Farmer Surveys and Rural Monitoring

New Zealand Farmer and Grower Intentions to Use Genetic Engineering Technology and Organic Production Methods

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Preface

Surveys of farmer opinion have been a long-standing tradition of the research in the AERU. This report continues that tradition by examining the topical issues of genetic engineering and organic production. In particular, it brings to the fore information about farmers' and growers' attitudes and opinions on these topics which will provide vital information to the current policy debate about these issues. This report is the first of two derived from the survey, and focuses on attitudes and intentions among the sample as a whole and in giving a preliminary characterisation of different groups as defined by intention. The second report will focus in detail on analysing differences among groups of farmers and growers. The results from both reports will be of interest to farmers and growers by showing how their industry currently is responding to these two issues, and to policy makers who are interested in how farmers and growers see the issues.

Ross Cullen
Director

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Summary

This research investigated the decisions of farmers and growers in relation to the issue of the introduction of gene technology to agricultural production in New Zealand. The main research objective was to determine and understand the reasons for New Zealand farmer and grower intentions to (i) use gene technology (ii) purchase GM food and (iii) use organic methods. The research utilised a modelling approach from Social Psychology which extended upon the Theory of Planned Behaviour (Ajzen, 1991). A model of each intention was constructed. Questionnaire items were developed and subsequently 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. A summary of the key results is provided below.

Summary of Key Results

	Gene Technology	**G M Food**	**Organic Methods**
	%		
Negative intention	44	49	19
No intention	35	39	44
Positive intention	21	12	37
R^2 for intention model	0.59	0.54	0.31
	Betas		
Determinants			
Environmental norm	-0.079	-0.081	0.138
Attitude	0.451	0.450	0.370
SN	0.132	0.230	(0.003)
Self-identity	(0.008)	(0.049)	(0.187)
PBC	0.062	(0.021)	(0.023)
Involvement in organic production	-	-	0.676
r between attitude and sum of perceived consequences	0.63	0.60	0.38

Note: numbers in parentheses indicate non-significant ($p > 0.05$) results.

Twenty-one per cent of farmers and growers intended to use gene technology or purchase GM food in comparison with the larger proportion of 37 per cent that intended to use organic methods. 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. Attitude was an important component in all the models, with subjective normative pressure (SN) important in two models and personal control over performing the activity (PBC) important in one model. Previous involvement in organic production was the most important determinant of intentions to use organic methods. Overall, the results supported the hypothesised models and R^2 values indicated good model fit comparable with similar research related to the topic areas.

In keeping with the theoretical approach of this study a strong relationship was found between

eight general consequences of using gene technology and farmer and grower attitudes towards using the technology and attitudes towards purchasing GM food. In addition, a significant relationship was found between ten general consequences of using organic methods and farmer and grower attitudes towards using organic methods.

Further, items were found to be positively associated with the intention to use gene technology and, in contrast, were negatively associated with intention to use organic methods. Three items were negatively associated with intention to use gene technology and positively associated with intention to use organic methods. There was a tendency for males more than females to intend to use gene technology, whereas there was a tendency for females more than males to intend to use organic methods.

Overall, farmers and growers who intend to use gene technology and farmers and growers who intend to use organic methods are different. Their views, preferences, practices and intentions are divergent in many respects, however, central to the decision making processes of each are commonly held consequences that are very influential on their decisions to use gene technology, purchase GM food or use organic methods. Reducing the perceived risks and increasing the possibility of desirable consequences will therefore have a direct effect on improving attitudes and intentions towards using gene technology and purchasing GM food. Similarly, the use of organic methods would increase with evidence that positive consequences would be realised and evidence that negative consequences were less likely. In general, policies which emphasise positive consequences and negate the perceived possibility of negative outcomes will increase participation in the respective activities. As uncertainty is a feature of the consequences of gene technology it is noted that any action or policy initiative that reduces uncertainty is likely to make gene technology more acceptable. However, many of the consequences of gene technology are distant prospects compared to those from the use of organic methods. Given the availability of information on the consequences of using organic methods, if favourable, this information would quickly encourage more widespread use of the methods.

Generally, farmers and growers are in favour of New Zealand adopting the policy of becoming GE free. In addition, while some presently intend to use gene technology and purchase GM food, significantly more farmers and growers intend to use organic methods. The results of this study show that widespread use of organic methods with a small gene technology sector would be the favoured development scenario by farmers and growers.

Chapter 1
Introduction: Background, Attitudes and Research Objectives

1.1 Introduction

The main objective of this research was to determine and understand New Zealand farmer and grower intentions to use (i) gene technology, (ii) to purchase GM food and to (iii) use organic production methods. A largely social-psychological approach was taken to model motivational determinants of these three intentions. This research focuses on the level of the individual farmer because decision-making by farmers about genetically modified (GM) production and organic production is an important component of the wider debate about a GM food industry. The emergence of this issue, and its contested nature, makes farmer intentions a very important topic of research.

Until comparatively recently, the adoption of GM foods by a limited number of food exporting nations (principally the US, Canada and Argentina) was strongly influenced by the actions of a number of parties in a variety of arenas. These were:

- The establishment within science institutions and corporate R & D facilities, of major research programmes into the commercial application of the 'life sciences' – particularly the applications of recombinant DNA techniques to modifying the characteristics of food crops and livestock.

- The emergence of particular testing regimes within the US, and the adoption of the principle of 'substantial equivalence' by US regulators, with a subsequent resistance to this decision by consumer and environmental groups.

- The emergence of a widespread campaign against GM foods, and the resulting decline in levels of consumer confidence in the technology.

- The amplification of consumer concerns through the media, through local level meetings, through the actions and stances of politicians, through the implementation of legislation demarcating between GM and non-GM products, through academic debate, and through the actions of multiple retailers seeking to obtain increased market share by assuring consumers of 'food safety' in their products.

- The initiation of trade barriers, and moratoria by various governments

It is likely that the evolution of the GM food industry will be conditioned by the interactions between all these different parties. One group, however, has been largely neglected in such accounts – the farmers/growers. Events in the US in 2000 have suggested that farmers and growers have a key role to play because their individual decisions will play a significant part in the degree of uptake of GM production.

The clearest evidence supporting the salience of farmer/grower decision making comes from those few countries where GM seed is widely commercially available, especially in the US.

Commencing in early 2000, it became clear that US farmer/grower purchasing decisions about the use of the few commercially available GM seeds would play a significant part in the pace and style of GM development in the US. Prior to 2000, the areas planted in GM crops had undergone three years of rapid expansion (Reuters News Service, 18/2/2000). This growth trend ceased in 2000. In January, 2000, Reuters conducted a survey of US farmers and concluded that GM plantings were down on 1999 by 15 per cent for soybeans, 22-24 per cent for corn, and 26 per cent for cotton (Reuters News Service, 13/1/2000). Later in the season, the USDA, industry bodies like the National Corn Growers Assoc., and various Biotech companies surveyed growers in the US. Benbrook summarises these findings as reflecting a generalised trend away from GM plantings, with decreases of around 24 per cent for corn, and 5-10 per cent for soybeans (Benbrook, 2000). These purchasing decisions then became the subject of intense industry lobbying, and varying responses of farm organisations advising their members as to what course of action they might follow.

The sudden interest in farmer purchasing and planting decisions in the US Spring of 2000, highlights the fact that little research had been conducted around the world, on what transpired – during 2000 – to be a significant element of the GM situation. Further, for countries in which GM seeds are not widely available, the kinds of survey undertaken in the US are not able to be conducted. Instead, we must look at farmer *intentions* to try and gauge the level of uptake of GM products should governments allow the commercial release of GM technologies in food production. Very little research on this topic is available. In Australia, The Land magazine conducted a poll of 800 Australian producers during September, 1999. In brief, their results were that 26.5 per cent of respondents believed the benefits of GM crops would outweigh the cost, while 32.5 per cent of respondents believed the opposite (Reuters News Service, 17/9/1999). In New Zealand, an AFFCO Rural Monitor Report (Affco, 2000) presented results from a survey of 750 adult New Zealanders. These respondents were asked whether the future of New Zealand agriculture lay with GM food production or organic production. A sub-sample of farmers and commercial growers was identified within this group. Among these farmers and commercial growers, 15 per cent thought that the future lay with GM production and 70 per cent with organic production. Respondents were only allowed these two choices, and 15 per cent of respondents volunteered their answer as 'Both', 'Neither', or 'Unsure'.

