Farmer Surveys and Rural Monitoring

Environmental Beliefs and Farm Practices of New Zealand Organic, Conventional and GE Intending Farmers

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Preface

In the year 2000, survey information was gathered on the attitudes and opinions of farmers and growers towards genetic engineering and organic production. This report is the second of two derived from that survey. Here, the responses are used to examine three types of farmers: those using organic methods, conventional farmers, and those intending to use gene technology. The focus is on differences in environmental values, farming practices and views on the consequences of each farming technique. The results will be of interest to those concerned about technology change in primary production and policy issues relating to sustainable agriculture.

Ross Cullen
Director

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Summary

The main objective of this report was to deepen our understanding of the different types of farmers and growers in New Zealand primary production with respect to novel technologies. It provides supplementary analysis of data from an AERU survey of 656 farmers and growers published in 2000 (Cook et al., 2000). The report develops a profile of three types of farmers and growers, namely: organic farmers, conventional farmers and GE intending farmers. In addition, it describes beliefs about nature, environmental values, reports of actual farming practices and the perceived consequences of each practice. Throughout it draws attention to how responses differ for the three farmer types. Data were examined to construct the profiles presented below.

Profile of Each Farmer Type

Organic	Conventional	GE Intending
Favourable response towards: • Organic methods • Keep NZ GE free Unfavourable response towards: • Purchasing GM food • Using gene technology. Typically horticulture Lowest gross farm income	Favourable response towards: • Organic methods • Keep NZ GE free Unfavourable response towards: • Purchasing GM food • Using gene technology Highest proportion of females Typically pastoral	Favourable response towards: • Purchasing GM food • Using gene technology Unfavourable response towards: • Keep NZ GE free Highest proportion of males Typically dairy Highest farm income

The results on environmental values showed that, generally, there was a consistent pattern of organic farmers having environmental values which accorded equal moral weight to all life forms, emphasised co-operation with nature and acknowledged that nature has intrinsic values independent of human valuation. Conventional farmers and GE intending farmers also have sensitivity to the environment, but not to the same degree. The key difference was not that different farmer types adhered to different attitudes to the environment, but that strength of the belief was significantly stronger for the organic farmers.

The results on the perceived influence of consumer demand on farming practices indicated that organic farmers were more influenced by the perceived demands of consumers, especially concerning environmental practices and the reduced use of chemicals. The results relating to farming practices are consistent with the results on stated environmental values.

The discussion focuses on the sizes of each group, how they can best be approached, and considers policy issues relating to sustainable agriculture.

Chapter 1
Introduction

This report provides supplementary analysis of data from an AERU survey of farmers and growers published in 2000 (Cook et al., 2000). That report investigated the decisions of farmers and growers in relation to their intentions to (i) use gene technology (ii) purchase GM food and (iii) use organic methods. That report was significant in that it presented the views of farmers and growers on the issue of novel technologies in agriculture and thereby enabled their views to have input into the policy debate about the place of new technology in New Zealand. There has been little research of this type on farmers and growers either in New Zealand or in any other country.

In that research a model of farmer/grower intentions was constructed using the Theory of Planned Behaviour (Ajzen, 1991). Questionnaire items were developed to test the model and in May 2000 a questionnaire was posted to 1,950 New Zealand farmers and growers from which 656 useable responses were received giving an adjusted response rate of 35 per cent. The Theory of Planned Behaviour provided an appropriate guiding framework for the model, as it attempted to understand farmer/grower intentions by matching broad stated intentions (e.g., 'I intend to use organic methods') with a range of other attitudes and beliefs. This allows a subtle and complex analysis that links stated intentions with other forms of evidence to give greater confidence in predictions of future behaviour.

The main findings were that 21 per cent of farmers and growers intended to use gene technology and 12 per cent to purchase GM food in comparison with the larger proportion of 37 per cent that intended to use organic methods. Very few intended to do both. In addition, many farmers and growers had a negative intention towards using gene technology or purchasing GM food. When asked whether they agreed or disagreed that "New Zealand should try and achieve GE free status" most agreed (49 per cent) some disagreed (32 per cent) and 19 per cent neither agreed nor disagreed. General attitude towards each of the three intentions was an important component in all the models – indicating that farmers/growers had a consistent overall attitude towards these new technologies and that this attitude carried through to their subsequent actions (while this seems obvious, some survey work shows the opposite – that what people say and what they do are at odds). How farmers/growers thought their peers felt about issues (subjective normative pressure (SN)) was important in two models, and the degree to which farmers/growers thought they could exert personal control over performing the activity (PBC) was important in one model. Overall, the results supported the hypothesised models, and the amount of variance explained (R^2 values) indicated good model fit comparable with similar research related to the topic areas.

A strong relationship was also found between eight general consequences of using gene technology and farmer and grower attitudes towards using the technology and attitudes towards purchasing GM food. Again this supported the theoretical approach of the study. In addition, a significant relationship was found between ten general consequences of using organic methods and farmer and grower attitudes towards using organic methods.

Overall, the survey found that farmers and growers who intended to use gene technology and farmers and growers who intended to use organic methods were different. Their views, preferences, practices and intentions were divergent in many respects, however, central to the decision making processes of each were commonly held *consequences* that were very influential on their decisions to use gene technology, purchase GM food, or use organic methods. The report examined how intentions might be influenced and it discussed policy

implications. The results of that study showed that 49 per cent of farmers and growers surveyed indicated a desire for New Zealand becoming gene technology free, and those with a definite intention clearly favoured using organic methods. Thus widespread use of organic methods with a small gene technology sector would be the development scenario for New Zealand favoured by farmers and growers. This claim rests on the assumption that it is likely that in future there will be movement of farmers from the conventional group to either the use of gene technology (the 21 per cent who reported a positive intention to use it) or the use of organic methods (37 per cent who reported a positive intention to use it).

The original report did not examine in detail the differences *between* farmers and growers in terms of their intentions. The main research objective then was to use the whole sample to examine the three models of intention. Clearly evident were the presence of different approaches, attitudes and intentions towards novel technologies (gene technology and organic methods). This report contrasts the differences among different types of farmers and growers. The main objective here is to deepen our understanding of the different types of farmers and growers in New Zealand primary production with respect to novel technologies. The report develops a profile of three types of farmers and growers. In particular, it describes beliefs about nature, environmental values, and reports of actual management practices and draws attention to how these differ for the three groups.

Examining different types of farmers and growers is important for two main reasons. First, the initial report contained data that indicated that different types of farmers have fundamentally different farming practices. If these have different environmental consequences then it is important that we can identify the farmers engaging in such practices. Information about the environmental consequences of different approaches to the use of novel technology is very timely, given that the sustainability of primary production is a major concern. Second, it may be that the different farmer types have different views about nature. If different beliefs are found then this suggests that there is a major change occurring in primary production which needs to be monitored.

Chapter 2
Survey Results Broken Down by Farmer Type

2.1 Introduction

The results presented in this chapter examine the main findings from the survey broken down by farmer and grower type (hereafter referred to as farmers). The three types of farmer were: organic farmers, conventional farmers and GE intending farmers. First, the attitudes and intentions of farmers that are used to assign them to these categories are examined. Having established these categories as robust, the characteristics of farmers in each category are examined. This includes information on the characteristics of respondents, the types of farm production, and farm characteristics. Next, the differences in farmer beliefs about the environment and practices relating to chemical use are considered. Finally, farmers' understanding of the likelihood and desirability of consequences of gene technology and organic methods are examined. In general, the focus will be on statistically significant differences between the three farmer types, and T tests (unequal variance) and Chi Square tests are used in this regard. Consideration is given to interaction effects between the variables used and farm type. Appendix 1 reports the details relating to these results.

2.2 A Description of Three Types of Farmer

The 656 farmers and growers were classified into three types, namely: organic farmers, GE intending farmers and conventional farmers. The organic farmers comprised 64 people (ten per cent of the sample) who indicated that they undertook 'the production of organic produce' on their farms. Only six of these (just under one per cent of all respondents) had certification of their organic status, which corresponds with estimates of the number of farmers certified (one per cent of all New Zealand farmers and growers). The GE intending farmers (114, 17 per cent) were those that stated they had intentions (very strong, strong or just an intention) of using gene technology. The remaining (478, 73 per cent) were those who were neither organic nor intending to use gene technology and were placed into the largest farmer type of conventional farmers.

This first section provides data which confirms the robustness of the categorisation into three types of farmers. It focuses on attitudes and intentions, and on respondent and farm characteristics. In effect this section develops a profile of each type of farmer.

2.2.1 Intention and Attitude Differences

The first element to these profiles are the three different intentions (to use gene technology, to use organic methods, to purchase GM food). The three types have intentions which mutually exclude each other.

The different intentions of the three farmer types towards the use of gene technology, use of organic methods and their intention to purchase GM are shown in Table 1. Respondents were asked to rate their intentions on a scale from one to seven. For the purposes of analysis scores were changed to –3 and +3 corresponding to 'I have a very strong intention not to use gene technology' to 'I have a very strong intention to use gene technology'. In the following presentation the mean score is reported along with the standard deviation.

