

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

Implementing Sustainable Agriculture

Perceptions of Hill-Country Farmers in
the Rangitikei District

A Thesis Presented in Partial Fulfilment
of the Requirements for the Degree of
Master of Resource and Environmental Planning

At

Massey University

By

Grant Frederick King

1006

MASSEY UNIVERSITY



1061209228

“All there is to thinking, is seeing something noticeable which makes you see something you weren't noticing which makes you see something that isn't even visible.”

Norman Maclean
'A River Runs Through It'

Abstract

This thesis investigates the perceptions concerning the implementation of sustainable agriculture in hill-country farming in New Zealand, primarily by using a survey of farmers from the Rangitikei District.

A literature review identified three main groupings of approaches to sustainable agriculture: a production or economic based approach; a stewardship and intergenerational equity approach; and a social approach which emphasised social equity and rural community issues. It also stressed the importance of scale issues in sustainable agriculture with the analysis focussing on horizontal, vertical and temporal scales.

It appears that the 'ideals' of sustainable agriculture as outlined in the literature are not being translated into reality in New Zealand, and indeed the ideals of New Zealand farmers may not correspond to those presented in the literature. A conceptual framework was constructed to further investigate this issue of the gap between the ideal end-state of sustainable agriculture and the actual practices. A survey of 260 'conventional' farmers in the high-terraces and hill-country of the Rangitikei was selected to empirically test the conceptual framework. The viewpoints of these farmers were contrasted with those of: a small sample of certified organic farmers who ran similar land-uses on similar land-classes; and a sample of professional staff who were selected from the regional councils, central government, industry groups, a farmer organisation, a conservation organisation, scientists and academic staff. A 78 question survey ascertained farmers ideals with regard to sustainable agriculture, what they considered to be desirable sustainable farming practices; what they considered to be barriers to sustainable agriculture; and what implementation methods (eg. regulation, education, rates rebates) they considered to be acceptable. The actual farmers practices (eg. pesticide use, fertiliser use, agroforestry, erosion control) were also surveyed using a relative scale which measured change over the last five years.

The key findings of the sample survey were as follows. The overall preference for the 'hands-off' implementation methods, such as 'education' and 'further research' by all three groups. There was a lack of recognition of social characteristics of sustainable agriculture by the professional staff, compared to their acknowledgement of economic and environmental considerations. The practices undertaken by farmers had improved over the timeframe measured, although much of the change was for economic reasons as opposed to environmental considerations. The most commonly identified barriers by all the respondents were economic in nature.

The thesis concluded with a discussion of the policy implications of research findings. The most important policy implication discussed was whether the preferred methods for implementing sustainable agriculture (ie. 'education' and 'further research') could actually overcome the perceived barriers to achieving sustainable agriculture which were predominantly economic in nature. Some further suggestions were also made on further research directions; most notably that the factors identified in the conceptual framework need to be tested on a wider range of farm-types and other regions in New Zealand.

Acknowledgements

My gratitude, first and foremost, goes to my supervisor Murray Patterson. The guidance provided by Murray towards undertaking the survey and completing the thesis was invaluable, along with his advice, feedback and encouragement, and the resulting discussion shaped the thesis and analysis within.

I am also indebted to Farmlands Trading Company for providing the prize for the prize draw for the completed conventional farmer responses to the survey, which would have increased the response rate from this sample group, and allowed for greater analysis.

A sincere vote of thanks also goes to the various people who offered ideas and opinion, and provided a foil to run ideas past on potential reasons for the survey results. The different perspectives on agricultural sustainability issues that they brought to the discussion in the thesis was very useful.

To the farmers and staff from various organisations who completed the survey responses I am very grateful, for without whose effort there would have been no results to analyse within this thesis. The time these people took to write responses and their thoughtful answers provided, and comments offered, were varied and very interesting, and also highlighted the breadth of opinions held about the issue of agricultural sustainability.

I am particularly grateful to my friends and family for their support and forbearance whilst I worked towards completing this thesis.