This rather extreme result, given that few farmers and commercial growers are actually organic producers, highlights two things. First, there is a paucity of reasoned scholarly analysis of purchasing and planting decisions about GM crops – the methodology behind the Affco results is not robust. And, second, that in much of this debate, the notion of GM is oppositionally tied to the concept of organic production[1].

The research reported here will attempt to rigorously examine the nature of grower decision making about GM and organic technologies in a way that has not been achieved by any of the

[1] Throughout the debate about GM food production in New Zealand, a repeated notion is that organic production provides a better alternative. This dualism is somewhat undermined by the IBAC (2000) contention that the major economic benefits of New Zealand becoming a GM-free food exporter would be experienced by *conventional* producers who may be able to secure a price premium for GM-free produce rather than organic producers who already trade as GM-free (IBAC, 2000). Despite this concern, we argue that the GM/organic dualism has been prominent in media discussion and thus will be well known to most producers. Further, the incompatibility of GM and organic techniques makes the two styles of production useful in creating a definite either/or option for producers.

research to date. In addition, the research will examine the intentions of farmers and growers towards purchasing genetically modified (GM) food.

The research utilises the Theory of Planned Behaviour (TPB) (Ajzen, 1991), an approach from Social Psychology that is designed for the prediction and understanding of human behaviour. The theory is adapted to meet the purposes of this research and is applied according to the recommendations of Ajzen and Fishbein (1980). The TPB is employed to identify the reasons for the intentions of farmers and growers. These reasons form the basis for projections of (i) the use of the technology by farmers and growers, (ii) their purchasing behaviour and (iii) their uptake of organic production. In addition, policy initiatives and events, which may influence these projections, are discussed and predictions are made of their effect on intentions and subsequent behaviour.

1.2 Attitudes to the use of genetic engineering in food production

In this research attitudes towards the use of genetic engineering in food production are expected to be an important influence on the intentions of farmers and growers to use the technology and intentions of farmers and growers to purchase GM food. A number of studies have been conducted of attitudes towards genetic engineering in New Zealand that can be drawn upon for this research. These research results are used in Chapter 2 to develop models of farmer and grower decision making.

The first, undertaken by means of face-to-face interviews, surveyed the attitudes of 2,034 adults to the genetic manipulation of a number of different organisms (Couchman and Fink-Jensen, 1990). The survey found that 74 per cent of respondents were aware of genetic engineering as a technology, of which 57 per cent thought research in this area was beneficial. The acceptability of the genetic engineering of plants (85.5 per cent) and animals (56.6 per cent) was higher than that of manipulating human cells (42.5 per cent).

A mail survey conducted by Macer (1994) was based on a sample of 329 respondents. The survey found that 56 per cent of respondents indicated that genetic engineering of plants was acceptable and that 29 per cent considered the genetic engineering of animals to be acceptable. The 80 per cent of respondents who were aware of the use of the technology to produce food were asked their level of concern in relation to types of food products. Genetic manipulation of meat was of most concern, followed by dairy products and vegetables, which drew the least amount of concern. Respondents also reported the reasons for their choice of level of concern. The most common reason against genetic modification was that the foods were considered to be unnatural (20 per cent) and 11 per cent reported the concern that safety measures were inadequate.

A survey conducted by Fitzgerald, Saunders and Wilkinson (1996), using telephone interviews, focused on gauging public opinion of the use of genetic engineering as a method of biological control. Of the 1,017 respondents, 89.5 per cent expressed familiarity with the potential of the technology to increase the quality or quantity of agricultural products. In a measure of the acceptability of the use of genetic engineering in agriculture 14 per cent found it unacceptable, 18 per cent reported indifference and 65 per cent reported approval.

Another study, conducted as part of an international study, was undertaken by means of a telephone survey (Macer, 1998). Of the 508 respondents, 69 per cent expressed approval for the use of genetic engineering in the production of food and drinks. The respondents were

also found to have a relatively better understanding of genetic engineering than people in other countries including Japan, Canada and the European Union. Sixty-six percent of respondents considered that the genetic engineering of crop plants for resistance to pests should be encouraged.

Research by Sharland (1999) focused on determining reactions to labelled GM food. The research used choice modelling to compare shopper reactions to non-GM food and food labelled as GM with a variety of price differences. The research found that choice was generally unrelated to knowledge of the technology and, while price influenced choice, more expensive non-GM food was generally favoured over GM food. The study also concluded that the comparative utility of a number of respondents did not alter for GM food regardless of price, nutritional value or taste.

Research comprising four separate studies was undertaken by Gamble et al. (2000). In the first study, 36 people participated in focus group discussions of GM food. The study found that food safety and risk to the environment were associated with GM food. GM food was also associated with food that had been produced using pesticides or food that had been irradiated. In addition, respondents reported that while they were aware of the technology, they had little understanding of genetic engineering. The second study engaged 60 growers from regions of the North Island in focus group discussions. A third of the growers were willing to utilise the technology and it was noted that only a small shift in attitudes would increase this proportion. Growers would, however, be less responsive should their action result in no benefits to themselves. The third study employed conjoint analysis to interpret responses of 115 participants. The participants in interviews reported whether or not they would purchase chocolate biscuits or tomatoes that were presented to them. Purchase of the products was considered using various descriptions including their being genetically modified. The exercise was followed by the completion of a questionnaire by the participants. The study found that price was important in the purchase decisions and was more important than health or environmental concerns. A proportion of the participants were described as ‘neophobic’; that is, as being reluctant to accept the technology. A postal survey was undertaken for the fourth study, which received 809 responses. The respondents were asked to consider purchasing either a GM tomato or a pair of jeans made from GM cotton. The study utilised a variation of the TPB. Attitudes towards the use of genetic engineering in food production were predominantly negative. Most respondents indicated they would avoid purchasing the two products.

Research by Cook (2000) also utilised the TPB and modelled intentions to purchasing GM food. Three focus groups (N = 26) were utilised for questionnaire development. One focus group consisted of residents of a farming community. Discussions centred on beliefs about the outcomes of using the technology in food production, including risks to the environment, harm to public health and improvements in food quality. Of 266 respondents to the postal survey, 60 per cent intended not to purchase, ten per cent intended to purchase and 10 per cent had no intention to either purchase or not purchase. In keeping with the TPB, beliefs about the outcomes of purchasing, sense of self-identity, personal control over purchasing and the views of family and friends were identified as proximal determinants of intentions to purchase. Relationships were also identified between model components and belief in statements by companies, prior purchasing behaviour, gender, and age.

1.3 Attitudes towards organic production

There are a number of studies of the decision making processes of New Zealand farmers and growers with regard to their production of organic food or 'green' produce. These studies are drawn upon for background to this research with an emphasis given to studies of farmers and growers who are not necessarily already involved in the production of organic or 'green' produce.

Saunders, Manhire, Campbell and Fairweather (1997) assessed the potential of organic agriculture and analysed factors that influenced the adoption rate of organic farming methods. A basis for this analysis was a study of motivational factors that determined farmers' choice between organic and conventional production. The study, which is presented with a detailed analysis by Fairweather (1999), used depth interviews of 83 New Zealand farmers and growers that were analysed using ethnographic decision tree modelling. The study identified a range of factors including financial and practical considerations and concern for the environment as proximal determinants of farmers' choice.