For farmers involved with organic farming there was a greater intention of not using gene technology (–1.7, sd 1.44), and farmers with GE intentions were prepared to use gene technology (1.33, sd 0.6). Conventional farmers were mid way between the organic and GE intending farmers, though overall they are on the side of not using gene technology (-0.98, sd 1.28). Not surprisingly organic farmers had the strongest intentions of using organic methods (+1.43, sd 1.71). However, the position of the other farmers was closer to zero in relation to intention to use organic methods (conventional +0.26, sd 1.08; GE intending –0.19, sd 1.2). For intention to buy GM food, organic farmers were not intending to buy it (-1.83, sd 1.41) as were conventional farmers to a lesser degree (-1.03, sd 1.27). GE intending farmers had some intention of purchasing GM food (+0.46, sd 0.69).

Table 1: Intentions to Use Gene Technology, Organic Methods and GM Food by Farmer Type

Intention		Organic (1)	Convent -ional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$)
To use gene Technology	$\bar{x}$	-1.7	-0.98	1.33	-0.64	1-2, 1-3, 2-3
	sd	1.44	1.28	0.6	1.53	
	n	63	472	114	649	
To use organic Methods	$\bar{x}$	1.43	0.26	-0.19	0.29	1-2, 1-3, 2-3
	sd	1.71	1.08	1.2	1.24	
	n	63	473	114	650	
To purchase GM food	$\bar{x}$	-1.83	-1.03	0.46	-0.85	1-2, 1-3, 2-3
	sd	1.41	1.27	0.69	1.36	
	n	64	472	114	650	

Farmers were asked to rate their general attitudes (in contrast to their intention), towards gene technology, organic methods and the purchase of GM foods. For each topic the respondents were asked to provide a rating on a seven-point scale, the numbers adapted for analysis, to range from (-3) 'Extremely unfavourable' to (+3) 'Extremely favourable'. The findings from this question are presented in Table 2. The organic farmers (-1.32, sd 1.84) and conventional farmers (-0.93, sd 1.62) had an unfavourable attitude towards gene technology. Their views were significantly different from the GE intending farmers (+1.31, sd 1.06) who had a positive attitude toward using gene technology. Organic farmers (+1.84, sd 1.48) had a very favourable view about the use of organic methods. Conventional farmers (+0.70, sd 1.4) also maintained a favourable view, while GE intending farmers' (+0.21, sd 1.32) views were closer to 'neither favourable nor unfavourable' towards organic methods. The attitudes towards the purchasing of GM food amongst the three farmer types were significantly different in two instances. First, organic farmers (-1.63, sd 1.81) had a highly unfavourable view compared to the favourable view of GE intending farmers (+0.44, sd 1.03). Second, conventional farmers (-1.22, sd 1.52) also had an unfavourable view about purchasing GM food as opposed to the favourable view of GE intending farmers.

Table 2: Attitudes Toward Gene Technology, Organic Methods and GM Food by Farmer Type

Attitude towards		Organic (1)	Conven-tional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$)
Using gene technology	$\bar{x}$	-1.32	-0.93	1.31	-0.58	1-3, 2-3
	sd	1.84	1.62	1.06	1.78	
	n	62	474	111	647	
Using organic methods	$\bar{x}$	1.84	0.70	0.21	0.73	1-2, 1-3
	sd	1.48	1.4	1.32	1.45	2-3
	n	64	475	110	649	
Purchasing GM food	$\bar{x}$	-1.63	-1.22	0.44	-0.98	1-3, 2-3
	sd	1.81	1.52	1.03	1.62	
	n	64	477	111	652	

When questioned about whether they felt New Zealand should try to adopt a GE free status, the variation in views was in line with the previous results (a similar rating scale was used). Table 3 shows that organic farmers agreed (+1.29, sd 1.82) that New Zealand should achieve a GE free status. Conventional farmers also indicated that they agreed (+0.76, sd 1.71) about a future GE free status for New Zealand, but not as strongly as organic farmers. The farmers with intentions to implement gene technology methods disagreed (-1.08, sd 1.32) that New Zealand should adopt a GE free status.

Table 3: Level of Approval with GE Free Status by Farmer Type

Statement		Organic (1)	Conven-tional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$) unequal
NZ should try to achieve GE free status	$\bar{x}$	1.29	0.76	-1.08	0.49	1-2, 1-3, 2-3
	sd	1.82	1.71	1.32	1.81	
	n	63	468	113	644	

The results presented in Tables 1 to 3 largely reflect the basis of our division of farmers into three farmer types. Statistical tests show that each group has different scores for the three intentions, for attitudes toward the new technologies, and for level of approval for GE free status. The remainder of this first section presents additional data that verifies this basis of classification into the three types and tells us more about each farmer type.

2.2.2 Respondent and Farm Characteristics

It is necessary to explore possible differences among the farmer types as they relate to respondent and farm characteristics. It is important for the following presentation to distinguish between *farmer* type (GE intending, organic or conventional) and *farm* type (horticultural, pastoral etc…). Occasionally we will present data on possible interaction effects between farm type and the selected variable in order to confirm that the observed differences between farmer types are not due to differences in farm type.

Table 4 shows the average ages of respondents, the number of years they have been farming, and their personal income, for each of the three farmer types. Overall, the average age of

farmers across the three groups was around 51 years of age. There were no significant differences in ages between the types. The time respondents had been in farming was over 30 years for each farmer type. A significant difference in years of farming appears to exist between organic farmers (34.26 years, sd 19.36) and GE intending farmers (41.05 years, sd 15.6). However, tests for interaction between years farming and type of farm showed that farm type rather than farmer type actually determined the difference (see Appendix 1). The average personal incomes for the farmer types ranged from $44,605 for organic farmers to $51,683 for GE intending farmers. This, however, was not a significant income differences between the farmer types. In summary, for age, years farming, and personal income, there were no significant differences between the farmer types.

Table 4: Farmer Age, Experience and Personal Income by Farmer Type

Personal Details		**Organic (1)**	**Convent. (2)**	**GE Intending (3)**	**Total**	**T-tests ($p < 0.05$)**
Age	$\bar{x}$	51.14	50.85	51.56	50.1	
	sd	11.14	11.5	9.54	11.14	
	n	58	460	108	626	
Years farming	$\bar{x}$	34.26	38.33	41.05	38.42	1-3
	sd	19.36	17.69	15.6	17.57	
	n	62	463	113	638	
Personal Income ($)	$\bar{x}$	44,605	49,867	51,683	49,780	
	sd	54,681	63,632	46,625	60,052	
	n	39	355	90	484	

Respondents were also asked to indicate their highest level of education. Table 5 shows that for all farmer types most had high school qualifications, rather than tertiary related qualifications. There were no statistically significant differences between the three farmer types and their levels of education.

Table 5: Education Levels by Farmer Type

Education Level	**Organic (n=64)**		**Convent-ional (n=478)**		**GE Intending (n=114)**		**Total (n=656)**		**Chi square test**
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	
Primary school	1	2	16	3	4	3	21	3	Between school qualification and the remainder: 0.23, df 2 $p > 0.05$
High school	18	28	118	25	22	19	158	24	
School certificate	7	11	73	15	17	15	97	15	
UE or 6th from certificate	8	12	61	13	20	18	89	14	
HSC, bursary, scholarship	3	5	16	3	3	3	22	3	
Sub-total (1)	***37***	***58***	***284***	***59***	***66***	***58***	***387***	***59***	
Diploma or trade cert.	9	14	116	24	31	27	156	24	
Bachelors degree	9	14	42	9	8	7	59	9	
Postgraduate qualification	6	9	17	4	6	5	29	4	
Sub-total (2)	***24***	***37***	***175***	***37***	***45***	***39***	***244***	***37***	
No response	*3*	*5*	*19*	*4*	*3*	*3*	*25*	*4*	
Total	**64**	**100**	**478**	**100**	**114**	**100**	**656**	**100**	

Table 6 shows the gender breakdown of the respondents and their family connection to farming broken down by the three farmer types. Out of the 656 respondents, 139 (21 per cent) were female. There was a significant difference in the proportions of males and females across the three farmer types. Overall, the proportion of female respondents was highest for conventional farmers (24 percent). Only nine percent of GE intending farmer respondents were female. There were no significant differences between farmer types and whether their parents were farmers.

Table 6: Gender and Family Farming History by Farmer Type

Personal Details		**Organic (n=64)**		**Convent. (n=478)**		**GE Intending (n=114)**		**Total (n=656)**		**Chi square test**
		No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	
Gender	Male	49	77	353	74	104	91	506	77	13.83
	Female	13	20	116	24	10	9	139	21	df 2
	No response	*2*	*3*	*9*	*2*	*0*	*0*	*11*	*2*	$p < 0.05$
	Total	**64**	**100**	**478**	**100**	**114**	**100**	**656**	**100**	
Were parents farmers	Yes	22	34	111	23	22	19	155	24	5.23
	No	42	66	361	76	92	81	495	75	df 2
	No response	*0*	*0*	*6*	*1*	*0*	*0*	*6*	*1*	$p > 0.05$
	Total	**64**	**100**	**478**	**100**	**114**	**100**	**656**	**100**	

Table 7 presents data on type of farm by farmer type and highlighting is used in the table to show the more important findings for the major groups of horticulture, pastoral and dairy. The chi square test shows that there were more organic farmers on horticultural farms, more conventional farmers on pastoral farms, and more conventional and GE intending farmers on dairy farms. The significance of these results underlines why interaction effects for farmer type and farm type in other sections is necessary.