Table Of Contents

Abstract	i
Acknowledgements	iii
List of Figures	viii
List of Tables	xiii
Glossary of Abbreviations	xiv
CHAPTER ONE	
Introduction	1
1.1 - Setting the Scene	1
1.2 - Extent and Scale of Agriculture in New Zealand	2
1.3 - History of Agriculture in New Zealand	2
1.4 - Hill-Country Agriculture in New Zealand	4
1.5 - Origins and History of Sustainable Agriculture	6
1.6 - Sustainable Agriculture in New Zealand	9
1.7 - Research Objective and Questions	11
1.8 - Thesis Outline	15
1.9 - Sustainable Agriculture versus Sustainable Land Management	16
1.10 - Limitations of the Research	16
CHAPTER TWO	
Definitions of Sustainable Agriculture	20
2.1 - Problems in Defining Sustainable Agriculture	20
2.2 - Three Schools of Sustainability Proposed by Douglass (1984)	23
2.2.1 - Sustainability as food sufficiency	24
2.2.2 - Sustainability as stewardship	26
2.2.3 - Sustainability as community	29
2.2.4 - Discussion	32
2.3 - Imperatives and Objectives of Agriculture	33
2.4 - Issues of Scale in Sustainable Agriculture	37
2.4.1 - Horizontal Scale	37
2.4.2 - Vertical Scale	40
2.4.3 - Temporal Scale	42
2.5 - Comprehensive Definition of Sustainable Agriculture	44
CHAPTER THREE	
Alternative Approaches to Sustainable Agriculture	47
3.1 - Low-Input Sustainable Agriculture (LISA)	49
3.2 - Organic Agriculture	54
3.3 - Regenerative Agriculture	59
3.4 - Agroecology	63
3.5 - Biodynamic Agriculture	67
3.6 - Agroforestry	70
CHAPTER FOUR	
Methodology for Survey Design, Process and Analysis	75
4.1 - Why a Survey?	75
4.2 - Survey Design and Piloting	76
4.2.1 - Characteristics of Sustainable Agriculture and Farmer Recognition of the RMA	79
4.2.2 - Stakeholder Perceptions of Ideal Practices	81
4.2.3 - Barriers to Adopting Sustainable Agriculture	84
4.2.4 - Actual Practices Undertaken by Farmers	85
4.2.5 - Implementation Methods to Overcome Barriers	85
4.2.6 - Personal Details of Respondents	86
4.2.7 - Piloting of the Survey	86

4.3	- Sample Selection	87
4.4	- Mailout of Survey	87
4.5	- Collation of Results	91
4.6	- Statistical Analysis of Survey Results	93
4.7	- Explanation of Analysis of Survey Results	95
CHAPTER FIVE		
Ideal Characteristics of Sustainable Agriculture and the Resource Management Act		96
5.1	- Perceived Characteristics of Sustainable Agriculture	96
5.1.1	- Biophysical Considerations	96
5.1.2	- Social Considerations	98
5.1.3	- Economic Considerations	99
5.1.4	- Overarching Themes	100
5.1.5	- Specific Resources Mentioned	102
5.2	- Awareness of the Resource Management Act and the term Sustainability	104
5.2.1	- 'Does agriculture need to become more environmentally friendly?'	104
5.2.2	- Resource Management Act	106
5.2.3	- Purpose of the Resource Management Act	106
5.2.4	- Understanding of the term sustainability	109
CHAPTER SIX		
Desirable Practices for Achieving Sustainable Agriculture		111
5.1	- Inputs	111
5.2	- Resource Use	115
5.3	- Management Practices	119
5.4	- Specific Attitudes to Sustainable Agriculture Issues	124
CHAPTER SEVEN		
Actual Practices and Sustainability Implications: Inputs and Resource Use		133
7.1	- Description and Rationale for Survey Questions	133
7.2	- Analysis of Practices termed 'Inputs'	135
7.2.1	- Pesticide Use	135
7.2.2	- Fertiliser Use	136
7.2.3	- Energy Use	139
7.2.4	- Fungicide Use	140
7.2.5	- Drenches/internal parasiticide Use	141
7.2.6	- Pour-on/external parasiticide Use	142
7.3	- Analysis of Practices termed 'Resource Use'	144
7.3.1	- Clearing of scrub for pasture on steep land	146
7.3.2	- Water resource use	146
7.3.3	- Loss of native habitat	146
CHAPTER EIGHT		
Actual Practices and Sustainability Implications: Management Practices		147
8.1	- Analysis of Practices termed 'Management Practices'	147
8.1.1	- Riparian Planting	149
8.1.2	- Agroforestry	149
8.1.3	- Space Planting	149
8.1.4	- Production Forestry	150
8.1.5	- Conservation Forestry	151
8.1.6	- Planting Windbreaks/shelterbelts	153
8.1.7	- Retiring Steep Land	155
8.1.8	- Retiring Gully Land	155
8.1.9	- Physical Erosion Prevention Measures in Streambeds	155
8.1.10	- Contouring and Physical Landworks	155