1.4 Research objectives

The main objective of this research was to determine and understand the reasons for New Zealand farmer and grower intentions to (i) use gene technology (ii) purchase GM food and (iii) use organic methods. By achieving these aims, informed predictions of changes in attitudes and intentions can be made with an emphasis on policy initiatives and events that influence the intentions of farmers and growers. Another objective was to extend our understanding of decision making regarding organic production by describing the population characteristics of the different reasons for and against organic production identified in earlier qualitative studies of decision making (Fairweather, 1999).

There were also a number of minor research objectives. These were:

- To develop a conceptual model of farmer and grower intentions.
- To gather and analyse information from farmers and growers about requisite attitudes and intentions and influences upon these attitudes and intentions.

1.5 Report structure

The following is a brief overview of the remaining chapters of this report.

Chapter 2 begins with a review of research of the attitude-behaviour relationship. The review is used to develop conceptual models of the intentions of farmers and growers.

Chapter 3 describes the construction of a quantitative survey to determine the attitudes and intentions of farmers and growers.

Chapter 4 presents the survey findings and their analysis. Current intentions are determined and predominant influences on these intentions are identified. The findings are evaluated in terms of the conceptual models developed in Chapter 2 and additional relationships of importance to meeting the aims and objectives of this thesis are also identified.

Chapter 5 is the concluding chapter of the report. The survey findings are discussed and consideration is given to factors that may affect attitudes and intentions. The chapter closes with a discussion of policy and research implications.

Chapter 2
Modelling the Attitude-behaviour relationship

2.1 Introduction

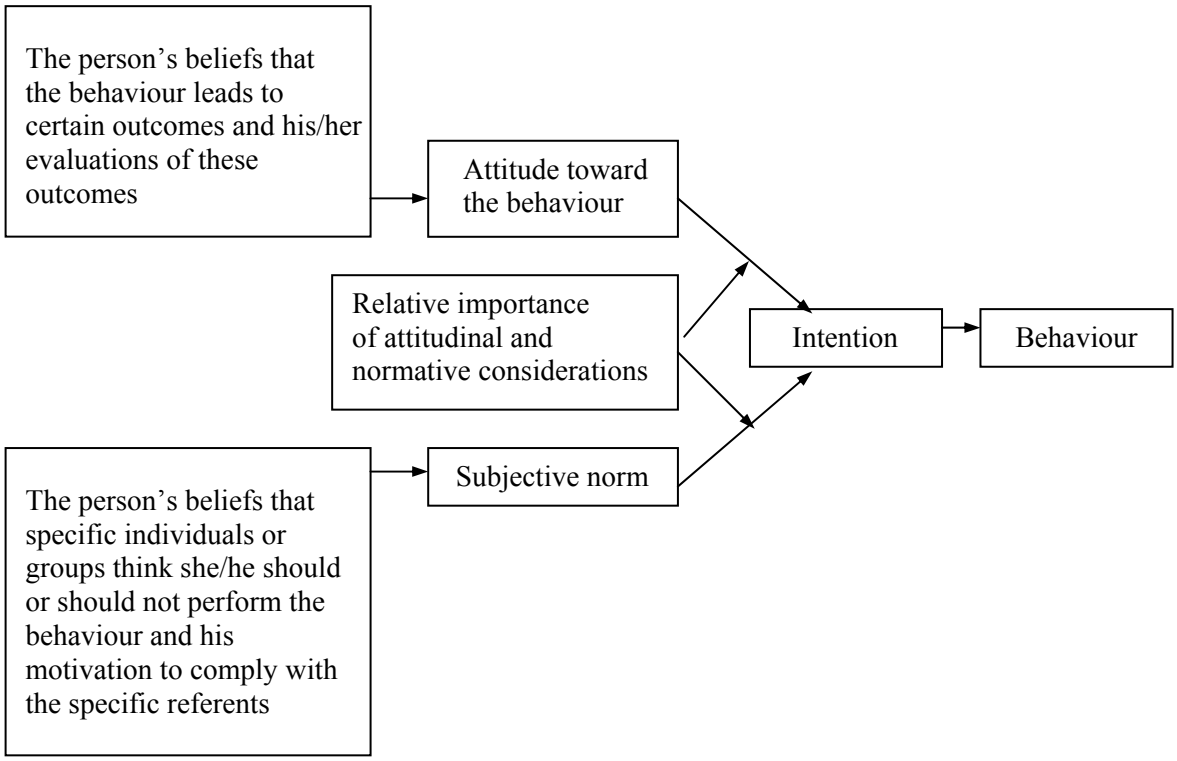
The analysis of the intentions of farmers and growers is based on the Theory of Planned Behaviour (TPB). The TPB is an extension of the more well known Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980). These theories of the attitude-behaviour relationship concentrate on determining an individual's motivations for his or her behaviour, when presented with a free choice over whether he or she should perform a behaviour. This choice is held to be primarily determined by an individual's attitude, which is interpreted as a predisposition towards the performance of a behaviour. Discerning the nature of attitudes and intentions and accounting for influences upon these attitudes and intentions are held to determine the reasons for the behaviour.

This chapter begins with a review of attitude-behaviour models of relevance to the research presented in this report. The review initially concentrates on the TRA, which is arguably the most successful conceptual model of the attitude-behaviour relationship. The TPB is then explained and a number of proposed improvements to this theory, in the form of additional variables, are presented. Drawing from this review, the chapter concludes by modelling the intentions of farmers and growers to use gene technology, purchase GM food and use organic methods.

2.2 The Theory of Reasoned Action

The TRA is a model of the relationship between attitudes towards undertaking a behaviour and the act of undertaking a behaviour. As illustrated in Figure 1, attitudes are posed as a determinant of behaviour through their effect on a person's intentions to undertake a behaviour. Intentions are also considered to be subject to motivations to comply with perceived pressure from people whose opinion is important to the individual. These perceived social pressures form the subjective norm. A central concept is that attitudes are formed from beliefs regarding the consequences for the individual of performing a behaviour. Attitude is held to be subject to pressure from the subjective norm indicating that one should conform to the views of one's peers. Attitude and subjective norm are considered to wholly form an intention to perform a behaviour, which is expected to be highly correspondent with the actual performance of a behaviour. Application of the model is restricted to behaviours that are undertaken voluntarily, as these are presumably only dependent on whether or not a person intends to perform them.

Figure 1: Factors Determining a Person's Behaviour (after Ajzen and Fishbein, 1980:8)



Attitude toward the behaviour is defined as the sum of the salient beliefs associated with the performance of a behaviour. Salient beliefs are beliefs about the consequences, which are of importance to the individual, of him or her performing the behaviour. To form attitude towards the behaviour, an evaluation is made of how good or bad each consequence will be. This evaluation is then multiplied by an expected value, which is an estimation of the likelihood of the consequence occurring. Attitude toward a behaviour is then derived from the sum of the value of all the important consequences of performing the behaviour, subject to an estimate of their likelihood.

The subjective norm is a function of salient beliefs concerning the opinion of important others regarding the individual performing a behaviour. These beliefs, termed normative beliefs, are formed from beliefs about what other people, of importance to the individual, think of the individual performing the behaviour. The subjective norm is formed by measuring how favourable or unfavourable important others are of the individual performing the behaviour, which is then multiplied by the individual's motivation to comply with views of others. Motivation to comply encompasses perceived pressure to adhere to another person's opinion, due to the nature of their opinion, and pressure to conform to the opinion of the person, due to their perceived status.

The TRA is built upon the view that intentions are wholly formed from attitude and the subjective norm. Ajzen and Fishbein (1980) class other possible variables that could affect intentions, such as attitudes towards people or institutions and personality traits, as external variables. External variables are held to have only an indirect effect on intention, through their influence on beliefs, attitude and subjective norm. Attitude and subjective norm are therefore presented as immediate determinants of intention that mediate the influence of external

variables on intention. On these grounds, Ajzen and Fishbein (1980) claim that their model can then be applied to a variety of behaviours, unhindered by the need to consider specific independent variables that may only pertain to the performance of a particular behaviour.