Table 7: Farm Type by Farmer Type

Farm Activity	**Organic (n=64)**		**Convent-ional (n=478)**		**GE Intending (n=114)**		**Total (n=656)**		**Chi square test**
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	
Horticulture	16	25	56	12	17	15	89	14	Excluding
Pastoral	31	48	262	55	49	43	342	52	specialist
Specialist livestock	8	13	18	4	4	4	30	5	livestock
Dairy	7	11	122	25	37	32	166	25	and arable
Arable	2	3	14	3	6	5	22	3	18.23 df 4
No response	*0*	*0*	*6*	*1*	*1*	*1*	*7*	*1*	$p < 0.05$
TOTAL	**64**	**100**	**478**	**100**	**114**	**100**	**656**	**100**	

Table 8 shows average farm size and gross farm income. The average size of farms ranged from 211 to 338 hectares and there was no significance difference across farmer types. There were significant differences across farmer types for average farm incomes. Organic farmers had the lowest incomes. GE intending farmers had the highest incomes, while conventional farmers were in the middle. While the difference between conventional farmers and GE

intending farmers is not significant, the difference between organic farmers and the other two types is significantly different.

Table 8: Average Farm Size and Average Income by Farmer Type

Farm Details		Organic (1)	Conven-tional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$)
Farm size (Hectares)	$\bar{x}$	210.6	251.44	338.39	262.95	
	sd	634.14	444.64	691.72	516.5	
	n	61	470	114	645	
Gross farm income ($)	$\bar{x}$	148,718	228,806	471,240	270,594	1-2, 1-3
	sd	212,506	323,049	1,726,537	822,695	
	n	39	352	97	488	

This section started by presenting data on farmer intentions which reflected the division of the respondents into three farmer types. Then attitudinal data were presented to support the classification. Finally, respondent and farm data helped to delineate some of the characteristics of each type of farmer. The results are summarised in Table 9 to provide a profile of each farmer type.

Table 9: Profile of Each Farmer Type

Organic	Conventional	GE Intending
Favourable response towards: • Organic methods • Keep NZ GE free Unfavourable response towards: • Purchasing GM food • Using gene technology. Typically horticulture Lowest gross farm income	Favourable response towards: • Organic methods • Keep NZ GE free Unfavourable response towards: • Purchasing GM food • Using gene technology Highest proportion of females Typically pastoral	Favourable response towards: • Purchasing GM food • Using gene technology Unfavourable response towards: • Keep NZ GE free Highest proportion of males Typically dairy Highest farm income

These profiles show some similarity between organic and conventional farmers. Perhaps unsurprisingly, attitudes to organic methods are more favourable in the horticultural sector. The large group of conventional farmers occurs in the pastoral sector, but while this group was sympathetic to organic methods and GE free status for New Zealand, the adoption of organic methods has not taken place. The most definitive group were those intending to use gene technology. This group included typically dairy farmers with high farm income and has the highest proportion of male respondents.

2.3 Environmental Values and Farming Practices

Environmental values were measured by having respondents indicate their level of agreement with four statements. Each of the statements represented an ethical or moral position relating to the environment. The four positions were: 'anthropocentricism' (nature exists for human use); 'deep ecology' (all life forms are equal and need to be accorded an equal moral weight); 'ecofeminism' (rather than controlling nature we need to learn to co-exist with the natural environment); and 'ecocentrism' (all of nature posses intrinsic values which are independent of human valuation). These attitudes are not intended to display a continuum of values, rather, they are derived from substantial international research outlined in the earlier report (Cook et al. 2000). Table 10 shows the data for each environmental attitude. Measurements were taken on a seven-point scale, the numbers modified for analysis to range from (-3) 'Very strongly disagree' to (+3) 'Very strongly agree'.

When considering the belief that nature exists for human use (anthropocentrism) there were no significant differences in the scores for each farmer type: generally they disagree slightly with the viewpoint. The 'deep ecological' position, that all life forms are equal and need to be accorded an equal moral weight, was strongly supported by organic farmers (+1.84, sd 1.48). Conventional farmers were neutral (-0.02, sd 1.62) and GE intending farmers slightly agreed (+0.21, sd 1.32). All farmer types agreed to an 'eco-feminist' position that rather than controlling nature we need to co-exist with it, but organic farmers and conventional farmers had significantly higher scores (1.73 and 1.38 respectively) than those of GE intending farmers. Each of the farmer types also agreed with the 'eco-centrism' position, that nature possesses intrinsic values independent of human valuation. Again, organic farmers had the highest score (+1.44, sd 1.38) ahead of conventional farmers (+0.99, sd 1.97) and GE intending farmers (+0.21, sd 1.32).

Table 10: Environmental Values by Farmer type

Environmental Value		Organic (1)	Convent -ional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$)
Nature exists for human use.	$\bar{x}$	-0.14	-0.53	0.21	-0.46	
	sd	1.96	1.7	1.32	1.7	
	n	64	473	110	650	
All life forms are equal and need to be accorded an equal moral weight.	$\bar{x}$	1.84	-0.02	0.21	0.73	1-2, 1-3, 2-3
	sd	1.48	1.62	1.32	1.45	
	n	64	471	110	649	
Rather than controlling nature we need to learn to co-exist with the natural environment.	$\bar{x}$	1.73	1.38	0.83	1.32	1-3, 2-3
	sd	1.33	1.29	1.34	1.34	
	n	63	473	112	648	
All nature possesses intrinsic values which are independent of human valuation.	$\bar{x}$	1.44	0.99	0.21	0.97	1-2, 1-3, 2-3
	sd	1.38	1.27	1.32	1.29	
	n	61	455	110	624	

Concern for the environment was established by asking respondents to agree or disagree the statement: "I believe I am the type of person who is concerned about the environment". Table 11 shows there are no farmer types which disagreed with this statement, that is, they all agree that they are concerned about the environment. Organic farmers rated the statement highest (+2.16, sd 0.89), and they were significantly higher in their concern for the environment than conventional farmers (+1.83, sd 1.01) and GE intending farmers (+1.69, 0.92).

Table 11: Rating of Concern for the Environment

	Organic (1)	Convent -ional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$)
$\bar{x}$	2.16	1.83	1.69	1.83	1-2, 1-3
sd	0.89	1.01	0.92	1.78	
n	64	475	113	652	

Generally, there is a consistent pattern in these results showing that organic farmers have environmental values which accord equal moral weight to all life forms, emphasise co-operation with nature and acknowledge that nature has intrinsic values independent of human valuation. This combination of values could be summarised as exhibiting a high level of sensitivity to nature. Consequently, organic farmers gave highest ratings for concern about the environment. Conventional farmers and GE intending farmers also have sensitivity to the environment, but not to the same degree. The key difference was not that different farmer types adhered to different attitudes to the environment, but it was the strength of the belief was significantly stronger for the organic farmers. For some dimensions, conventional farmers had stronger beliefs than GE intending farmers.

The influence of consumers on the practices of farmers was assessed in two areas. First, the farmers were asked to rate influences of consumer demand for environmentally friendly production. Second, they were asked to rate the influence of consumer demand for produce with less chemicals. In both cases respondents were asked to rate the level of influence they attributed to consumer demand on a seven-point scale anchored by (1) “Not at all influential” to (7) “Extremely influential”.

Table 12 shows that consumer demand for environmentally friendly production was scored 4.97 by organic farmers which is equivalent to “more than moderately influential”. For conventional farmers the score was 3.99 (sd 1.58) or “moderately influential”, and for GE intending farmers the score was 3.55 (sd 1.6) or between moderately and less than moderately influential. All these scores are significantly different. The influence of consumer demand for produce with less chemicals was again “more than moderately influential” for organic farmers (5.12, sd 1.59), “moderately influential” for conventional farmers (4.3, sd 1.63), with a similar result for GE intending farmers (4.1, sd 1.67).

The results on the influences of consumer demand indicate that organic farmers are more responsive to the demands of consumers, especially concerning environmental practices and the reduced use of chemicals.

Table 12: Influence of Consumer Demand on Farming Practice by Farmer Type

Consumer Influence		Organic (1)	Convent-tional (2)	GE Intending (3)	Total	T-tests ($p < 0.05$)
Influence of demand for environmentally friendly production	$\bar{x}$	4.97	3.99	3.55	4	1-2, 1-3, 2-3
	sd	1.72	1.58	1.6	1.63	
	n	59	448	110	617	
Influence of demand for produce with less chemicals	$\bar{x}$	5.12	4.3	4.1	4.34	1-2, 1-3
	sd	1.59	1.63	1.67	1.65	
	n	58	446	111	615	

Respondents were also asked to indicate the actions they undertook on their farms to either reduce or replace the use of chemicals. They were asked to indicate which of 15 actions had been done on their farm. Table 13 presents the relevant data and bolding is used to indicate which farmer type had the highest proportion that selected the given action. The percentage values displayed in the table do not add to 100 per cent because respondents were able to indicate use of more than one practice. The percentage given represents the proportion of participation in that practice for each farmer type.

