and herd testing are very tightly matched at 100 per cent and then clustered with artificial insemination at 96 per cent. He said these three elements were closely related because they were easy to use to maximise milk production. He would try to grow as much grass as possible so as to produce sufficient feed for the cows in order to produce more milk. He said cows have to be genetically good to produce more milk.

He also observed that feed budgeting (not adopted and located at the bottom of the tree) was linked to the adopted innovations. He argued that although he did not use the formal method of evaluating feed levels, he used eye appraisal based on his long experience on his farm. In other words, this feed budgeting was also related to the adopted innovations.

Figure A1.46 is the focused grid of subject 23 displaying the three construct dimensions he used to construe the elements: importance, relevancy and hassle. The following sub-sections explain each of these dimensions.

Importance

The first construct dimension used by subject 23 to construe the elements is how important the innovation is to his farming operation. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the programme is less important to him. The subject had indicated that he was aware of heifer synchronisation but considered the programme was less important to him on three aspects. Firstly, he said that he was not expanding the farm and he did not have to worry about trying to get extra heifer calves.

Secondly, there was a Tb problem in the area where he grazed his heifers. If he were to bring these heifers out from the area, that would mean another Tb test has to be done. He said that would be another hassle for him. Thirdly, he said that he had the problem of labour. He argued that having a bunch of heifers at one time would create a lot of disruption and hence synchronisation could lower the conception rate among the animals. Because of these reasons, he considered heifer synchronisation was less important to him

Relevancy

The second construct dimension used is related to the relevance of such a programme in his farming operation. Subject 23 gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that heifer synchronisation is not relevant. He argued that if he were to bring home all these heifers for the purpose of doing the heifer synchronisation that would mean putting more pressure on the grazing available for the milking cows. He said that was the reason why he preferred to keep his heifers at his run-off all the time. In other words, he said that such synchronisation would not be relevant in his farming system.

Hassle

The third construct dimension used is connected to hassle. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the programme creates a lot of hassle and pressure for the subject. For example, he said, if he were to take all the heifers home from the run-off grazing area, this would mean a lot of hassle for him and a lot of labour would be required. He said he did not want to face all this hassle. In other words, he would prefer to work at a slower pace and in stages with a small number of cows at a time.

PrinCom analysis

The percentage of variance in subject 23's grid attributable to the first principal component is 92.3 per cent (Table A3.1). In Figure A1.47a, the negative end of the pole shows three construct pole labels which score highly on this component: not relevant in my system, more

Figure A1.47a: PrinCom analysis for subject 23

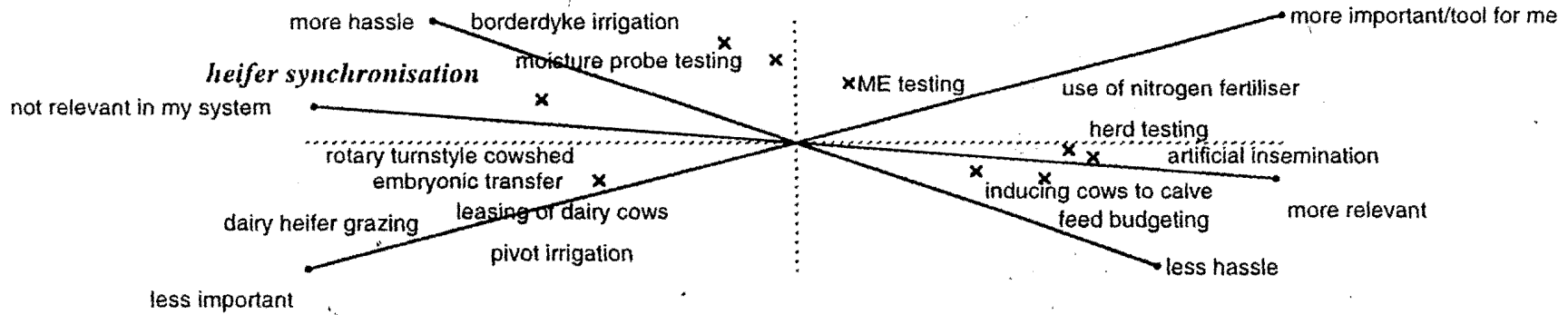
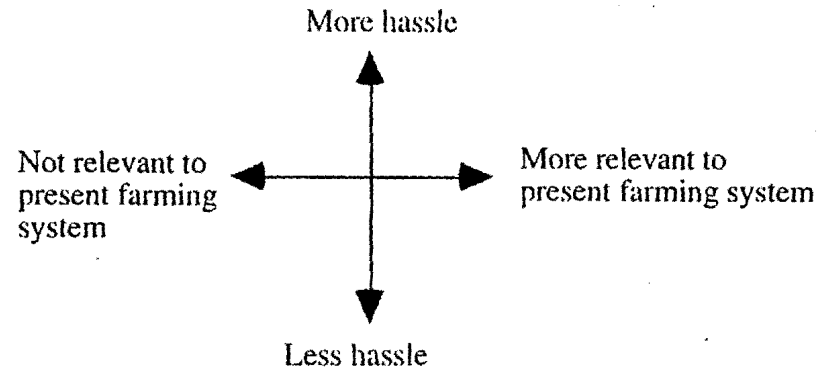