The TRA has been applied to the study of a wide range of behaviours. Ajzen and Fishbein (1980) included drug and alcohol use, voting, contraceptive use, breast feeding and consumer behaviour, as examples of behaviours that were well predicted through use of the model. A comprehensive review by Sheppard et al., (1988) found that, in their examination of 87 cases, the model produced an average correlation of 0.66 between beliefs and intention and an average correlation of 0.53 between intention and behaviour. The review included studies of blood donation, exercise, leisure activities, food consumption and criminal acts.

2.3 The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) (Ajzen, 1991) is a modification of TRA that is designed to include the consideration of behaviours that are not entirely subject to volitional control. The theory introduces an additional variable termed perceived behavioural control (PBC), which is a measure of a person's perceived ability to perform a behaviour. This measure of perceived ability is intended to incorporate a person's consideration of resources and opportunities that are recognised as conditional for the performance of some behaviours. This addition brings a new approach to the formation of intention that is not included in the TRA. The more recent TPB emphasises the activity of planning, as the motivation to perform a behaviour is supplemented with a consideration of the means necessary for its performance.

The TPB has been applied to the study of a variety of behaviours. Ajzen (1991) reviewed a range of these including: voting, playing a video game, losing weight, shop lifting and cheating in an exam. Examples of more recent studies include: the purchase of organic food (Sparks and Shepherd, 1992), newspaper recycling (Boldero, 1995; Cheung, Chan and Wong, 1999), home composting (Taylor and Todd, 1995) and expectations regarding the acceptability of using genetic engineering in food production (Sparks, Shepherd and Frewer, 1995).

The TPB is promoted as an improvement to the TRA, due to its provision for dealing with behaviours that are not entirely volitional. A further advantage in using the TPB is that when PBC is found to be non-significant, the remaining variables, which constitute the more tested TRA, may be utilised to predict behaviour. PBC can be non-significant when the behaviour is volitional and little or no degree of personal control is perceived to be needed for its performance. In addition, problems that require PBC may be ameliorated to the extent that they have no effect on intention.

2.4 Additional determinants of intention

The TRA and the TPB have been recognised as effective means of predicting behaviour from attitudes. The theories has also received criticism, particularly for their claim that all variables of relevance are taken into account (Eagly and Chaiken, 1993). Many of these criticisms have led to the development of variations in the form of additional variables that are promoted as improvements to the model. These proposed variations relate to some behaviours more than others and challenge the generalised way in which the TRA has been applied. The value of

using a variation is therefore subject to its relevance to a particular type of behaviour and should be considered accordingly. Three of these additional variables are considered below.

2.4.1 Past behaviour

Through tests of the assumptions of the TRA, Bentler and Speckart (1979) found that including the effects of past behaviour improved the understanding and prediction of behaviour. They observed that people have a tendency to behave as they had in the past and concluded that past behaviour had an independent influence on intention. Past behaviour is also held to be associated with attitude and subjective norm, which is not inconsistent with the TRA, which considers many external factors to be influential in this manner. The proposal that past behaviour be considered a separate determinant is based on the view that, if prominent, its effect on intention would only be partially related through attitude and subjective norm. More significantly, importance is given to past behaviour due to its prominence in behaviourism as a predictor of future behaviour. Tests by Bentler and Speckart (1979), found evidence to verify this supposition, supporting the establishment of past behaviour as an independent determinant of intention.

2.4.2 Personal morals

Research suggests that for some behaviours a separate measure of personal morals, the subjective assessment of right and wrong, is warranted. Schwartz and Tessler (1972) found that personal normative beliefs, which were defined as personal beliefs about whether the behaviour should or should not be performed, differed from social normative beliefs. Their study of organ donation found that personal normative beliefs had a stronger effect on intentions than social normative beliefs. Zukerman and Reis (1978), similarly found an independent effect for personal morals in the study of blood donation when combined with attitudes and social norms. Gorsuch and Ortberg (1983) present further evidence in a study that included consideration of whether people would return a tax refund overpayment, or work on a Sunday rather than attend church. Their view was that personal morals did not incorporate utilitarian factors and that to obey a personal moral was to respect it as something important in itself.

Personal morals are considered to invoke a sense of duty to adhere to a personal standard of behaviour, which may contrast with personal interests in the performance of a behaviour (Biddle, Bank and Slavings, 1987). Ajzen and Fishbein (1980) assume that moral rules are adequately accounted for in their measure of the subjective norm. Biddle et al. (1987) agree and observe that while a person's own morals are distinguishable from others, personal morals do not develop in isolation and are likely to reflect those of others. More recently, however, Ajzen himself (Beck and Ajzen, 1991) found an independent effect for perceived moral obligation, which incorporates beliefs about right and wrong. Parker, Manstead and Stradling (1995) also studied perceived moral obligation. In their modification of Beck and Ajzen's (1991) design they considered that perceived moral obligation was best measured as a level of anticipated regret that arises when acting in conflict with personal morals. In testing this proposal with respect to reckless driving, perceived moral obligation was found to have a significant independent effect on intention. This finding indicated that a separate measure of personal morals was warranted, because its effect on intention was not adequately translated through attitudinal beliefs or the subjective norm. Therefore, the incorporation of personally held notions of right and wrong, as a separate variable in determining intention, is a consideration for behaviours that are likely to challenge them.

2.4.3 Self-identity

Self-identity is generally interpreted as a label that people use to describe themselves. It is assumed to be the product of social interaction and the cause of subsequent behaviour (Biddle et al., 1987). A number of attitude-behaviour studies have included self-identity as a determinant of intention. Charng, Piliavin and Callero (1988) found that an independent measure of self-identity improved predictions of intentions and behaviour in a study of blood donation. Biddle et al. (1987) found that students' intentions to remain at college were influenced by their self-identity. Granberg and Holmberg (1990) found that intentions to vote were subject to the effects of self-identity.

2.5 Structuring farmer and grower attitudes and intentions.

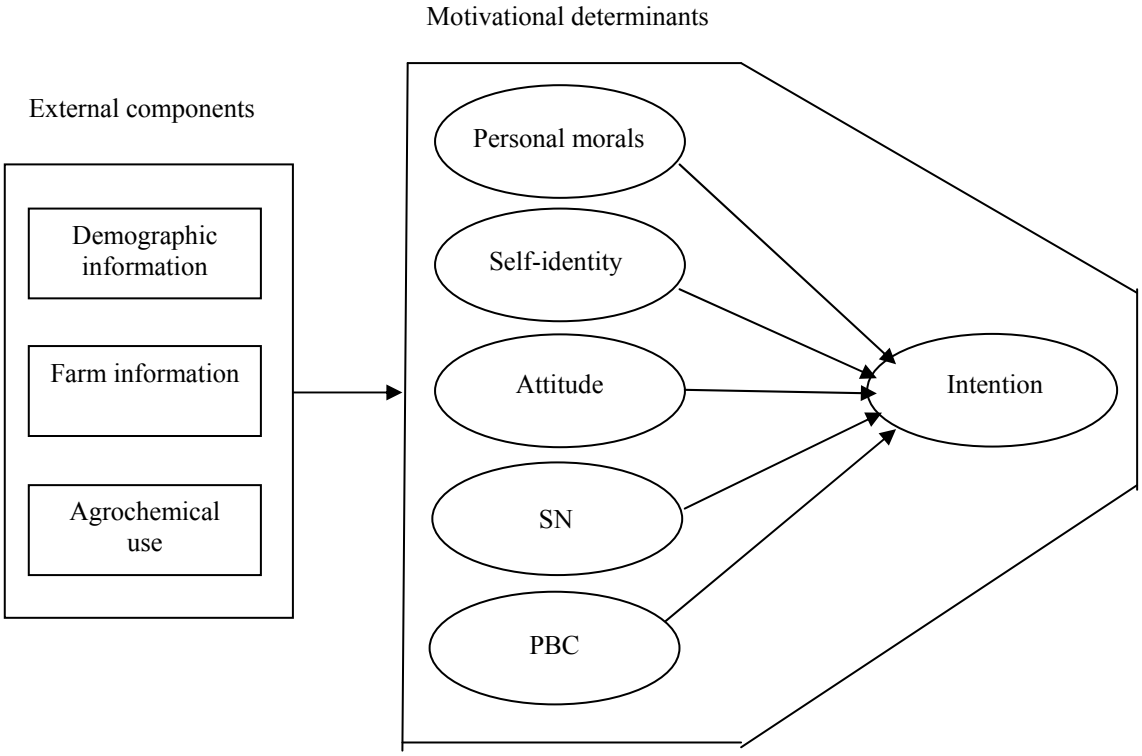
Research indicates that attitude and subjective norm influence behaviours whose performance is subject to the motivations of the individual. It is also evident that other variables can be added to provide a fuller understanding of the reasons for these behaviours. The research presented in this report utilises the other variable approach as promoted by Eagly and Chaiken (1993) and practiced by researchers who extend upon the TRA or TPB. In taking this approach the TRA and the TPB remain central concepts in understanding the intentions of farmers and growers.