Across all the farmer types the most common practices used were: monitoring the use of chemicals or fertilisers (46 per cent), using animals to manage weeds (45 per cent), being selective over pharmaceutical treatments (41 per cent), and being selective over pest or disease treatments (41 per cent). Overall, the table indicates that many of the methods more common to organic and IPM systems (e.g., adopted practices to avoid herbicides, encourage insect predators) were used across all the farmer types, but, unsurprisingly, these actions were selected significantly more frequently by the organic farmer type. Generally, about one half of the organic farmers said they used the seven practices typical of organic or IPM systems. Tests for an interaction effect between practices and farm type showed that five of the seven practices were determined by farmer type and therefore the scores for two of the practices (to avoid herbicides, have been selective over food for animals) were determined by farm type.

Farming practices were further assessed by four additional questions. The first question assessed changes in expenditure on agrochemicals. The next three questions assessed how dependent the farm was on agrochemicals for the management of pests, the management of weeds and the level of dependency on manufactured fertilisers. These results are shown in Table 14.

Table 13: Practices to Reduce or Replace Chemicals by Farmer Type

Practices used	Organic (n=64)		Convent-ional (n=478)		GE Intending (n=114)		Total (n=656)		Chi square Test
	No.	%	No.	%	No.	%	No.	%	
Received professional advice on the use, storage or disposal of chemicals	16	25	157	33	42	37	215	33	2.61, df 2, p > 0.05
Monitored use of chemicals or fertilisers	23	36	217	45	59	52	299	46	4.16, df 2, p > 0.05
Monitored soil for chemical residues	10	16	79	17	13	11	102	16	1.84, df 2, p > 0.05
Monitored water for levels of chemical residues	14	22	60	13	14	12	88	13	4.38, df 2, p > 0.05
Adopted practices or treatments to avoid or replace the use of certain insecticides	**34**	**53**	155	32	39	34	228	35	**10.68, df 2, p < 0.05**
Adopted practices or treatments to avoid or replace the use of certain herbicides	**39**	**61**	161	34	31	27	231	35	**22.27, df 2, p < 0.05**
Applied manure to improve soil, to avoid or replace the use of manufactured fertilisers	**35**	**55**	131	27	30	26	196	30	**20.89, df 2 p < 0.05**
Grown legumes to improve soil, to avoid or replace the use of manufactured fertilisers	**24**	**38**	81	17	15	13	120	18	**18.39, df 2 p < 0.05**
Adopted practices to encourage natural insect predators	**30**	**47**	103	22	23	20	156	24	**20.96, df 2 p < 0.05**
Used crop rotation to manage pest or week problems	18	28	93	19	30	26	141	21	1.81,df 2 p > 0.05
Used cultivation to manage pest or weed problems	23	36	137	29	37	32	197	30	2.96, df 2 p > 0.05
Used animals to manage pest or weed problems	**40**	**63**	211	44	43	38	294	45	**10.5, df 2 p < 0.05**
Been selective over food or food additives for animals	**28**	**44**	142	30	23	20	193	29	**11.04, df 2 p < 0.05**
Been selective over pharmaceutical treatments for animals	31	48	195	41	42	37	268	41	2.82, df 2 p > 0.05
Been selective over treatments for pest or disease controls for animals	29	45	199	42	40	35	268	41	2.21, df 2 p > 0.05

Respondents were asked to indicate their changes in expenditure on agrochemicals over the last five years. They were asked to select from a rating scale of seven options (one to seven), the numbers modified for analysis to range from (+3) "A very large increase in expenditure" to (-3) "A very large reduction in expenditure". Organic farmers (-0.96, sd 1.39) indicated that they had reduced expenditure on agrochemicals in the last five years. While conventional (-0.4, sd 1.02) and GE intending farmers (-0.1, 1.97) had ratings closer to there being "no reduction or increase in expenditure" over the past five years.

The next three assessments were on the level of dependency on chemicals for pest control, weed control, and on manufactured fertilisers. For each, respondents were asked to indicate their level of dependency from a scale of (1) "Not dependent at all" to (7) "Extremely dependent". Regarding chemicals for pest control the dependency ratings for the three farmer types were significantly different in each case. For organic farmers - 2.14 ("less than moderately dependent"), for conventional farmers - 2.66 (near to "moderately dependent"), and for GE intending farmers - 3.06 (near to 'more than moderately dependent", sd 1.84). For dependency on chemicals for weed control, GE intending farmers were again highest with a rating of 3.83 which is near to (4) "more than moderately dependent". For dependency on manufactured fertilisers GE intending farmers had the highest dependency (5.1, sd 1.48) and organic farmers had a much lower score of 2.7. These results show GE intending farmers exhibit the greatest levels of dependency on chemicals, followed by conventional and then organic farmers. All of these differences were statistically significant. Organic farmers are reporting that they have reduced expenditure on chemicals and this is consistent with the finding that they report lower levels of dependency on chemicals and manufactured fertilisers.

Table 14: Changes in Expenditure and Dependency on Chemicals in Last Five Years by Farmer Type

Agrochemicals		**Organic (1)**	**Convent-ional (2)**	**GE Intending (3)**	**Total**	**T-tests ($p < 0.05$)**
Increase or reduction in expenditure on chemicals.	$\bar{x}$ ***sd*** ***n***	-0.96 1.39 55	-0.4 0.95 461	-0.1 1.97 114	-0.4 1.02 630	1-2, 1-3, 2-3
Dependency on chemicals for pest control.	$\bar{x}$ ***sd*** ***n***	2.14 1.53 53	2.63 1.43 449	3.06 1.84 110	2.66 1.54 618	1-2, 1-3 2-3
Dependency on chemicals for weed control.	$\bar{x}$ ***sd*** ***n***	2.47 1.30 62	3.31 1.42 458	3.83 1.55 112	3.32 1.47 656	1-2, 1-3, 2-3
Dependency on manufactured fertilisers.	$\bar{x}$ ***sd*** ***n***	2.7 1.71 61	4.17 1.64 461	5.14 1.48 113	4.2 1.73 635	1-2, 1-3, 2-3

The results relating to farming practices show that organic farmers report the use of practices which are compatible with organic and IPM farming. In addition, they report that they have reduced both expenditure and dependency on chemicals. The results relating to farming practices are consistent with the results on environmental values.

2.4 Views on the Consequences of Gene Technology and Organic Methods

An important part of the method used was to understand what consequences farmers perceive might occur if they adopt novel techniques like GE or organic production. Two dimensions were investigated: likelihood of consequences occurring, and the desirability of consequences occurring.

A set of potential consequences of the use of gene technology was listed and respondents were asked, first, to indicate the likelihood of consequences occurring, using a seven-point scale (the scores were recoded to range from (-3) "Extremely Unlikely" to (+3) "Extremely Likely"). Second, respondents were asked to indicate the desirability of the consequences of gene technology. The scale used here was from (- 3) "Extremely Undesirable" to (+ 3) "Extremely Desirable". While the questions regarding desirability and likelihood of consequences were asked separately in the questionnaire, they have been presented side by side in Table 15.

The first consequence of gene technology for which respondents were asked to rate the likelihood and desirability was that of 'better quality food'. Organic and conventional farmers did not rate the desirability of GE providing better quality food much above being 'neither desirable nor undesirable' (organic, +0.16, sd 1.95; conventional, +0.39, 1.55). They also rated the likelihood of GE providing better quality food as being slightly below 'neither likely nor unlikely' (organic, -0.51, sd 1.9; conventional, -0.16, 1.7). Organic and conventional farmers' views were significantly different to GE intending farmers who presented a more confident view about better quality food arising from GE technologies. They saw that better food was 'desirable' to 'very desirable' (+1.57, sd 0.93), and that better food was 'likely' to 'very likely' (+1.50, 0.95). The results indicate that farmers who did not have an intention to use gene technology remained unsure about whether GE food will be better. In contrast, GE intending farmers were confident that better quality food is a desirable and likely consequence with the use of gene technology.

The next consequence was that of "new risks to public health". All the farmer types saw new public health risks as undesirable. Organic farmers rated the risks as significantly less desirable than the other two farmer types. Further differences in views appear when the farmer types considered the likelihood of new public health risks. Both organic (+1.05, sd 1.77) and conventional farmers (+0.74, sd 1.52) rate this consequence as close to "likely", in contrast to GE intending farmers (-0.75, sd 1.14) who tended towards it being unlikely.

Another perceived consequence of the use of gene technology was "enhanced economic growth for New Zealand". Organic farmers saw this being "neither desirable nor undesirable" (+0.20, sd 1.9), whereas conventional farmers were closer to agreeing that it was a "desirable" (+0.65, sd 1.48) consequence. Organic farmers saw economic growth was "unlikely" (-0.63, sd 1.74) to occur, and conventional farmers thought it was "neither likely nor unlikely" (-0.21, sd 1.49) to eventuate. GE intending farmers again displayed a confidence in gene technology that differed to the other types of farmers. They believed that enhanced economic growth for New Zealand was "very desirable" (+1.64, sd 0.87) and that it was a "likely" (+1.46, sd 0.93) consequence of gene technology.