8.1.11	- Living/dead Barriers to Soil Erosion	155
8.1.12	- Oversowing/Direct Drilling	157
8.1.13	- Cultivating Across Slopes	157
8.1.14	- Sediment Traps in Streambeds	157
8.1.15	- Feed Crop Rotations	158
8.1.16	- Intensive Grazing	159
→ 8.1.17	- Fenced Riparian Strips for Stock Exclusion	160
8.1.18	- Pesticide Management Programmes	160
8.1.19	- Integrated Pest Management (IPM) Programmes	160
8.1.20	- Increased Fertiliser Management	162
8.2	- Summary of Analysis of Practices Covered in Chapters 7 and 8	163
CHAPTER NINE		
Perceived Barriers to Achieving Sustainable Agriculture		166
9.1	- Economic Barriers	167
9.2	- Education Barriers	171
9.3	- Attitudinal Barriers	175
9.4	- Institutional and Legal Barriers	179
9.5	- Physical and Technical Barriers	181
9.6	- Summary of Perceived Barriers	183
CHAPTER TEN		
Implementation Methods for Achieving Sustainable Agriculture		185
10.1	- Justification and Description of Implementation Methods	185
1	- Pollution Charges	187
2	- Subsidies for desirable practices, taxes for undesirable practices	187
3	- Grants	187
4	- Income tax deductions or rebates	187
5	- Rates Rebates	188
6	- Regulation	188
7	- Education	189
8	- Further Research	189
10.2	- Analysis of Significant Responses to Implementation Methods	191
10.2.1	- Pollution Charges	191
10.2.2	- Subsidies for desirable practices, taxes for undesirable practices	193
10.2.3	- Grants	195
10.2.4	- Income tax deductions or rebates	195
10.2.5	- Rates Rebates	198
10.2.6	- Regulation	200
10.2.7	- Education	207
10.2.8	- Further Research	207
10.2.9	- Overall Favourability of the Methods Queried	207
CHAPTER ELEVEN		
Conclusions and Implications of Survey Findings		210
11.1	- Main Research Findings from the Sample Survey	210
11.1.1	- Ideal Characteristics of Sustainable Agriculture	211
11.1.2	- Desirable Practices for Sustainable Agriculture	212
11.1.3	- Changes in Actual Practices Undertaken and Resultant Implications	214
11.1.4	- Barriers to Sustainable Agriculture	217
11.1.5	- Favourability of Implementation Methods for Achieving Sustainable Agriculture	219
11.1.6	- Recognition of the RMA and Sustainability Concepts	221
11.1.7	- Specific Attitudes to Sustainable Agriculture Issues	222
11.2	- Policy Implications	223
11.3	- Further Research	226
REFERENCES		228

APPENDICES

APPENDIX A

Examples and Critique of ‘Sustainable Agriculture’ Definitions Proposed in the Literature	A1
A.1 - Explanation	A1
A.2 - Definitions and Brief Critique	A1