Of relevance to the development of this research approach, Gamble et al., (2000) identified a range of influences related to the attitudes of growers towards using gene technology. Studies have also been undertaken of attitudes and intentions towards purchasing GM food (Sharland, 1999; Gamble et al., 2000; Cook, 2000) and of influences on decisions to use, or not use, organic methods (e.g., Fairweather, 1999). Information for the construction of model components and questionnaire items for the study of attitudes and intentions to use gene technology and to purchase GM food were drawn principally from Cook (2000) and Gamble et al., (2000). Information for the construction of model components and questionnaire items for the study of attitudes and intentions to use organic methods were drawn principally from Fairweather (1999). A recent study by Bennett, Meister and Wilkinson (1999) found a modified TPB model useful in understanding farmer and grower motivations towards undertaking practices for sustainable soil management. Their study noted predictive power to be lower where factors relating to a specific farm practice are not accounted for. As this study investigates relationships between factors generally held by farmers and growers to be important influences on their use of organic methods, it would not be unexpected to find low predictive power given that more specific influences pertaining to particular farmers and growers will not be taken into account. In which case the influences used in this study would stand as the most important common influences on decisions to use organic methods as established by the ethnographic decision tree modelling studies.

The proposed model, depicted in Figure 2, comprises the components of the TPB with additional determinants of intention. The TPB is applied, in preference to the TRA, because of its capacity to account for the amount of control a person believes they have over the behaviour. Additional variables are added to the TPB to understand further the motivations that determine intention. As depicted in Figure 2, attitude, subjective norm (SN) and perceived behaviour control (PBC) are hypothesised as determinants of intention, with independent effects also hypothesised for self-identity and personal morals. This model applies to intentions to use gene technology and intentions to purchase GM food. The model for intentions to use organic methods has the same components with past behaviour as an additional determinant of intention. The components of the TPB are defined according to

Ajzen (1991), with attitude being formed from attitudinal beliefs. SN and PBC are measured, however, because these components as generally of less importance than attitude in determining intention the beliefs that constitute these constructs are not measured. The determinant components are linked, because it is not discounted that they are interrelated. The link between intention and behaviour is not depicted because it will not be tested. However, empirical research indicates that intentions generally correspond well with actual behaviour .

Figure 2: A model of Farmer and Grower Intentions



Past behaviour was not expected to have an independent effect on intention to use gene technology, because gene technology is not available to farmers and growers. Past behaviour was also not expected to have an independent effect on intentions to purchase GM food, because the public cannot readily identify these foods. It cannot, however, be discounted that some behaviours, for example, those which could be considered to be expressions of concern for the environment, may be found to have a negative association with attitudes towards these two behaviours. In contrast, past behaviour was expected to be a strong influence on intentions to use organic methods for farmers or growers that already use organic methods. Past behaviour is, therefore, expected to have an independent effect on intentions to use organic methods.

Self-identity is included to embody concern for the environment. Surveys conducted in New Zealand have noted concerns that gene technology could produce harmful environmental effects (Couchman and Fink-Jensen, 1990; Macer; 1994 and 1998). Of some relevance to the study of intentions to use organic methods, Sparks and Shepherd (1992) identified a positive relationship between this form of self-identity and intentions to purchase organically produced food. This form of self-identity was also tested by Sparks, Shepherd and Frewer, (1995) in a variation of the TPB that sought expectations, rather than intentions, regarding the

eating of food produced using genetic engineering and providing support for the development of the technology. Their study did not find evidence of an independent effect for self-identity on intention, however, self-identity was found to be an important determinant of attitude.

Personal morals were hypothesised as a having an independent effect on intention towards using gene technology and purchasing GM food because studies of attitudes towards genetic engineering in New Zealand observe moral objections to the technology (Couchman and Fink-Jensen, 1990; Macer, 1994, 1998; Gamble et al., 2000). Morals have also been linked to attitudes and intentions regarding the use of organic methods with adherence to an organic philosophy being linked to involvement in organic agriculture (Fairweather, 1999).

A number of external components were hypothesised as having an influence on intention through the determinant components. These included demographic measurements including sex, income from the farm, income from other sources and educational qualification. Also, the type of farm, predominant farming activity, gross farm income, the number of years the person has lived in a farming community and whether the person's parents were farmers are tested for relationships with model components. As a measure of propensity to engage in organic production indicators of the use of, and dependency upon agrochemicals were also included. In addition, because this research is designed to inform the debate on the use of genetic engineering in agriculture, respondents were asked their opinion on whether New Zealand should or should not become GE free.

Chapter 3
Survey Method

3.1 Introduction

A postal questionnaire was developed to gather information about the intentions of farmers and growers. The postal questionnaire was selected as the best method of gathering this information, because it allowed for a large number of farmers and growers from various parts of New Zealand to be sampled within the time period available for the study. The questionnaire was designed to test the theoretical models and to provide information that would be valuable for understanding intentions. Information for the development of questionnaire items was principally drawn from Cook (2000) and Fairweather (1999). The design of the questionnaire items and the measurement of these items conform to the recommendations of Ajzen and Fishbein (1980) and Ajzen (1991).

3.2 The questionnaire

Questionnaire items were presented in an A4-size booklet with questions on facing pages. A copy of the questionnaire is provided in Appendix 1. A letter of introduction stating the purpose of the questionnaire, introducing the topics in the questionnaire and inviting voluntary participation was included at the start of the booklet. Instructions were also provided that explained the terms used in the questionnaire and prompted consideration of the possibility that gene technology could be available for farmers within the next ten years. This prompt was provided because an individual is less likely to form an intention to perform a behaviour when they do not have the means to perform it (Ajzen and Fishbein, 1980). Introducing the possibility of being able to perform the behaviour (to use gene technology) facilitates intention formation. Intention to use gene technology is therefore interpreted in light of the possibility that gene technology may be available to farmers rather than the present situation in which gene technology is not available.

The following sections cover the major categories of items used in the questionnaire. Measurements for the main components of the intention models are covered first, followed by external components and remaining items. Please note that for some items the scales provided for taking responses in the questionnaire do not represent the scales used for their statistical analysis.

Intention
Intentions to use gene technology, purchase GM food and use organic methods were assessed using three separate items. Response was measured on fully labelled seven-point scales. For example, intentions to use gene technology was measured using a seven-point scale anchored by (1) ‘I have a very strong intention to use gene technology’ and (7) ‘I have a very strong intention not to use gene technology’.

Attitude
Attitude towards the three behaviours was assessed by asking how favourable or unfavourable was the respondents attitude was towards the three behaviours. Response was measured using a single scale anchored by (1) 'Extremely unfavourable' and (7) 'Extremely favourable'.