The fourth consequence was "consumer acceptance of food produced using gene technology". Organic farmers saw this consequence as "undesirable (-1.00, sd 1.6) and "unlikely"(-1.00, sd 1.43). Conventional farmers were also on the negative side, though their views were closer to "neither desirable nor undesirable" (-0.35, sd 1.59) and "neither likely nor unlikely" (-0.49, sd 1.38). The farmers intending to use gene technology saw consumer

acceptance as desirable (+1.13, sd 0.9) but with only a marginal likelihood (+0.57, sd 1.00) that this would occur. There were significant differences between all the farmer types on desirability and likelihood.

The fifth consequence was "adverse effects on future generations" as a consequence of gene technology. All the farmer types saw this as an undesirable consequence, while organic farmers (-2.1, sd 1.33) saw it as more undesirable than both the other farmer types. When asked about likelihood of this consequence, organic (+1.1, sd 1.64) and conventional farmers (+0.66, sd 1.56) viewed it as "likely". GE intending farmers (-0.88, sd 1.02) held the view that it would be an "unlikely" consequence.

The consequence of "damage to ecological systems" was another area where all farmer types saw it as "very undesirable". Organic farmers (-2.26, sd 1.09) had the higher rating and GE intending farmers (-1.50, sd 1.23) the lower rating. As with previous results, organic (+ 1.31, sd 1.49) and conventional farmers (+0.89, sd 1.51) saw this potential negative effect as likely, while the GE intending farmers (-0.89, sd 1.06) viewed damage to ecological systems as an unlikely consequence of gene technology. There were significant differences between all the farmer types on desirability and likelihood.

"Increased food production" was the next consequence of gene technology considered. The response to this potential consequence from organic farmers was that it was "neither desirable nor undesirable" (-0.02, sd 1.77), but it was "likely" (+0.79, sd 1.64) to occur. Conventional farmers did have a marginally positive view on desirability (+0.50, sd 1.49), and also saw it as a "likely" consequence (0.99, sd 1.34). GE intending farmers were noticeably more positive in both the desirability (+1.65, sd 1.05) and the likelihood (+1.82, sd 0.81) of increased food production.

The last consequence of gene technology was personal health risk. All farmer types rated this as near to a "very undesirable" consequence, though only the views of organic and GE intending farmers were significantly different. Organic (+0.9, sd 1.83) and conventional farmers (+0.48, sd 1.58) saw a degree of likelihood in this consequence. GE intending farmers (-1.16, sd 1.26) believed that it was unlikely that gene technology would put their personal health at risk.

In summary, the views of the respondents regarding the desirable and likely consequences, of gene technology were largely representative of views expected for their farmer types. Of the eight consequences examined, four are negative (e.g., risks to public health, adverse effects on future generations) and the remaining four are positive (e.g., better quality food, enhanced economic growth). All the farmer types agreed that the negative effects were undesirable, and most of the positive effects were desirable. However, there is a striking pattern in the data. GE intending farmers rated the positive consequences as very desirable. Their desirability ratings were consistently much higher than either organic or conventional farmers. In contrast, the organic farmers rated the negative consequences as very undesirable. The data display a clear trend when likelihood of consequences occurring is examined. For seven out of the eight consequences, GE intending farmers rated the likelihood as opposite to the other two farmer types. This contrasts strongly with most of the results in this report. Usually the three farmer types hold a similar view, albeit with differing strength of agreement. In this case, the GE intending farmers hold firmly opposite views to the other farmers. They generally do not believe that negative consequences will occur. Even in the negative consequences, where all farmer types agree that the consequence is undesirable, the GE intending farmers see the consequence as unlikely.

Table 15: Assessment of the Consequences of Gene Technology by Farmer Type

Consequences		Desirability				Likelihood			
		Org (1)	Conv (2)	GE (3)	T-test p<0.05	Org (1)	Conv (2)	GE (3)	T-test p<0.05
Better quality food	$\bar{x}$	0.16	0.39	1.57	1-3	-0.51	-0.16	1.5	1-3
	sd	1.95	1.55	0.93	2-3	1.9	1.7	0.95	2-3
	n	61	456	113		63	471	114	
New risks to public health	$\bar{x}$	-1.98	-1.57	-1.55	1-2	1.05	0.74	-0.75	1-3
	sd	1.31	1.41	1.25	1-3	1.77	1.52	1.14	2-3
	n	61	455	113		64	471	114	
Enhanced economic growth for NZ	$\bar{x}$	0.2	0.65	1.64	1-3	-0.63	-0.21	1.46	1-3
	sd	1.9	1.48	0.87	2-3	1.74	1.49	0.93	2-3
	n	60	454	113		63	471	114	
Consumer acceptance of food produced using GE	$\bar{x}$	-1	-0.35	1.13	1-2	-1	-0.49	0.57	1-2
	sd	1.6	1.59	0.9	1-3	1.43	1.38	1	1-3
	n	61	454	113	2-3	63	469	113	2-3
Adverse effects on future generations	$\bar{x}$	-2.1	-1.73	-1.55	1-2	1.1	0.66	-0.88	1-3
	sd	1.33	1.39	1.37	1-3	1.64	1.56	1.02	2-3
	n	61	451	113		63	471	113	
Damage to ecological systems	$\bar{x}$	-2.26	-1.77	-1.5	1-2	1.31	0.89	-0.89	1-2
	sd	1.09	1.35	1.23	1-3	1.49	1.51	1.06	1-3
	n	61	450	113	2-3	64	472	113	2-3
Increased food production	$\bar{x}$	-0.02	0.5	1.65	1-2	0.79	0.99	1.82	1-3
	sd	1.77	1.49	1.05	1-3	1.64	1.34	0.81	2-3
	n	61	452	113	2-3	63	472	114	
Placing own health at risk	$\bar{x}$	-2.03	-1.78	-1.79	1-3	0.9	0.48	-1.16	1-3
	sd	1.57	1.38	1.29		1.83	1.58	1.26	2-3
	n	61	453	112		64	470	114	

A set of ten consequences of organic methods was listed and respondents were asked to indicate likelihood and desirability. The results are shown in Table 16.

The first consequence of organic methods examined was “increased production costs”. All farmer types saw this as undesirable, but GE intending farmers (-1.15, sd 1.29) more so than conventional farmers (0.98, sd 1.38). Organic farmers (+0.15, sd 1.84) thought that it was neither a likely nor unlikely consequence, while conventional farmers (+0.81, sd 1.55) and GE intending farmers (+1.03, sd 1.54) thought that organic methods would be likely to increase production costs.

The prospect of “better premiums for produce” was the second potential consequence of organic methods considered. There were similar views in the desirability of this consequence, and all farmer type ratings were positive (rating between ‘desirable’ and ‘very desirable’). Organic farmers (+1.4, sd 1.17) thought better premiums were likely. The other farmer types agreed but with less strength.

When asked whether they thought an “increased workload for farmers” as a consequence for farmers was desirable, all farmer types rated it as a close to “undesirable”. Organic farmers (-0.69, sd 1.26) views where significantly higher than GE intending farmers (-1.1, sd 1.32). All the farmer types believed that organic methods were “likely” to increase workload for farmers, though there were no significant differences.

The desirability of "reduced damage to ecological systems" as a consequence of organic methods was rated from "very desirable" by organic farmers (+1.97, sd 1.37), compared to between "desirable" and "very desirable" for conventional (+1.48, sd 1.28) and GE intending farmers (+1.33, sd 1.21). The likelihood of reduced damage to ecological systems was highest for organic farmers (+1.68, sd 1.3), moderate for conventional farmers (+1.01, sd 1.52), and slightly likely for GE intending farmers (+0.54, sd 1.31).

"Improved economic viability for farmers" was a desirable consequence of organic methods for all farmer types. As would be expected, the highest desirability was for organic farmers (+1.92, sd 1.16), followed by conventional farmers (+1.66, sd 1.12). Both were significantly higher than GE intending farmers (+1.37, sd 1.33). In terms of likelihood, organic farmers (+0.84, sd 1.38) exhibited an optimism, whereas conventional farmers (+0.03, sd 1.47) tended towards "neither likely or unlikely" and GE intending farmers (-0.4, sd 1.53) rated it as "slightly unlikely".

All farmer types indicated that it is "very desirable" to reduce the health risk for farmers who use organic methods. The highest desirability was from organic farmers (+2.16, sd 1.32) which was significantly higher than the score for the other two types. All the farmer types saw that it was likely that organic methods will reduce health risks for farmers. However, the likelihood was rated highest by organic farmers (+1.63, sd 1.6), ahead of conventional farmers (+0.99, sd 1.48), and GE intending farmers (+0.43, sd 1.43).

The next consequence of organic methods is the reduction of chemicals in food. Again, all farmer types saw this as very desirable, with organic farmers (+2.16, sd 1.35) featuring a significantly higher rating than GE intending farmers (+1.57, sd 1.02). Organic farmers (+2.13, sd 1.30) had the highest likelihood, ahead of conventional farmers (+1.45, sd 1.44) and GE intending farmers (+1.2, sd 1.15).