APPENDIX B

Copies of Surveys and Covering Letters from Thesis Sample Survey	B1
B.1 - Covering Letter Mailed with Conventional Farmer Survey	B1
B.2 - Covering Letter Mailed with Organic Farmer Survey	B2
B.3 - Conventional Farmer and Organic Farmer Survey	B3
B.4 - Covering Letter Mailed to Senior Staff Member at Organisations Covered by Professional Staff Sample	B12
B.5 - Covering Letter Mailed with Professional Staff Survey	B13
B.6 - Professional Staff Survey	B14

APPENDIX C

Rationale for Demographic Details and Distribution of Resulting Staple	C1
C.1 - Gender	C1
C.2 - Age	C2
C.3 - Education	C3
C.4 - Farm-type	C5
C.5 - Farm-Size	C6
C.6 - Professional Affiliations	C7
C.7 - Occupation	C8
C.8 - Location	C8

APPENDIX D

Analysis of Interrelationships Between Demographic Attributes of Survey Respondents	D1
D.1 - Explanation and Justification for this Analysis	D1
D.2 - Chi-Square Analysis of Demographic Attributes	D2
D.3 - Analysis of Variance (ANOVA) on Demographic Attributes Against Farm-Size	D10

APPENDIX E

Figures Associated with the Analysis of Actual Agricultural Practices in Chapters 7 and 8	E1
E.1 - Figures for Analysis of Practices termed ‘Inputs’	E1
E.2 - Figures for Analysis of Practices termed ‘Resource Use’	E6
E.7 - Figures for Analysis of Practices termed ‘Management Practices’	E7

List of Figures

1.1	- Interrelationships between different chapters of the thesis and research questions.	12
2.1	- Vertical integration in the agricultural sector requiring consideration for sustainability issues.	41
4.1	- Survey methodology	78
4.2	- Rationale for survey sections	80
5.1	- Conventional and Organic farmers responses to 'Does agriculture need to become more environmentally friendly.'	104
5.2	- Conventional and Organic Farmers responses to 'Have you heard of the RMA?'	106
5.3	- Conventional and Organic farmers responses to 'Please outline the main purpose of the Resource Management Act.'	107
5.4	- Responses to 'Please outline the main purpose of the Resource Management Act' by education level of respondent.	107
5.5	- Responses to 'Please outline the main purpose of Resource Management' by farm-size of the respondent.	108
5.6	- Conventional and Organic farmers responses to 'Please outline your understanding of the term sustainability.'	109
5.7	- Responses to 'Please outline your understanding of the term sustainability' by farm-size of the respondent.	110
6.1	- Responses to Question 7 - 'Reliance on non-renewable resources, such as fertilisers, threatens the long-term viability of agriculture' by membership of stakeholder group of the respondent.	112
6.2	- Responses to 'Reliance on non-renewable resources, such as fertilisers, threatens the long-term viability of agriculture' by farm-size of the respondent.	114
6.3	- Responses to Question 3 - 'Current soil erosion rates are an acceptable byproduct of agricultural land-use' by membership of stakeholder group of the respondent.	116
6.4	- Responses to 'The use of marginal land involves practices that are not economically sustainable' by age of the respondent.	118
6.5	- Responses to Question 5 - 'The use of marginal land involves practices that are not environmentally sustainable' by membership of stakeholder group of the respondent.	118
6.6	- Responses to Question 1 - 'Agricultural systems involving monocultures are more susceptible to pests/diseases than polycultural agricultural systems' by membership of stakeholder group of the respondent.	120
6.7	- Responses to 'Agricultural systems involving monocultures are more susceptible to pests/diseases than polycultural agricultural systems' by the level of education held by the respondent.	121
6.8	- Responses to 'Agroforestry gives greater returns' by age of the respondent.	122
6.9	- Responses to 'Information requirements for 'environmentally friendly' agricultural systems are higher due to knowledge and management requirements' by age of the respondent.	123
6.10	- Responses to 'Some loss of short-term profit may be required to ensure long-term financial returns' by the number of professional affiliations held by the respondent.	125
6.11	- Responses to Question 10 - 'Extension research and education with the rural community will be important to ensure that future agriculture is environmentally friendly.' by membership of stakeholder group of the respondent.	126