Subjective norm
Subjective norm (SN) was assessed by having respondents indicate their level of agreement with five statements, with measurements taken on a seven-point scale anchored by (1) 'Very strongly agree' and (7) 'Very strongly disagree'. SN was assessed for the use of gene technology and use of organic methods using paired questions. One of the questions measured the SN for others who influence their business decisions and the other question measured the SN for others who were of importance to the respondent. The two items were summed to provide a measure of SN. The SN measure for purchasing GM food was assessed using a single question regarding people's views who were of importance to the individual.

Perceived Behaviour Control
Perceived Behaviour Control (PBC) was assessed by asking, 'How much personal control do you think you have over the following decisions', with responses taken on a seven point scale anchored by (1) 'No control at all' and (7) 'Complete control'. The three behaviours were presented with the addition of 'The business decisions on your farm', as it was presumed that this is an important control factor that may not have otherwise been adequately accounted for by the general measures of perceived control. PBC for using gene technology was derived by the summation of control over this behaviour with control over business decisions. Similarly, PBC for using organic methods was derived by the summation of control over this behaviour with control over business decisions. PBC for purchasing GM food was measured without including control over business decisions.

Personal morals
Personal morals were measured by having respondents indicate their level of agreement with four statements. Measurements were taken on a seven-point scale anchored by (1) 'Very strongly agree' and (7) 'Very strongly disagree'. Each of the statements represented an ethical or moral position related 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 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). The ethical positions were drawn from Armstrong and Botzler (1993). The position that best describes a personal moral for each model was selected by establishing which position was most important in relation to each intention. Importance was derived from comparative weightings interpreted from the coefficients of each intention when regressed onto the four positions.

Self-identity
Self-identity was assessed by asking for the level of agreement, or disagreement with the statement 'I believe I am the type of person who is concerned about the environment'. Measurement of self-identity was taken on the same agreement or disagreement scale used for assessing personal morals.

Beliefs about the consequences of using gene technology
Eight attitudinal beliefs about the outcomes of using gene technology were assessed. The beliefs were derived from Cook (2000) where they were identified in focus groups which discussed the use of gene technology in food production (N=26). In this study these beliefs were found to be significant determinants of intentions to purchase GM food in a survey of Canterbury residents (N=266). Many of these beliefs were also identified by Gamble et al. (2000) and a similar set of beliefs have been tested in a TPB model of expectations regarding the use of gene technology in food production (Sparks et al., 1995). These beliefs formed

sixteen questions about consequences of the use of gene technology. Each belief was measured using two questions, one question assessed the importance of the consequence and one question assessed the likelihood of its occurrence. 'Importance' was measured on a seven-point scale of desirability, as used in a TPB study by Ajzen and Driver (1992) and likelihood was measured on a seven-point scale, as recommended by Ajzen and Fishbein (1980).

The summation of these beliefs was undertaken by first multiplying together the likelihood and desirability scores for each of the eight beliefs. The products were then summed. This produced a single measure of beliefs to be tested for correspondence with attitude towards using gene technology. A summation of these beliefs was also tested for correspondence with attitude towards purchasing GM food.

Beliefs about the consequences of using organic methods
Nine attitudinal beliefs about the consequences of using organic methods were assessed. The beliefs were derived from Fairweather (1999) where they were developed from interviews with New Zealand farmers and growers (N=83). In this study these beliefs were found to be important determinants of decisions to undertake, or not undertake, organic farming. These beliefs were also identified as important in studies by Fairweather and Campbell (1998), Campbell, Fairweather and Steven (1997) and Coombes, Campbell (1996). The measurement of these beliefs and their summation was undertaken using the same method used to measure beliefs about the consequences of using gene technology. The summation of these beliefs was tested for correspondence with attitude towards organic farming.

Past behaviour
Past behaviour was measured by asking whether the production of organic produce was undertaken on the farm. It was also asked whether the production of 'green produce' was undertaken, or whether the farm was involved in a quality assurance scheme or programme. An indication of whether these undertakings were formalised was sought by asking whether registration or certification was held for these undertakings. Current involvement in organic production and production of 'green' produce were expected to be significant determinants of intentions to use organic methods. Information regarding a quality assurance scheme or programme was sought to provide a better understanding present farming practices.

Considered organic production and biggest barrier
A measure was taken of whether or not farmers who were not already involved in organic production had seriously considered undertaking organic production. Those who were considering organic production were asked to indicate which of three barriers ({1} not economically feasible, {2} not technically feasible, {3} not compatible with current high production low cost farming) was the most important in preventing them undertaking organic farming. The barriers were drawn from Fairweather (1999). These measurements were taken to find out which of these three common barriers to undertaking organic production was most prominent.

Actions to reduce the use of chemicals
Actions undertaken on the farm to either reduce or replace the use of chemicals were also assessed. These assessments were undertaken to identify whether actions, which could be considered organic practices, were being undertaken. Indication was sought as to whether each of 15 actions had been done on the farm to either reduce or replace the use of chemicals. Which actions were important in relation to intentions were determined by interpreting their relative importance when loaded as dummy variables in a regression analysis. The

relationship with these actions and intentions to use organic methods were examined and also the relationship between these actions and intentions to use gene technology was explored.

Chemical expenditure and dependency on agrochemicals
Three separate assessments were made of how dependent the farm was on agrochemicals for the management of pests, the management of weeds and the level of dependency on manufactured fertilisers. A separate assessment was also made of changes in expenditure on agrochemicals. These assessments were made to investigate the relationship between prior actions and their relationship with intentions to use organic methods and to explore their relationship with intentions to use gene technology.

Consumer demand
An assessment was made of the influence of consumer demand for environmentally friendly production, and the influence of consumer demand for produce with less chemical residues, on farming practices. These influences were measured on seven-point scales anchored by (1) not influential at all, and (7) extremely influential. These assessments were made to investigate the relationship perceived consumer preferences and intentions

GE free
Measurements were taken of the level of agreement or disagreement with New Zealand becoming GE free and New Zealand not becoming GE free. These measurements were taken on the same agreement or disagreement scale used for assessing personal morals.

Prominent farming activity
Information was sought regarding the most predominant farming activity undertaken on the farm. Seventeen activities were provided with a category labelled 'other' for an activity that was not presented. The 'other' category asked for the activity to be specified. This measure facilitated the examination of relationships between the predominant farming activity and other survey information.

Demographic Information
Information was sought regarding sex, age, education and personal income. Income information was collected by asking for personal income from the farm and income from other sources. Income information then served as an indicator of whether or not the farm was the principle source of the respondent's income. Both incomes were added to provide personal income. Demographic information was sought to enable comparisons to be made with census information and to explore relationships between the information and other survey information.

Information was also sought regarding gross farm income; what the person's position was (in terms of ownership or responsibility) in relation to their farm; the number of years they had lived in a farming community and whether their parents were farmers. This information was sought to provide more depth to understanding the views of respondents and to explore relationships between this information and other survey information.

Additional information

Information regarding the type of farm was provided with the random sample of farmers used for distributing the questionnaire. This information is available for a list of farms in New

Zealand with the random sample derived from this list. Farm type therefore provided a ready means of assessing the representativeness of the returned questionnaires.

3.3 Pre-testing

Seven individuals from farming families, with no connection to the university, completed the questionnaire and subsequently provided their thoughts and opinions about the questionnaire and the questionnaire topics. In addition, a number of researchers involved in the study of organic farming were also consulted. Subsequently, minor adjustments were made to questionnaire items before producing the questionnaire presented in this report.

3.4 Survey distribution

A total of 1,950 questionnaires were distributed to randomly selected farms in New Zealand. The questionnaire was posted to farmers in the form of a booklet with a freepost return envelope. A random list of farmer addresses was provided by Quotable Value from their list of properties in New Zealand. The organisation also provided information of farm type for both the survey sample and for their list of properties. The questionnaires were posted on May 10th, 2000. In addition, a polite reminder postcard, to encourage return of the questionnaire, was posted on May 22nd 2000.