All farmer types consider that a desirable consequence to organic methods was to avoid the problems of conventional production. Organic farmers (+1.79, sd 1.24) had the highest desirability rating of all farmer types. Organic farmers (+1.10, sd 1.58) also expressed a view that it will be likely that the problems associated with conventional production will be avoided. Conventional farmers (+0.23, sd 1.42) and GE intending farmers (+0.11, sd 1.35) saw it as neither a "likely nor unlikely" consequence

When asked to consider the desirability of a "reduced reliance on expensive and/or inefficient chemicals", all farmer types saw it as desirable. The strongest rating was from organic farmers (+2.18, sd 1.13), which was significantly different to the view of GE intending farmers (+1.53, sd 1.03). Organic farmers (+1.89, sd 1.4) rated the highest likelihood of this consequence occurring. Both the other types thought it likely, but the strength of this belief was significantly lower.

The last consequence of organic methods examined was that of "better community health". All three farmer types rated better community health as "very desirable". The highest rating was from organic farmers (+2.37, sd 0.96). Conventional (+1.93, sd 1.0) and GE intending farmers (+1.7, sd 0.95) also had reasonably high ratings. All scores were significantly different. When asked to rate the likelihood of better community health occurring, organic farmers (+1.81, sd 1.34) again offered the highest rating placing their view nearer to "very likely". Conventional farmers (+0.83, sd 1.59) saw it as "likely". GE intending farmers (+0.24, sd 1.27) expressed a belief that better community health from organic methods was "neither likely nor unlikely". All these scores were significantly different.

In summary, the results provide similar patterns to the previous table. Organic farmers consistently gave positive consequences a higher desirability score. Conventional farmers often did not significantly differ from these scores. However, in all cases organic and GE intending significantly differed. The two negative consequences are less consistent. Organic farmers rated one negative consequence as being less undesirable than the other types. In the other negative consequence, organic and conventional farmers were almost identical.

Summarising the likelihood scores, there is a clear pattern for all consequences, where organic farmers rated consequences as desirable, they also consistently rated them as likely. Conversely, negative consequences were rated by organic farmers as less likely. For six of the positive consequences, each farmer type assigns a significantly different likelihood where organic farmers see the highest likelihood and GE intending farmers the least likelihood. Organic farmers are more optimistic about consequences than the norm, while GE intending farmers are less optimistic than the norm.

Table 16: Assessment of the Consequences of Organic Methods by Farmer Type

Consequences		Desirability				Likelihood			
		Org (1)	Conv (2)	GE (3)	T-test p<0.05	Org (1)	Conv (2)	GE (3)	T-test p<0.05
Increased production costs	$\bar{x}$	-0.97	-0.98	-1.15	2-3	0.15	0.81	1.03	1-2
	sd	1.39	1.38	1.29		1.84	1.55	1.54	1-3
	n	62	466	111		62	471	113	
Better premiums for produce	$\bar{x}$	1.55	1.49	1.42		1.4	0.92	0.78	1-2
	sd	1.33	1.18	1.18		1.17	1.42	1.24	1-3
	n	62	464	110		63	474	113	
Increased workload for farmers	$\bar{x}$	-0.69	-0.87	-1.1	1-3	0.97	1.27	1.20	
	sd	1.26	1.23	1.32		1.54	1.31	1.41	
	n	61	463	110		63	473	113	
Reduced damage to ecological systems	$\bar{x}$	1.97	1.48	1.33	1-2	1.68	1.01	0.54	1-2
	sd	1.37	1.28	1.21	1-3	1.3	1.52	1.31	1-3
	n	62	463	111		62	473	113	2-3
Improved economic viability for farmers	$\bar{x}$	1.92	1.66	1.37	1-3	0.84	0.03	-0.42	1-2
	sd	1.16	1.12	1.33	2-3	1.38	1.47	1.53	1-3
	n	62	460	111		61	474	113	2-3
Reduced health risk for farmers	$\bar{x}$	2.16	1.79	1.65	1-2	1.63	0.99	0.43	1-2
	sd	1.32	1.11	0.98	1-3	1.6	1.48	1.43	1-3
	n	62	462	111		62	472	113	2-3
Reduced chemicals in food	$\bar{x}$	2.16	1.85	1.57	1-3	2.13	1.45	1.2	1-2
	sd	1.35	1.1	1.02		1.3	1.44	1.15	1-3
	n	62	462	111		63	472	113	
Avoid problems of conventional production	$\bar{x}$	1.79	1.29	1.22	1-2	1.1	0.23	0.11	1-2
	sd	1.24	1.12	1.03	1-3	1.58	1.42	1.35	1-3
	n	61	456	110		62	467	113	2-3
Reduced reliance on expensive and/or inefficient chemicals	$\bar{x}$	2.18	1.67	1.53	1-3	1.89	1.01	1.08	1-2
	sd	1.13	1.12	1.03		1.4	1.48	1.26	1-3
	n	61	459	111		63	470	113	
Better community health	$\bar{x}$	2.37	1.93	1.7	1-2	1.81	0.83	0.24	1-2
	sd	0.96	1.03	0.95	1-3	1.34	1.59	1.27	1-3
	n	62	461	111	2-3	63	473	113	2-3

Chapter 3
Discussion and Conclusion

3.1 Summary

The objective of this research was to deepen our understanding of the different types of farmers and growers in New Zealand primary production with respect to novel technologies. This was achieved by developing a profile of three types of farmers and growers, describing their beliefs about nature, their environmental values, and reporting their actual management practices.

The first task of this analysis was to separate out the total sample into three groups distinguished by statistically significant differences in their intentions and attitudes. The results presented earlier in Tables 1 to 3 on intentions and attitudes largely reflected the basis of our division of farmers into the three types: organic, conventional and GE intending. Statistical tests show that each group had significantly different scores for: the three intentions, for attitudes toward the new technologies, and for level of approval for GE free status. These and additional data verified the basis of classification into the three farmer types. Having determined that our classification was robust, additional data were examined to construct the profiles presented again in Table 17.

Table 17: Profile of Each Farmer Type

Organic	Conventional	GE Intending
Favourable response towards: • Organic methods • Keep NZ GE free Unfavourable response towards: • Purchasing GM food • Using gene technology. Typically horticulture Lowest gross farm income	Favourable response towards: • Organic methods • Keep NZ GE free Unfavourable response towards: • Purchasing GM food • Using gene technology Highest proportion of females Typically pastoral	Favourable response towards: • Purchasing GM food • Using gene technology Unfavourable response towards: • Keep NZ GE free Highest proportion of males Typically dairy Highest farm income

These profiles show some similarities between organic and conventional farmers. Both groups had similar responses towards organic methods and the issue of keeping New Zealand GE free, and similar unfavourable responses to purchasing GM food and using gene technology. GE intending farmers had distinctive views which were opposite those of the other two types. There were proportionally more males in the GE intending group and proportionally more females in the conventional group. Perhaps unsurprisingly, organic attitudes were more favourable in the horticultural sector. The large group of conventional farmers occurs in the pastoral sector, one of the largest in New Zealand primary production, but while this group is sympathetic to organic methods and GE free status for New Zealand, the adoption of organic methods has not taken place in that group. The more definitive group

were those intending to use gene technology. This group included more dairy farmers and had high farm incomes. The organic group had lowest gross farm income.

The results on environmental values showed that, generally, there was a consistent pattern of organic farmers having environmental values which accorded equal moral weight to all life forms, emphasised co-operation with nature and acknowledged that nature has intrinsic values independent of human valuation. This combination of values shows that organic farmers exhibit a high level of sensitivity to nature. Consequently, they gave highest ratings for concern about the environment. Conventional farmers and GE intending farmers also have sensitivity to the environment, but not to the same degree. The key difference was not that different farmer types adhered to different attitudes to the environment, but that strength of the belief was significantly stronger for the organic farmers.

The results on the perceived influence of consumer demand on farming practices indicated that organic farmers were more influenced by the perceived demands of consumers, especially concerning environmental practices and the reduced use of chemicals. GE intending farmers were the least influenced by consumer demands for environmentally friendly farm practices. These attitudinal results were then compared to reports of actual farming practices. This comparison showed that organic farmers did indeed report the use of practices which are compatible with organic and IPM farming. In addition, they reported that they have reduced both expenditure and dependency on chemicals. Therefore, the results relating to farming practices are consistent with the results on stated environmental values. It is interesting that while the majority of farmers in the organic category were not certified organic growers, they were genuinely pursuing some ideas and practices that would be identified as organic.

The views of the respondents regarding the desirable and likely consequences of gene technology were largely representative of views expected for the farmer types. Of the eight consequences being examined, four were negative (e.g., risks to public health, adverse effects on future generations) and the remaining four were positive (e.g., better quality food, enhanced economic growth). All the farmer types agreed that the negative effects were undesirable, and most of the positive effects were desirable. However, there is a striking pattern in the data. GE intending farmers rated the positive consequences as very desirable. Their desirability ratings were consistently much higher than either organic or conventional farmers. In contrast, the organic farmers rated the negative consequences as very undesirable. Further, the data displayed a clear trend when likelihood of the consequences occurring was considered. For seven out of the eight consequences, GE intending farmers rated the likelihood as opposite to the other two farmer types. This contrasts strongly with most of the results in this report. Usually the three farmer types hold a similar view, albeit with differing strength of agreement. In this case, the GE intending farmers held firmly opposite views to the other farmers. Generally, they do not believe that negative consequences will occur. Even in the negative consequences, where all farmer types agree that the consequence is undesirable, the GE intending farmers see the consequence as unlikely.