Figure A1.47b: Principal components for subject 23



hassle and less important. There are four elements which score highly on the component: heifer synchronisation, dairy heifer grazing, rotary cowshed and leasing of dairy cows. One general theme that best describes this component is “relevancy and simplicity” (Figure A1.47b and Table 3). The innovations stated above are not relevant to the subject’s farming system because they do not give any benefit but instead create a lot of hassle for the subject.

A1.6.5 Subject 24’s Constructs

Subject 24, aged 47 years, has his high school certificate education. He has been farming on this 60-hectare family farm for about 14 years. He is now milking 150 Friesian cows with an average milk production of 400 kg ms per cow. His farming objectives are to make his farm more profitable in order to have a better income for his family and be able to enjoy life more better.

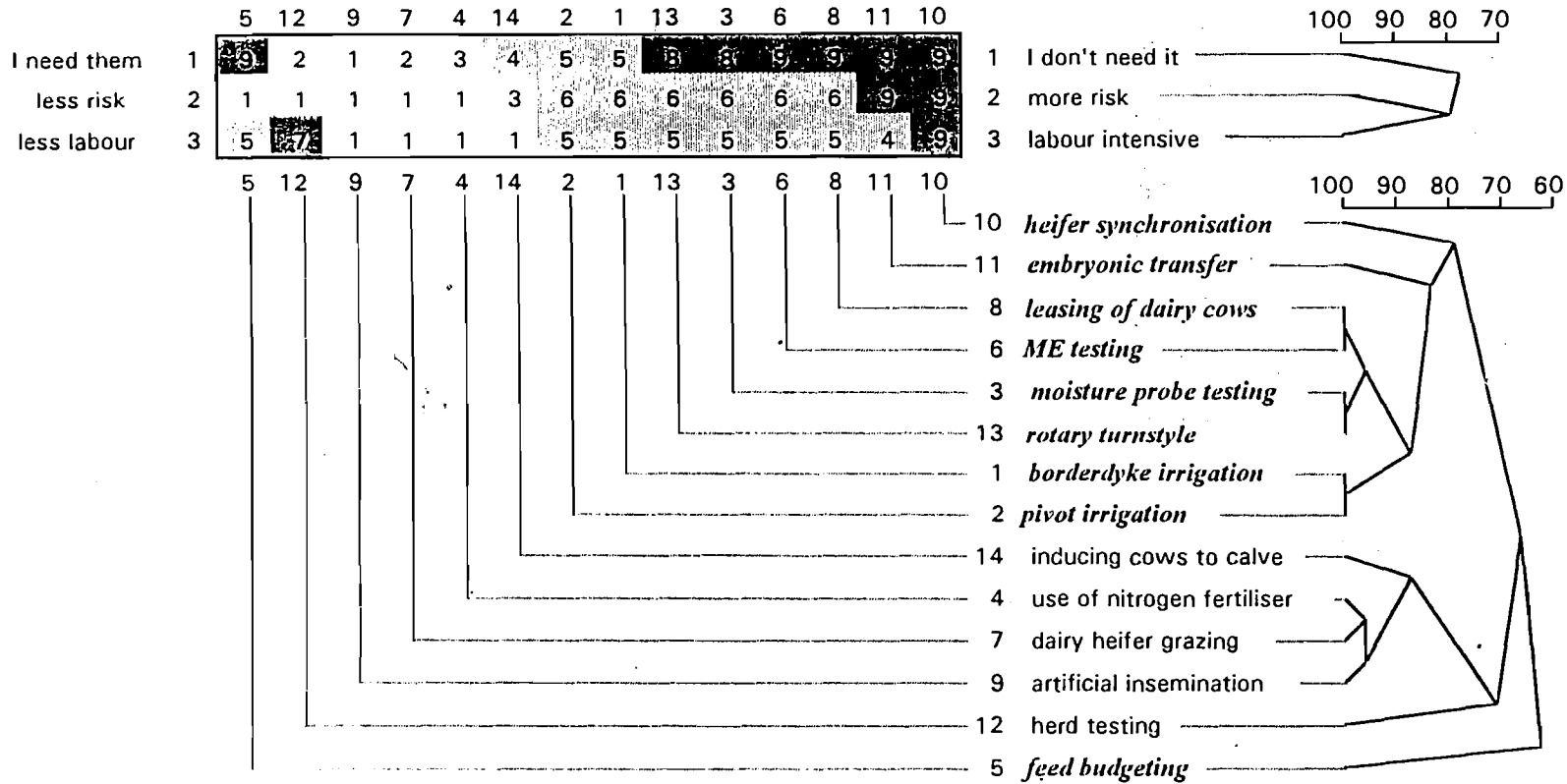
Focus analysis

The focus analyses results for subject 24 are shown in Figure A1.48. The Element Tree shows 14 elements of which five are adopted and nine are not adopted. The Construct Tree displays three construct dimensions which he used to construe the innovations.

Subject 24 observed that the non-adopted innovations were clustered and located at the top of the Element Tree. All these innovations, he said, were not necessary and therefore not applicable to achieving his farming objectives. However, with regard to feed budgeting, although he had not done any feed budgeting, he used eye appraisal instead, based on his field experience. He mentioned that he might do feed budgeting in future because he has observed his neighbours doing that and was very pleased to see the advantages of its use.

Use of nitrogen fertiliser and dairy heifer grazing were tightly matched at 96 per cent and are then clustered with artificial insemination at 94 per cent. He said that nitrogen fertiliser was useful because without that he would not be able to achieve his production. His heifers are grazed off and with the use of artificial insemination help him obtain his current level of

Figure A1.48: Focused grid for subject 24



production. He said that all those adopted innovations were linked to each other because all of them were useful to his farm operation in increasing production and hence farm income.

Figure A1.48 is the focused grid of subject 24 showing the three construct dimensions he used to construe the innovations: need, risk, and labour. The following sub-sections explain each of the construct dimensions in relation to heifer synchronisation.