Chapter 4
Results

4.1 Introduction

This chapter presents basic questionnaire results and results of statistical analyses designed to test the models of farmer intentions. The response rate for the postal questionnaire is provided, followed by the presentation of demographic information and an evaluation of the representativeness of the questionnaire. Descriptions of the remaining items are provided with an explanation of the construction of model components. The models of farmer intentions are then analysed and relationships between model components and external components are examined.

4.2 Response rate and Representativeness of the Sample

Within five weeks of posting the 1,950 questionnaires, 680 were returned. In addition, 70 were returned undelivered, 16 were returned because the respondent was no longer farming or had leased out the property, and three were returned because the farmer had passed away. Of the 680 questionnaires returned, 24 had too few responses to be included in the analysis and the remaining 656 useable questionnaires were coded for analysis. The response rate from those questionnaires delivered to those presently farming was 35.25 per cent. In comparison with other research in the topic area the response rate was higher than Cook (2000) (22.39 per cent) and Gamble et al. (2000) (12 per cent recruitment rate). Response rates from farmer surveys have decreased since the 1970s. Figure 3 shows response rates from farmer surveys conducted by the AERU since 1979. The 35 per cent for the present survey is in line with the overall declining rate.

Because some questionnaires did not have responses for every item, the number of responses to each item is included with the analysis. Subsequently, 619 cases were included in analysis of the model of intentions to use gene technology, 626 cases were included in analysis of the model of intentions to purchase GM food and 622 cases were included in analysis of the model of intentions to use organic methods. Examination of relationships between external components and model components is restricted to these numbers.

Demographic information (sex, income, qualification and age) from the questionnaire was coded to enable comparison with census information about New Zealand farmers. Frequencies per category and percentages per category for sex, income, qualification and age are provided in Table 1. In addition, percentages of the population of New Zealand farmers, derived from census information (Supermap3) are also provided in the last column of the table. Census information was limited to people over the age of 15 to more closely correspond with the age of survey respondents. Table 1 also provides farm type for comparison with data from Quotable Value New Zealand, and farm size data which is compared to information from Statistics New Zealand (Agricultural Statistics).

Figure 3: AERU Farmer Survey Response Rates, 1979-2000

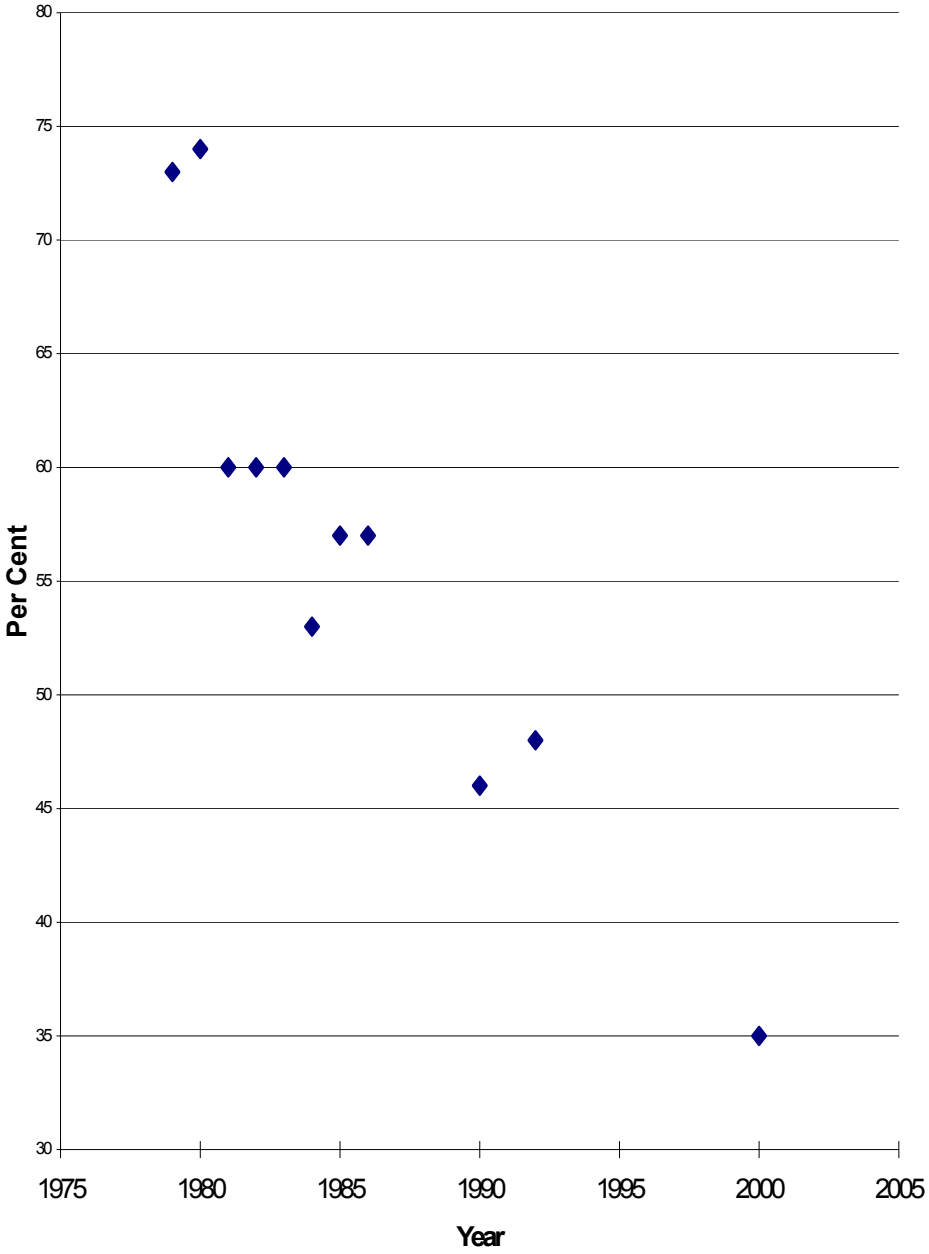


Table 1: Comparison of Sample and Population Data

Item	Freq.	%	Population %
Sex (n=645)			
Male	506	78.4%	69.0%
Female	139	21.6%	31.0%
Income (n=484)			
< $5000	21	3.2%	15%
$5001-$10000	20	3.0%	11.3%
$10001-$15000	30	4.6%	13.6%
$15001-$20000	55	8.4%	12.4%
$20001-$25000	48	7.3%	10.7%
$25001-$30000	38	5.8%	9.7%
$30001-$40000	68	10.4%	9.8%
$40001-$50000	68	10.4%	4.6%
$50001-$70000	50	7.6%	4.1%
$70001-$100000	45	6.9%	2.3%
$100000+	41	6.3%	3.4%
Qualifications (n=631)			
No qualification	179	27.3%	15.8%
School certificate	97	14.8%	16.6%
Sixth form certificate or UE	89	13.6%	10.6%
Higher school qualification	22	3.4%	3.9%
Trade certificate or equivalent	156	23.8%	23.6%
Bachelors degree	59	9.0%	3.4%
Further qualifications	29	4.4%	1.1%
Age (n=626)			
15-24	2	0.3%	15.8%
25-34	25	3.8%	19.6%
35-44	176	26.8%	24%
45-54	206	31.4%	20.9%
55-64	135	20.6%	13.1%
65+	82	12.5%	6.5%
Farm Type (n=649)			
Horticulture	89	13.6%	10.8%
Pastoral	342	52.1%	56.3%
Specialist livestock	30	4.6%	4.0%
Dairy	166	25.3%	25.3%
Arable	22	3.4%	3.4%
Farm Size (n=645)			
< 5	22	3.6%	12.7%
5-9	23	3.7%	9.4%
10-19	36	5.9%	9.4%
20-39	61	9.9%	10.3%
40-59	56	9.1%	7.9%
60-99	98	15.9%	12.1%
100-199	118	19.2%	14.9%
200-399	93	15.1%	12.8%
400-799	68	11.1%	6.1%
> 800	40	6.5%	4.3%

Using the information provided in Table 1, Chi-square tests of goodness of fit between information about the respondents and frequencies derived from information about New Zealand farmers were used to test whether survey respondents were representative of New Zealand farmers. The results of these tests are provided in Table 2.