6.12	- Responses to 'Extension research and education with the rural community will be important to ensure that future agriculture is environmentally friendly' by professional affiliations held by the respondent.	127
6.13	- Responses to 'Extension research and education with the rural community will be important to ensure that future agriculture is environmentally friendly' by the age of the respondent.	128
6.14	- Responses to Question 11 - 'Human health risks from food and fibre produced from agriculture will become increasingly important in the future' by membership of stakeholder group of the respondent.	129
6.15	- Responses to Question 13 - 'Social and community services, such as schools in the rural community are essential to its survival' by membership of stakeholder group of the respondent.	130
6.16	- Responses to 'Social and community services, such as schools in the rural community are essential to its survival' by the number of professional affiliations held by the respondent.	131
10.1	- Agreement with Pollution Charges as a method to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	191
10.2	- Mean response for approval of Pollution Charges as a method to achieve sustainable agriculture by age of the respondent.	192
10.3	- Agreement with Subsidies for desirable practices, taxes for undesirable practices as a method to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	193
10.4	- Mean response for approval of Subsidies for desirable practices, taxes for undesirable practices as a method to achieve sustainable agriculture by the number of professional affiliations held by the respondent.	195
10.5	- Agreement with Income tax deductions or rebates as a method to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	196
10.6	- Mean response for approval of Tax deductions or rebates as a method to achieve sustainable agriculture by highest level of education achieved by the respondent.	197
10.7	- Mean response for approval of Tax deductions or rebates as a method to achieve sustainable agriculture by age of the respondent.	198
10.8	- Agreement with Rates deductions or rebates as a method to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	198
10.9	- Mean response for approval of Rates deductions or rebates as a method to achieve sustainable agriculture by highest level of education achieved by the respondent.	199
10.10	- Agreement with Regulation as a method to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	200
10.11	- Mean response for approval of Regulation as a method to achieve sustainable agriculture by farm-size of the respondent.	201
10.12	- Mean response for approval of Regulation as a method to achieve sustainable agriculture by highest level of education achieved by the respondent.	202
10.13	- Mean response for approval of Regulation as a method to achieve sustainable agriculture by age of the respondent.	203
10.14	- Agreement with Education as a method to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	204
10.15	- Mean response for approval of Education as a method to achieve sustainable agriculture by highest level of education achieved by the respondent.	205

10.16	- Mean response for approval of Education as a method to achieve sustainable agriculture by age of the respondent.	206
10.17	- Mean responses to implementation methods to achieve sustainable agriculture by the membership of stakeholder group of the respondent.	207
C.1	- Gender distribution of entire sample.	C1
C.2	- Gender distribution of resulting respondents from each stakeholder group.	C2
C.3	- Age distribution of entire sample.	C2
C.4	- Age distribution of resulting respondents from each stakeholder group.	C3
C.5	- Education distribution of entire sample.	C4
C.6	- Education distribution of resulting respondents from each stakeholder group.	C4
C.7	- Farm-type distribution of entire sample.	C5
C.8	- Farm-type distribution of conventional farmer and organic farmer samples.	C5
C.9	- Farm-size distribution of entire sample.	C6
C.10	- Farm-size distribution of conventional farmers and organic farmer samples.	C7
C.11	- Professional affiliation distribution of entire sample.	C7
C.12	- Professional affiliations distribution of resulting respondents from each stakeholder group.	C8
D.1	- Mean farm-size for each age-group using SAS ANOVA command.	D12
E.1	- Distribution of responses for changes in 'Pesticide use' as an agricultural practice by the stakeholder group of the respondent.	E1
E.2	- Mean response for level of change in 'Pesticide use' as an agricultural practice by the number of professional affiliations held by the respondent.	E1
E.3	- Distribution of responses for changes in 'Fertiliser use' as an agricultural practice by the stakeholder group of the respondent.	E2
E.4	- Mean response for level of change in 'Fertiliser use' as an agricultural practice by the number of professional affiliations held by the respondent.	E2
E.5	- Mean response for level of change in 'Fertiliser use' as an agricultural practice by the highest level of education held by the respondent.	E2
E.6	- Mean response for level of change in 'Energy use' as an agricultural practice by the number of professional affiliations held by the respondent.	E3
E.7	- Mean response for level of change in 'Energy use' as an agricultural practice by the highest level of education held by the respondent.	E3
E.8	- Distribution of responses for changes in 'Fungicide use' as an agricultural practice by the stakeholder group of the respondent.	E3
E.9	- Mean response for level of change in 'Pesticide use' as an agricultural practice by the number of professional affiliations held by the respondent.	E4
E.10	- Distribution of responses for changes in 'Drenches/internal parasiticide use' as an agricultural practice by the stakeholder group of the respondent.	E4
E.11	- Distribution of responses for changes in 'Drenches/internal parasiticide use' as an agricultural practice by the age of the respondent.	E4
E.12	- Distribution of responses for changes in 'Pour-ons/external parasiticide use' as an agricultural practice by the stakeholder group of the respondent.	E5