Need

The first construct dimension used by subject 24 to construe the innovations is whether there is a need for such an innovation. The subject gave a high rating value of "9" to heifer synchronisation on this dimension, meaning that the subject does not need the programme in his farming operation. He has indicated his awareness of heifer synchronisation but mentioned four main reasons why he considered it was not needed in his operation. Firstly, the programme was time-consuming. He said that his heifers were grazed off farm, 30 km away from the main property. In view of the distance and the time involved following the programme and the fact that he has to look after the activities at his own property, the programme would inevitably change the present work schedule on his farm. He said that he could not afford this change. Secondly, because heifer synchronisation would involve handling a large group of animals at one time during calving, that would mean putting a lot of pressure on his feed supply. He said that he could not afford this pressure. Thirdly, he said that he would have to make contact with the veterinary technician who was situated away from his district. Fourthly, he also indicated that he was very pleased with the existing performance of his animals using the natural mating and also artificial insemination. He did not have any trouble calving his heifers. He was very pleased with the conception rate that he was getting. For example, he said, last year he had only two empties out of 29. Usually he had only one or two empties every year and he regarded that result was not unusual.

Risk

The second construct dimension he used is related to the risk involved in the programme. The subject gave a very high rating value of “9” to heifer synchronisation on this dimension, meaning that the programme would involve a high risk of feed shortage. Subject 24 had indicated the problem of feed shortage especially in spring or September. He pointed out that if he were to have a bulk of cows calving in August or September in one group, the risk of feed shortage would be very high. He said that he did not have any alternate winter grazing or sufficient grass to feed these animals.

Labour

The third construct dimension used is related to the labour requirement. The subject gave a high rating value of “9” to heifer synchronisation on this dimension, meaning that the programme is very labour-intensive. Subject 24 said that he was very concerned about the labour needed to do the exercise. He said, at the moment, he was working with his wife to do the milking and feeding the calves and there was no extra labour available. He was only handling a few animals, 6-10 a day, at the time of calving using natural mating. Therefore, he said, if he were to use the synchrony programme that would involve changing the amount of labour required and also increasing the pressure of work on him and his wife. He said he could not afford to change their present work schedule.

PrinCom analysis

The percentage of variance in subject 24’s grid attributable to the first principal component is 76.7 per cent (Table A3.1). In Figure A1.49a, the positive end of the component shows three construct pole labels score highly on this component: I don’t need it, more risk, and labour intensive. There are two elements which score highly on the component: heifer synchronisation and embryonic transfer. One general theme that best describes this component is “need, relevant and happy with the programme” (see Figure A1.49b & Table 3). These two innovations are not important to the subject because they are not relevant to his system and he is not pleased with their performance.