The results relating to consequences of organic methods provides similar patterns to those summarised above. Organic farmers consistently gave positive consequences a higher desirability score. Conventional farmers often did not significantly differ from these scores. However, in all cases organic and GE intending significantly differed. The two negative consequences are less consistent. Organic farmers rated one negative consequence as being less undesirable than the other types. For the other negative consequence, the scores for organic and conventional farmers were almost identical.

Summarising the likelihood scores, there is a clear pattern for all consequences, where organic farmers rated consequences as desirable, they also consistently rated them as likely. Conversely, negative consequences were rated by organic farmers as less likely. For six of the positive consequences, each farmer type assigned a significantly different likelihood where organic farmers see the highest likelihood and GE intending farmers the least likelihood. In summary, organic farmers were more optimistic about consequences than the norm, while GE intending farmers were less optimistic than the norm.

3.2 Discussion and Conclusion

In this discussion and conclusion we give attention to the sizes of each of the groups in New Zealand agriculture and consider likely future developments. The discussion also considers how the recruitment of farmers into either organic or GE production might be best targeted, and other policy issues relating to sustainable agriculture.

There is an important general theme to the results of this more detailed study of the different types of farmer. That theme is that over many of the variables considered, organic and conventional farmers have similar views. Often it was the case that they had the same general view but that the organic farmers held it more strongly. This theme is consistent with findings in the first report. GE intending farmers were more identifiable as a distinct group – sometimes (but not always) holding distinctly different ideas to the organic and conventional groups.

The three farmer groups are very dissimilar in size. The organic farmers comprised ten per cent of the sample, conventional farmers 73 per cent and GE intending farmers 17 per cent. Thus, nearly three quarters of New Zealand farmers have not made a commitment to either novel technology. The nearly one fifth who are interested in using gene technology are nearly double in number to those pursuing organic methods. It is possible that this last fact is a result of the ease with which a farmer could express interest in gene technology as an idea rather than having to actually do it. If this is the case then the two minority groups are possibly similar in size. However, data from the survey are available to indicate the potential size of the organic group assuming that some conventional farmers will become organic farmers. The total number of farmers intending to use organic methods in the next five years was 37 per cent, so if ten per cent are already using organic methods (to some extent) then the balance is 27 per cent. On this basis it is possible that about one quarter of all farmers may yet become organic farmers.

There are important results in this survey for those seeking to increase supply development for organic or GE producers. The issue of supply development, and the potential levels of conversion to organic or GE was discussed in the previous report (Cook et al., 2000). Those findings can be supplemented by the analysis in this report to provide the followingaccount.

While only one per cent of farmers in the sample were certified as organic producers, there were another nine per cent of the sample who were highly sympathetic to organic ideas, had adopted many practices on their farms that might be considered organic, and would see themselves as organic rather than conventional. The relatively large size of this group will surprise many organic industry readers of this report. It is important to qualify this observation by referring back to the results relating to practices used on farms. These results showed there were seven practices that are more typical of organic farmers but these practices were not used by all farmers in the organic group. The ‘compliance rate’ ranged from 44 per cent to 63 per cent. Clearly there were many producers who use a range of techniques that

might be part of an organic system, without fully committing themselves to certified organic production. Nevertheless, this group still exhibits values that are consistent with organic production rather than conventional – they are different to conventional farmers without fufilling all the criteria of certified organic production. The organic group was strongest in the horticulture sector, and this probably reflects the significance of the Integrated Pest Management systems of KiwiGreen and Integrated Fruit Production-Pipfruit in that sector. Such systems may have had an important influence on farming practices and have encouraged many growers to move closer to organic production.

It would seem that from a supply mangement point of view that it may not be difficult to encourage these organic farmers to move on to fully registered status. This group must comprise the prime candidates for conversion to fully certified organic production, and judging by this survey, it is not implausible that conversion of ten per cent of primary producers could be achieved in the short term. Beyond this, the gap between those describing themselves as organic, and the conventional group is not large. There is clearly a second body of potential converts to organic methods among the conventinal farmers. While it is unlikely that all of this group will automatically move into organics, the results suggest that a considerable proportion of primary producers are open to the possibility. The first study reported that 37 per cent of farmers had an intention to use organic methods in the next five years. In addition, the majority of farmers (49 per cent) indicated a desire for New Zealand becoming gene technology free. These results suggest that the broad group of conventional farmers who had not made a commitment to either new technology were more sympathetic to organic farming than gene technology. The data presented in this report strengthen this claim because of other identifiablesimilarities between conventional and organic farmers. Likewise, another recent farm survey (AFFCO, 2000) showing 70 per cent of primary producers would prefer to be organic than GE also supports the claim that there is much support for organic methods among farmers as a whole, expecially if the middle ground options are removed.

For the purposes of identifying primary producers interested in converting to organics, the following characteristics should be born in mind. A general theme is that organic farmers are a group with strong views. The have heightened attitudes and values. They have strong views on nature seeing all life forms as equal, a need to coexist with nature and nature as having intrinsic values. These values combining to lead them to strongly agree with the statement that they are concerned about the environment. They are also sensitive to consumer demand. Organic producers are more likely to be found in the horticulture sector, followed by the pastoral sector. Dairy is least likely to have organic farmers. Potential converts to certified organic production will also tend to have lower than average farm incomes.

Similarly, this report can identify primary producers interested in converting to gene technology. The first report showed that 17 per cent of farmers intended to adopt GE. While this looks small compared to the potential organic group, the results should be tempered by the consideration that intending conversions to organic are commencing from a group of ten per cent already describing themselves in this way, while GE intending farmers commences from zero per cent as there are no existing GE producers.

Our analysis in this report showed that the group of GE intendering farmers was quite distinct from other primary producers in a number of ways. Recognising these distinctions would assist in targeting potential recruits to GE production. GE intending farmers are more likely to be male and work in the dairy industry. They are also more likely to hold the view that the negative consequences of GE are unlikely to happen. They are more likely to be interested in the idea that gene technologies will increase production and improve on-farm production systems, rather than improving the consumer appeal of GE products. In fact, while GE

intending farmers thought consumer appeal of GE products was desirable, they thought this outcome was not very likely. They also tend to be less concerned with their relationship with nature, and they tend to be on higher income farms.

While it is possible to identify characteristics of both organic and GE intending farmers, one interesting finding is that some predicted characteristics of each group turned out to be insignificant. Organic farmers appear not to be new to farming. The relevant question asking if respondent's 'parents were farmers' clearly showed that there was not a significant variation between the types. This single question does not provide a basis to conclude definitively on this issue. This finding is in contrast to the expectation of some commentators and the international literature (e.g., Egri, 1999) that organic farmers are more likely to be new entrants to primary production. Neither were there any obvious educational differences between the types of farmers.

The organic farmers studied here have distinctive values, and attitudes towards nature. The scores on a number of variables were significantly different. It is likely that they have such fundamentally different views that we can conclude that their beliefs about the nature of reality, that is their ontological beliefs, are distinctive. This finding is in accord with some overseas studies. For example, Rickson et al., (1999) found that organic farmers in Australia endorse the 'alternative agricultural paradigm' more strongly than conventional farmers and they have different views on sustainable farming. Egri (1999) also found that organic farmers in Canada expressed higher levels of general environmental concern compared to conventional farmers, and the latter were more positive about the environmental benefits of synthetic agrochemicals.

What appears to be happening in New Zealand agriculture is that some of the older ontological beliefs, such as harnessing nature for the benefit of humans, or increasing production to feed the world, are no longer so dominant. The conventional farmers also had similar values to organic farmers, albeit not to the same degree, and this suggests that there may be an even broader change to basic farming values. The results give a strong indication of such changes but future research is needed to focus more explicitly on ontological values in order to document any changes more definitively.

On the topic of future developments in primary production an interesting question is the effect of the Royal Commision's findings on GM technology in New Zealand. The Commission gave some support for the use of gene technology and this may encourage farmers to take it up. If this is the case we would predict that in future surveys of farmers' intentions the proportion who choose gene technology would increase. Similarly, the Royal Commissions suggestion that GE and organic systems can exist in tandem – which has been strongly rejected by the organic industry – may slightly dampen farmer enthusiasm for organics. Both these points are speculative, and could not be corroborated until future surveys are undertaken.

The objective of a clean and green New Zealand is often considered important especially in the context of trying to achieve sustainable agriculture. The results of this study show that there are significant differences in the practices of the different farming types. The organic farmers have environmental values, matched by actual practices, which are consistent with the dominant ideas about what comprises sustainable production. While few would claim to have fully reached perfect sustainability, this group are deploying techniques and strategies that are moving in that direction. If the long-term policy goal is to achieve sustainable production then this might be achieved by encouraging farmers along a continuum towards greater sustainability, and the group that are moving along this continuum are – according to

this survey – the organic producers, and some of the conventional producers. While this advice may appear to be stating the obvious, the contrast with GE intending farmers is interesting.