E.13	- Distribution of responses for changes in 'Pour-ons/external parasiticide use' as an agricultural practice by the age of the respondent.	E5
E.14	- Mean response for level of change in 'Pour-ons/external parasiticide use' as an agricultural practice by the highest level of education held by the respondent.	E5
E.15	- Mean response for level of change in 'Water Resource Use' as an agricultural practice by the number of professional affiliations held by the respondent.	E6
E.16	- Distribution of responses for changes in 'Water Resource Use' as an agricultural practice by the farm-size of the respondent.	E6
E.17	- Mean response for level of change in 'Riparian planting' as an agricultural practice by the number of professional affiliations held by the respondent.	E7
E.18	- Distribution of responses for changes in 'Space planting' as an agricultural practice by the age of the respondent.	E7
E.19	- Mean response for level of change in 'Production Forestry' as an agricultural practice by the number of professional affiliations held by the respondent.	E8
E.20	- Distribution of responses for changes in 'Production Forestry' as an agricultural practice by the farm-size of the respondent.	E8
E.21	- Distribution of responses for changes in 'Conservation forestry' as an agricultural practice by the stakeholder group of the respondent.	E8
E.22	- Mean response for level of change in 'Conservation forestry' as an agricultural practice by the number of professional affiliations held by the respondent.	E9
E.23	- Distribution of responses for changes in 'Conservation forestry' as an agricultural practice by the farm-size of the respondent.	E9
E.24	- Distribution of responses for changes in 'Planting windbreaks/shelterbelts' as an agricultural practice by the stakeholder group of the respondent.	E9
E.25	- Mean response for level of change in 'Planting windbreaks/shelterbelts' as an agricultural practice by the number of professional affiliations held by the respondent.	E10
E.26	- Mean response for level of change in 'Retiring steep land' as an agricultural practice by the number of professional affiliations held by the respondent.	E10
E.27	- Distribution of responses for changes in 'Contouring and Physical Land Works' as an agricultural practice by the farm-size of the respondent.	E10
E.28	- Distribution of responses for changes in 'Living/dead barriers to soil erosion on slopes' as an agricultural practice by the stakeholder group of the respondent.	E11
E.29	- Mean response for level of change in 'Living/dead barriers to soil erosion on slopes' as an agricultural practice by the number of professional affiliations held by the respondent.	E11
E.30	- Distribution of responses for changes in 'Cultivating across slopes' as an agricultural practice by the stakeholder group of the respondent.	E11
E.31	- Distribution of responses for changes in 'Sediment traps in streambeds' as an agricultural practice by the age of the respondent.	E12
E.32	- Distribution of responses for changes in 'Feed crop rotations' as an agricultural practice by the age of the respondent.	E12
E.33	- Distribution of responses for changes in 'Intensive grazing' as an agricultural practice by the farm-size of the respondent.	E12
E.34	- Distribution of responses for changes in 'Intensive grazing' as an agricultural practice by the age of the respondent.	E13
E.35	- Distribution of responses for changes in 'Fenced riparian strips for stock exclusion' as an agricultural practice by the farm-size of the respondent.	E13