Figure A1.49a: PrinCom analysis for subject 24

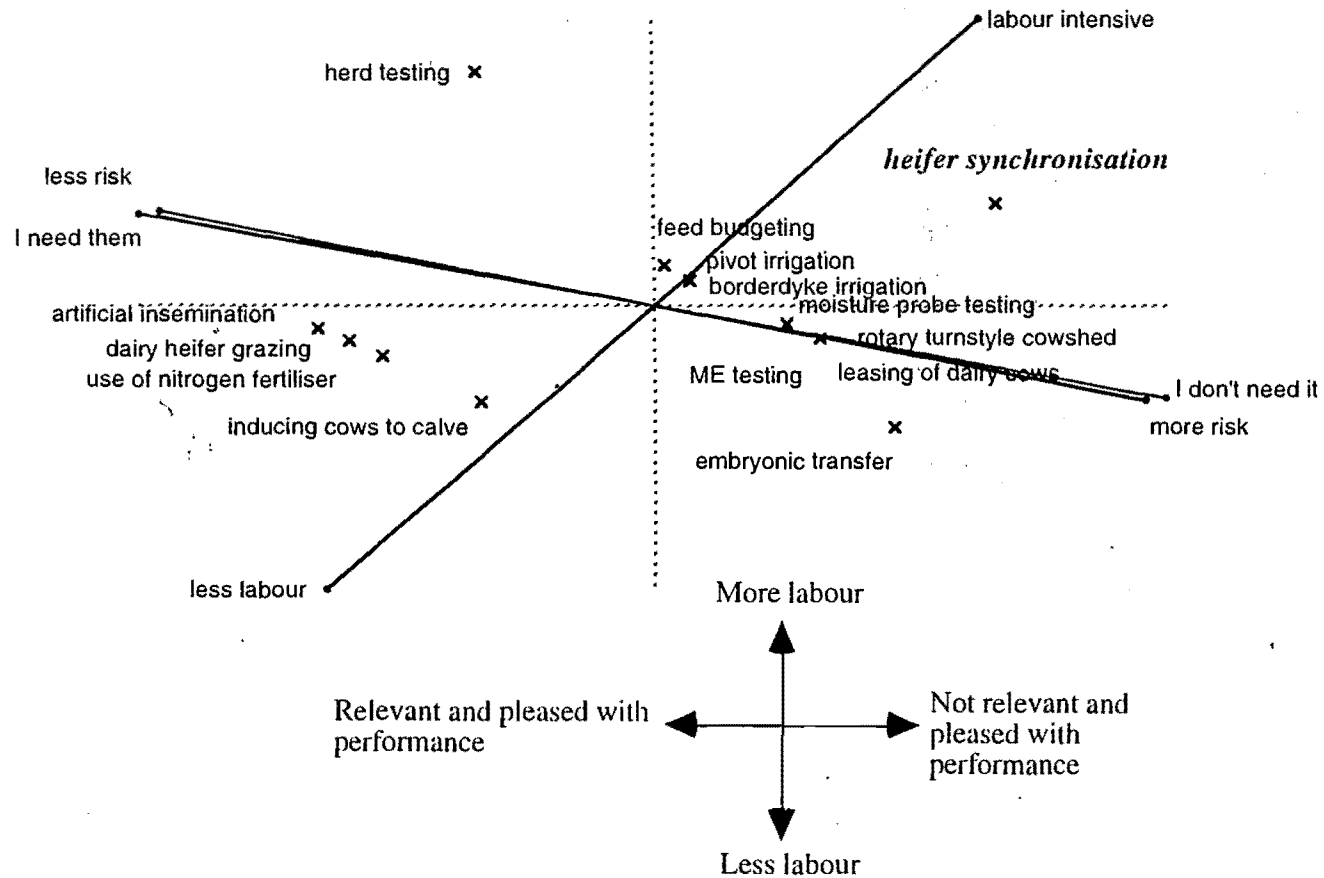


Figure A1.49b: Principal components for subject 24

The negative end of the component shows these construct labels: I need them, less risk and less labour. Some of the elements which score highly on the component are: artificial insemination, dairy heifer grazing and use of nitrogen fertiliser. The subject considers the innovations above are less risky and more relevant to him in terms of attaining his farming objectives.