GE intending farmers are sensitive to their environment, but not emphatically, and they are the least influenced by consumer demand for environmentally friendly practices. Further, they report higher levels of dependency on chemicals and manufactured fertilisers than the other two farmer types. Consequently, the GE intending farmers' pathway to sustainable production is rather dramatic. Rather than move along a continuum of farm practices heading towards sustainability, they are hoping that specifically engineered crops and stock can quickly shift them into sustainable production. It appears that their tactic is to remain on the continuum of increasing intensification until GE products emerge to deal with environmental issues.

If markets for primary produce are experiencing greater sensitivity to how production occurs then these consumers would find the production preferences of the GE intending farmers less desirable and this could be reflected in prices paid, or market access for such products. Our conclusion is that if achieving a clean and green New Zealand, and being responsive to market signals, is important for the future of New Zealand agriculture, then it is by encouraging organic and conventional farming further along a continuum towards greater sustainability that these objectives are more likely to be achieved.

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Appendix 1: Interaction Effects

The significant differences highlighted in the findings are limited to the differences in results for organic farmers, conventional farmers and GE intending farmers. Some of the differences in environmental beliefs and farming practices may be due to differences in types of farm. In other words, there may be an interaction between farmer type and farm type as they are both related to attitudes and behaviours. For example, pastoral farmers may not consider organic farming methods to be viable and may be more inclined to use gene technology. Consequently, farm type may influence attitude in addition to farmer type. It is, therefore, appropriate to investigate farm types as another potential influence on the differences in environmental beliefs and farming practices.

The tests of the differences were undertaken using two different statistical methods, which depended on the form of data variable being examined. For rating or numerical response variables, the differences in means were tested using ANOVA and T-Tests, or both. Where the data is categorical, for example, 'Yes' or 'No' responses, the proportional differences were tested using a Chi-square method. The following discussion examines differences of farmer types within farm types first by means then by proportions.

Tests found some significant differences (ANOVA f-value, $p < 0.05$) between mean scores between farm type and relationships identified as significantly different for the three farmer types. The variables where differences occurred were: intention to use gene technology; intention to purchase GM food; number of years farming; consumer demand for environmentally friendly produce and produce with less chemicals; and the three measures on the dependency of agrochemicals. For these variables, further tests for interactive effects were conducted using the breakdowns of three farmer types, within farm type.

In summary, at the level of farm type, differences (ANOVA f-value, $p < 0.05$) were still found between the three farmer types (organic, conventional and GE intending) for intention to use gene technology and intention to purchase GM food. This indicates that while there were differences between farm type and these intentions, differences based on the three farmer types remains a valid explanation of differences in intention. In contrast, the number of years farming was found to be non-significant at the farm type level indicating that farm type rather than the three farmer types determined differences. Determining which was predominant in consumer demand for environmentally friendly produce and produce with less chemicals, and the three agrochemical dependency measures could not be clearly determined because of mixed results. To resolve this two farm type groups were used. They were Group 1: horticulture and arable farms; and Group 2: pastoral, dairy and specialist livestock farms. By using the two groups it was found that the influence of consumer demand for environmentally friendly produce and produce with less chemicals, and dependency on agrochemicals for weed control and manufactured fertilisers, were determined by farm type with no significant differences (ANOVA f-value, $p > 0.05$) between means for the three farmer types when divided into each of the two groups. Dependency on chemicals to control pests was, however, determined by farm type for horticulturists (ANOVA f-value, $p < 0.05$) although only for the grouping of horticulture versus arable (Group 1) but not for pastoral, dairy and specialist livestock (Group 2),

When chi-square tests were conducted across the proportional data significant differences ($p < 0.05$) between six of the fifteen practices to reduce chemical use and farm type were found. Table 18 shows the data relating to these six practices, which were: adopted practices to reduce insecticide use; applied manure; grown legumes; encouraged insect predators; used animals to manage weeds; and been selective over food for animals.

Table 18: Tests for Differences between Farmer Type and Activity

Practices to reduce chemical use		Hort. (n=89)		Past. (n=342)		S.L. (n=30)		Dairy (n=166)		Arable (n=22)		Total (n=649)		Chi square test
		No	%	No	%	No	%	No	%	No	%	No	%	
Adopted practices to reduce insecticide use	N	34	38	231	68	21	70	118	71	17	77	421	65	33.49, df 4
	Y	55	62	111	32	9	30	48	29	5	23	228	35	p < 0.05
Applied manure	N	49	55	261	76	22	73	105	63	16	73	453	70	19.7, df 4
	Y	40	45	81	24	8	27	61	37	6	27	196	30	p < 0.05
Grown legumes	N	67	75	276	81	24	80	150	90	12	55	529	82	21.72, df 4
	Y	22	25	66	19	6	20	16	10	10	45	120	18	p < 0.05
Encouraged insect predators	N	55	62	262	77	22	73	136	82	18	82	493	76	13.16, df 3
	Y	34	38	80	23	8	27	30	18	4*	18	156	24	p < 0.05
Used animals to manage weeds	N	71	80	260	76	27	90	141	85	10	45	509	78	19.09, df 3
	Y	18	20	82	24	3*	10	25	15	12	55	140	22	p < 0.05
Been selective over food for animals	N	51	57	239	70	21	70	131	79	11	50	453	70	17.23, df 4
	Y	38	43	103	30	9	30	35	21	11	50	196	30	p < 0.05

*Excluded from calculation due to low cell count

When testing for interactive effects at the level of farm type the analysis suffered from low cell numbers. In addition, where numbers were sufficient to interpret results they were somewhat contrasting. For example, for four of the six practices to reduce chemicals, differences were found between the three farmer types within the pastoral farm type (n = 342). For the same practices to reduce chemicals no difference was found for some other types such as horticulture (n = 89). As with the comparison of means, farm types were re-categorised into two new groups of Group1: horticulture and arable farms; and Group 2: pastoral, dairy and specialist livestock farms. Table 19 and 20 show the results of testing the interactive effects of these two groups using Chi-square.

Table 19: Test for Differences with Farmer Types Divided into Group 1 Farm Type

Practices to reduce chemical use		Org. (n=18)		Conv. (n=70)		GE. (n=23)		Total (n=111)		Chi square
		No.	%	No.	%	No.	%	No.	%	
Adopted practices to reduce insecticide use	N	7	39	32	46	12	52	51	46	0.72
	Y	11	61	38	54	11	48	60	54	df 2, n s
Applied manure	N	7	39	42	60	16	70	65	59	4.07
	Y	11	61	28	40	7	30	46	41	df 2, n s
Grown legumes	N	10	56	51	73	18	78	79	71	2.79
	Y	8	44	19	27	5	22	32	29	df 2, n s
Encouraged insect predators	N	9	50	48	69	16	70	73	66	2.73
	Y	9	50	22	31	7	30	38	34	df 2, n s
Used animals to manage weeds	N	17	94	50	71	14	61	81	73	3.86
	Y	1	6	20	29	9	39	30	27	df 2, ns*
Been selective over food for animals	N	9	50	38	54	15	65	62	56	1.38
	Y	9	50	32	46	8	35	49	44	df 2, n s

*Low cell count

Table 20: Test for Differences with Farmer Types Divided into Group 2 Farm Type

Practices to reduce chemical use		Org. (n=46)		Conv. (n=402)		GE. (n=90)		Total (n=538)		Chi square
		No.	%	No.	%	No.	%	No.	%	
Adopted practices to reduce insecticide use	N	23	50	285	71	62	69	370	69	8.39, df 2
	Y	23	50	117	29	28	31	168	31	p < 0.05
Applied manure	N	16	35	273	68	67	74	356	66	23.54, df 2
	Y	30	65	129	32	23	26	182	34	p < 0.05
Grown legumes	N	22	48	299	74	67	74	388	72	13.48, df 2
	Y	24	52	103	26	23	26	150	28	p < 0.05
Encouraged insect predators	N	25	54	321	80	74	82	420	78	16.76, df 2
	Y	21	46	81	20	16	18	118	22	p < 0.05
Used animals to manage weeds	N	29	63	330	82	69	77	428	80	9.76, df 2
	Y	17	37	72	18	21	23	110	20	p < 0.05
Been selective over food for animals	N	32	70	298	74	61	68	391	73	1.73, df 2
	Y	14	30	104	26	29	32	147	27	n s

Table 21 summarises the findings from Tables 18 and 19 to assist in ascertaining whether there were interactive effects for Group 1 and Group 2. Group 1, which mainly comprised horticultural farms with some arable farms, exhibited no differences at this level. This indicates that whether or not the farm was horticulturist or arable determined the farm practice. In terms of Group 2, which mainly comprises diary and pastoral farms, differences were exhibited for five of the practices. This indicates that dairy and pastoral farm types had no bearing on determining the farm practice. Further, this indicated that differences in terms of whether the respondent was organic, conventional or a GE intending determined participation in the practice.

Table 21: Summary Results for Two Farmer Type Groups

Practice	Group one	Group two
Adopted practices to reduce insecticide use	No difference between 3 types	Difference between 3 types
Applied manure	No difference between 3 types	Difference between 3 types
Grown legumes	No difference between 3 types	Difference between 3 types
Encouraged insect predators	No difference between 3 types	Difference between 3 types
Used animals to manage weeds	Low cell count, but no difference between 3 types	Difference between 3 types
Been selective over food for animals	No difference between 3 types	No difference between 3 types

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