- | | | |
|-------------|---|-----|
| E.36 | - Distribution of responses for changes in 'Pesticide management programmes' as an agricultural practice by the stakeholder group of the respondent. | E13 |
| E.37 | - Mean response for level of change in 'Pesticide management programmes' as an agricultural practice by the number of professional affiliations held by the respondent. | E14 |
| E.38 | - Distribution of responses for changes in 'Increased fertiliser management' as an agricultural practice by the stakeholder group of the respondent. | E14 |

List of Tables

2.1	- Comparison between Douglass (1984) approaches to agricultural sustainability and general terms used in sustainability literature.	23
2.2	- Various types of objectives involved in the agricultural system proposed by Lowrance (1990).	33
2.3	- Horizontal scale within agriculture and dominant constraint at each level.	37
2.4	- Comparison of definitions of 'sustainable agriculture.'	46
4.1	- Advantages and disadvantages of mail surveys (adapted from MUIED 1994).	77
4.2	- Scale of response to questions in Part II of all surveys and response value assigned.	81
4.3	- References for questions in Part II of surveys covering ideal practices.	82-83
4.4	- Scale of response to questions in Part III of all surveys and response value assigned.	85
4.5	- Scale for coding of question 'Do you think agriculture needs to become more environmentally friendly?'	92
4.6	- Scale of coding for questions asking 'have you heard of the Resource Management Act' and 'have you heard of the term sustainability.'	92
4.7	- Scale of coding for questions asking 'outline the purpose of the Resource Management Act' and 'please describe your understanding of the term sustainability.'	93
4.8	- Methods of statistical analysis and explanation of sections of the survey.	94
5.1	- Perceived characteristics of sustainable agriculture by professional staff respondents.	97
5.2	- F-ratios and levels of significance for questions in Part I of the conventional and organic farmer surveys.	105
6.1	- F-ratios and levels of significance for questions on 'Opinions on Sustainable Agriculture' in all surveys.	113
7.1	- Scale for level of change in agricultural practices for Part IV of farmer surveys and response values assigned.	134
7.2	- F-ratios and levels of significance for reported practices termed 'Inputs' in conventional and organic farmer surveys.	137
7.3	- F-ratios and levels of significance for reported practices termed 'Resource Use' in conventional and organic farmer surveys.	145
8.1	- F-ratios and levels of significance for reported practices termed 'Management Practices' in conventional and organic farmer surveys.	148
9.1	- Economic barriers to the implementation of sustainable agriculture identified by all survey respondents.	168
9.2	- Education barriers to the implementation of sustainable agriculture identified by all survey respondents.	172
9.3	- Attitudinal barriers to the implementation of sustainable agriculture identified by all survey respondents.	176
9.4	- Institutional and legal barriers to the implementation of sustainable agriculture identified by all survey respondents.	180
9.5	- Physical and technical barriers to the implementation of sustainable agriculture identified by all survey respondents.	182
10.1	- References for the eight implementation methods queried.	186
10.2	- F-ratios and levels of significance for responses to questions on implementation methods by all respondents.	190

Glossary of Abbreviations

The following are the abbreviations used commonly throughout this thesis, along with their meaning in full.

BDGFA	-	Biodynamic Gardening and Farming Association
CRI	-	Crown Research Institute
ICRAF	-	International Centre for Research in Agroforestry
IFOAM	-	International Federation of Organic Agriculture Movements
IUCN	-	The World Conservation Union
LISA	-	Low-Input Sustainable Agriculture
MAF	-	Ministry of Agriculture and Fisheries
MfE	-	Ministry for the Environment
MUIED	-	Massey University Institute for Executive Development
NZBPCC	-	New Zealand Biological Producers and Consumers Council
NZFFA	-	New Zealand Farm Forestry Association
RMA	-	Resource Management Act 1991
SCGSLMR	-	Strategic Consultative Group on Sustainable Land Management Research
USDA	-	United States Department of Agriculture
WCED	-	World Commission on Environment and Development