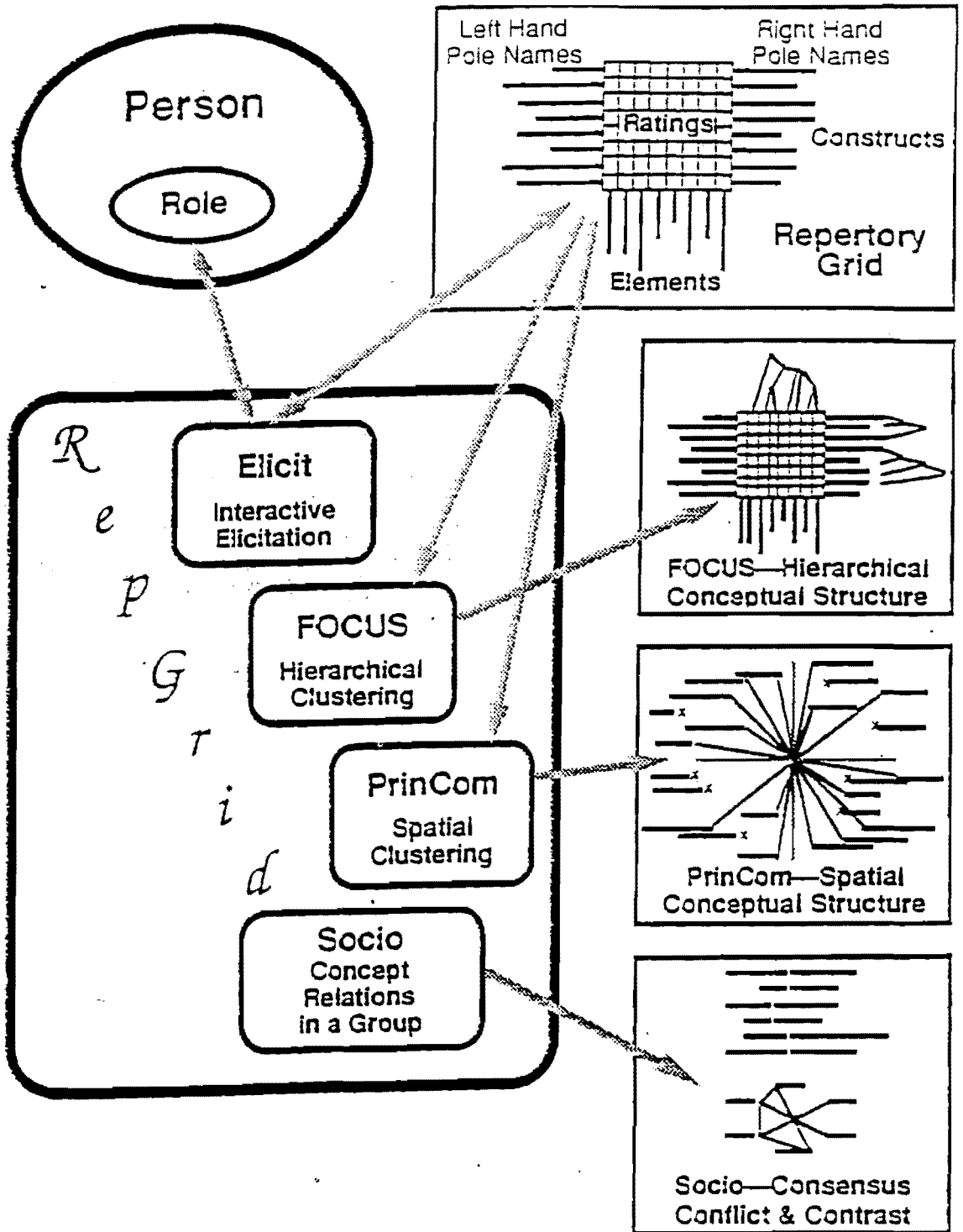


Figure A2.1: RepGrid Functionality

Appendix 2: RepGrid Programme

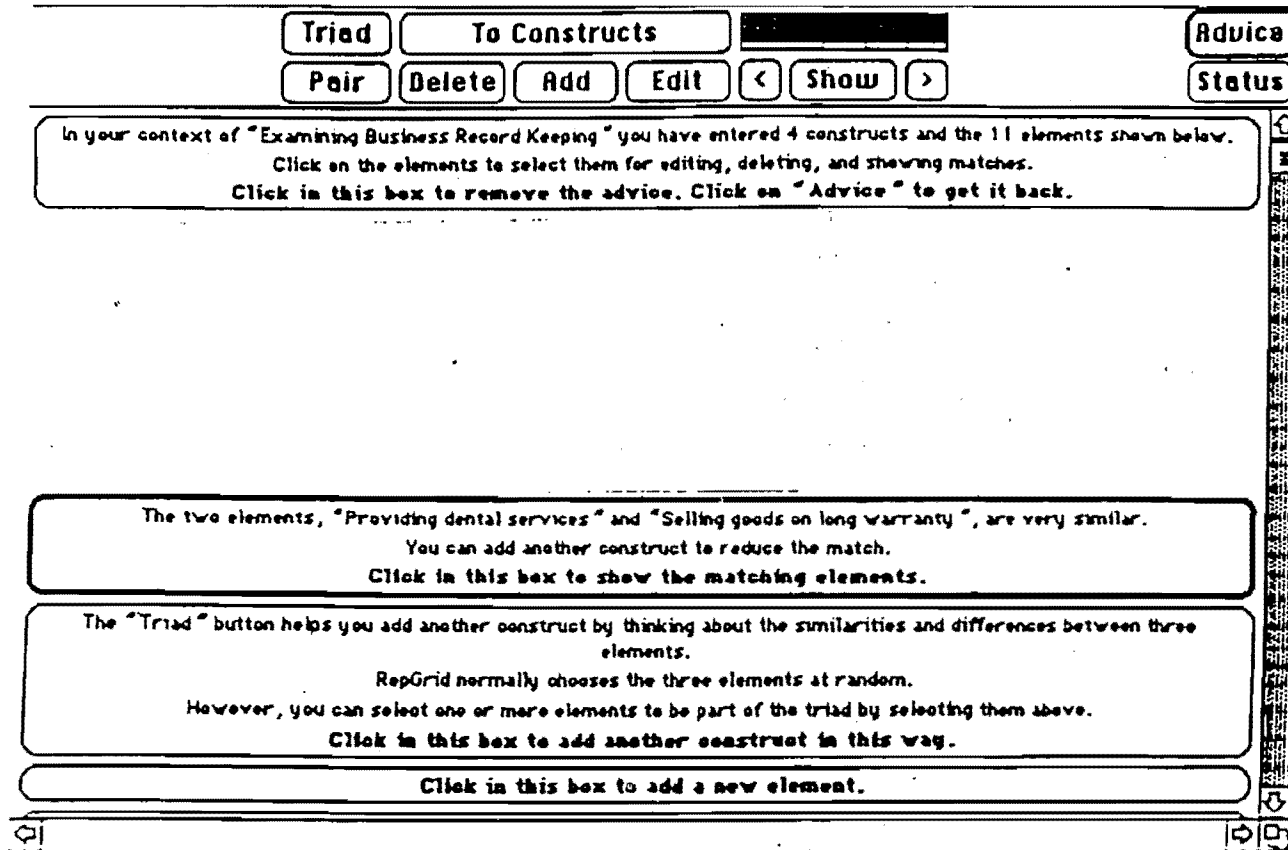


Figure A2.2: RepGrid Triadic Elicitation and Constructs

Appendix 2: RepGrid Programme

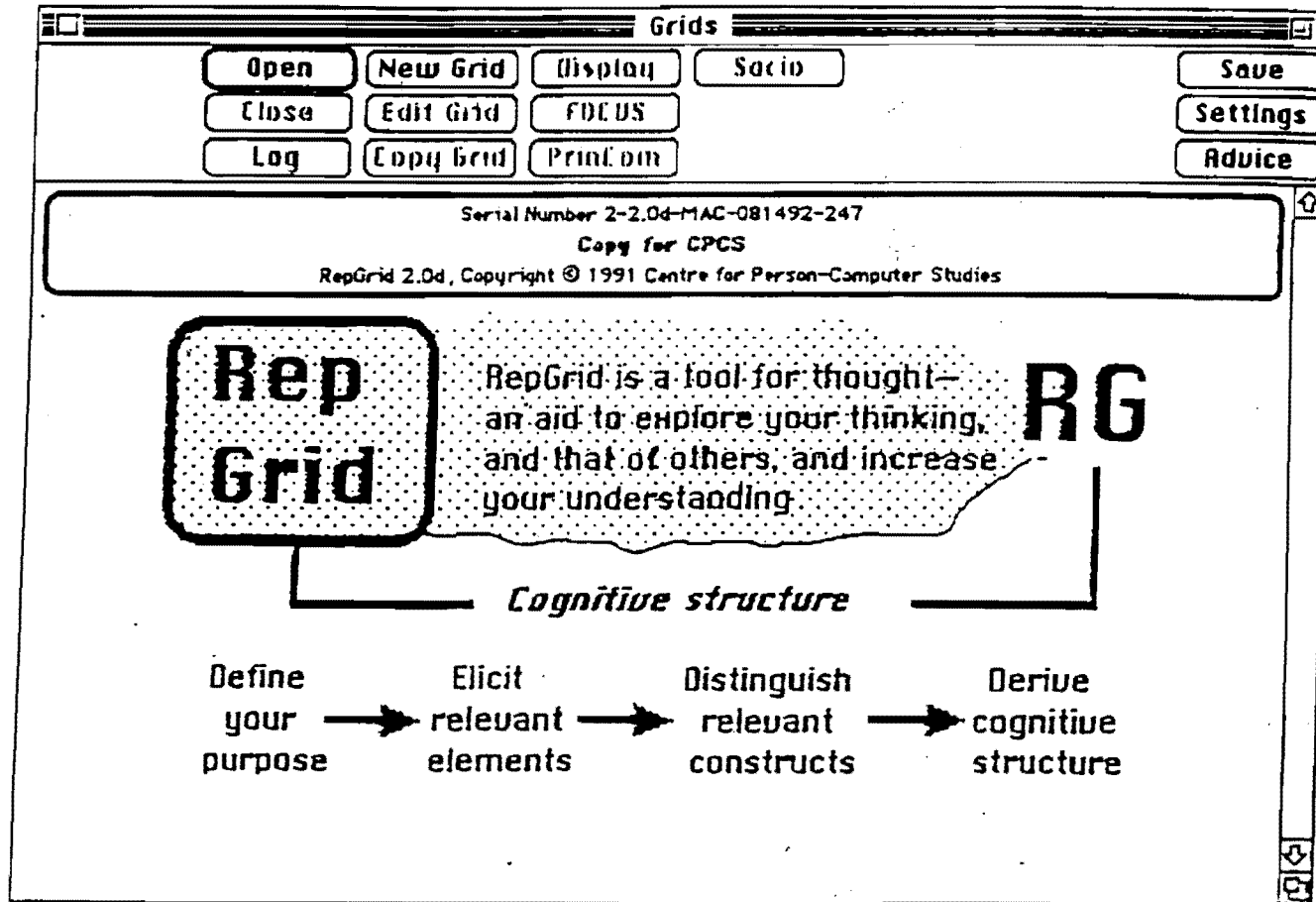



Figure A2.3: Starting a new Grid Elicitation



PrinCom Analysis of ch5

Save

OK

Settings

Cancel

Graph

Axes Horizontal Vertical Scale

Reverse Horizontal Vertical Axes

Title

Elements

Constructs

Dimensions

Text

Correlations

Components


Loadings Elements

Constructs

Window: Log

ch5_FOCUS

Figure A2.4: RepGrid PrinCom Dialog



**Socio Construct Analysis of 2 grids with 9
elements in common**

Common Elements Constructs Both

Match Level Grids

Graphs

Text

Difference

Element Links Construct Links

Grids Elements Constructs

Element Matches Links Mode

Construct Matches Links Mode

Window: Log ch5_FOCUS

Figure A2.6: RepGrid Socio Dialog

Appendix 3: Percentage of Variance

Category of decision makers	Subject number	Percentage of Variance (%)
Adopters	3	60.3
	5	56.6
	6	60.8
	8	53.3
	9	56.2
Discontinued	1	66.0
	2	79.1
	4	56.1
	11	71.2
	12	55.2
Wait-and-see	10	44.0
	13	54.2
	17	59.6
	19	88.0
	22	53.0
Constrained	15	71.0
	16	57.0
	18	63.9
	21	66.9
	25	51.9
Would never adopt	7	59.7
	14	90.3
	20	80.9
	23	92.3
	24	76.7

Table A3.1: Summary of Percentage of Variance in First Component (%)