Table 2: Chi-square Tests of Representativeness

	Chi-square	Degrees of Freedom	Significance
Sex	26.92	1	0.000
Income	357.02	10	0.000
Qualification	116.11	6	0.000
Age	296.227	5	0.000
Type	7.22	4	0.124
Size	119.96	9	0.000

As is evident from Table 2, in terms of sex, income, qualification and age there were significant differences ($p < 0.001$) between respondent information and census information. These differences are evident in Table 1 with: a higher proportion of males responding than females; fewer low-income respondents; fewer respondents with no qualification and a smaller proportion of responses from younger age groups.

No significant difference ($p > 0.05$) was found between farm type and information from Quotable Value New Zealand on farm type. A significant difference ($p < 0.001$) was, however, found between farm size and farm size data from the Agricultural Statistics.

Based on this analysis the sample is representative of New Zealand farmers in terms of farm type. The differences for other factors can be attributed to the nature of the samples used for the comparisons. The survey sought responses from a sample of farm owners. Census data provides information about respondents who report themselves to be farmers and who may or may not be farm owners. In addition, the Agricultural Statistics provide information for only 61,137 farms, whereas the sample, supplied by Quotable Value, was taken from a list of 106,880 holdings. These differences are very likely to be the main reasons why the respondent sample does not match the data from these other populations. However, where the respondent sample is compared to the population from which the survey sample was drawn the results suggest strongly that the respondent sample is representative of the population.

4.3 Basic Questionnaire Results

Means and standard deviations for variables measured with ordinal data are provided in Table 3. Frequencies for variables measured using nominal data are provided in Table 4 and Table 5. The data relating to these variables are presented prior to their use for analysis in the models of farmer intentions.

Table 3: Means and Standard Deviations for Ordinal-level Variables

Item	Range	n	Mean	Std. Dev.
Attitude towards using gene technology	-3 to 3	647	-0.58	1.78
Attitude towards using organic methods	-3 to 3	649	0.73	1.45
Attitude towards purchasing GM food	-3 to 3	652	-0.98	1.62
Subjective norm for using gene technology	-6 to 6	636	-0.90	2.91
Subjective norm for using organic methods	-6 to 6	638	0.98	2.49
Subjective norm for purchasing GM food	-3 to 3	641	-0.81	1.45
PBC for using gene technology	2 to 14	648	11.82	2.19
PBC for using organic methods	2 to 14	649	12.16	2.03
PBC for purchasing GM food	1 to 7	652	5.51	1.66
Intention to use gene technology	1 to 7	649	-0.64	1.36
Intention to use organic methods	1 to 7	650	0.29	1.25
Intention to purchase GM food	1 to 7	650	-0.85	1.36
Self-identity	-3 to 3	652	1.83	0.99
Anthropocentricism	-3 to 3	650	-0.47	1.70
Deep ecology	-3 to 3	646	-0.02	1.64
Eco-feminism	-3 to 3	648	1.32	1.34
Eco-centrism	-3 to 3	624	0.97	1.29
Try to achieve GE free status	-3 to 3	644	0.49	1.81
Try not to and achieve GE free status	-3 to 3	641	-0.37	1.86
Sum of GE consequences	-45 to 63	616	-0.52	17.83
Sum of organic consequences	-72 to 90	612	-12.91	22.75
Increase in expenditure on chemicals	-3 to 3	630	-0.42	1.02
Dependency on chemicals for pest control	1 to 7	618	2.66	1.54
Dependency on chemicals for weed control	1 to 7	632	3.32	1.47
Dependency on manufactured fertilisers	1 to 7	635	4.20	1.73
Influence of demand for environmentally friendly production	1 to 7	617	4.00	1.63
Influence of demand for produce with less chemicals	1 to 7	615	4.34	1.65
Years farming	2 to 90	638	38.42	17.57

Interpretation of the results provided in Table 3 shows that most respondents had a negative attitude towards using gene technology and purchasing GE food, whereas attitude was generally positive towards using organic methods. SN for using gene technology was constructing by adding measurements of the perceived views of important others ($\bar{x}$ -0.55, sd 1.54, range –3 to 3, n = 643) with measurement of the perceived views of people who influence respondents' business decisions ($\bar{x}$ -0.36, 1.52, range –3 to 3, n = 637). Similarly, SN for using organic methods was constructing by adding measurements of the perceived views of important others ($\bar{x}$ 0.35, sd 1.34, range –3 to 3, n = 638) with measurement of the perceived views of people who influence respondents' business decisions ($\bar{x}$ 3.35, sd 1.36, range –3 to 3, n = 641). SN for purchasing GM food used the measure of the views of others of this behaviour. SN was generally negative for using gene technology and purchasing GM food, with a generally positive SN for using organic methods.

PBC for using gene technology was derived by adding perceived control over using the technology ($\bar{x}$ 5.76, sd 1.42, range 1 to 7, n = 649) with perceived control over the business decisions for the farm ($\bar{x}$ 6.06, sd 1.18, range 1 to 7, n = 650). Perceived control over business decisions was also added to perceived control over using organic methods ($\bar{x}$ 6.09, sd 1.11, range 1 to 7, n = 654) to produce PBC for using organic methods. PBC for purchasing GM food was derived from a single item. PBC was generally above the mid point on the measurement scales indicating a moderate to high level of PBC for performing the

three behaviours. In general PBC was higher for using organic methods and for using gene technology than for purchasing GM food.

Intention to use gene technology and purchase GM food was generally negative, while intention to use organic methods was generally positive. Intention to purchase GM food was more negative than intention to use gene technology. Examination of frequency of these responses shows that 44.2 per cent had a negative intention towards using gene technology, 34.7 per cent had no intention to either use or not use the technology and 21.1 per cent had a positive intention to use the technology. Forty-nine per cent of respondents had a negative intention towards purchasing GM food, 38.5 per cent had no intention to either purchase or not purchase and 12.5 per cent had a positive intention towards purchasing the food. Positive intentions (37.4%) were more predominant for the use of organic methods with 44 per cent having no intention to either use or not use organic methods and 18.6 per cent having a negative intention.

Investigation of the relationship between intentions to use organic methods and intentions to use gene technology found a significant, though only moderate correlation, between these items ($r = -0.32$, $p < 0.001$, $n = 648$). Cross-tabulation shows that 41 respondents had positive intentions to perform both behaviours. These 41 constitute 16.9 per cent of those who had a positive intention to use organic methods. Intentions to use gene technology and intentions to purchase GM food were also only moderately correlated ($r = 0.34$, $p < 0.001$, $n = 648$).

In the measure of self-identity, most respondents indicated they considered themselves to be someone who was concerned about the environment. In general, respondents did not agree that nature exists primarily for human use (anthropocentricism). Responses were generally neutral regarding the accordance of equal moral weight to all life forms (deep ecology). Respondents generally agreed with the need to learn to co-exist with the environment (eco-feminism) and agreed that nature possesses intrinsic values independent of human valuation (bio-centrism).

In general, respondents agreed (49.1 per cent) rather than disagreed (32.2 percent) that New Zealand should try to become GE free. Overall 20.5 per cent of respondents very strongly agreed that New Zealand should try to become GE free. Respondents in general disagreed with the assertion that New Zealand should not try and become GE free. There was a strong negative correlation between these two responses ($r = -0.83$, $p < 0.001$, $n = 634$).

Regarding the use of agrochemicals, in general a small reduction in expenditure was indicated by respondents. In general, respondents were only moderately dependant on agrochemicals for the management of pests while comparatively more dependant on agrochemicals for the management of weeds. Of the three items measured on the dependency scale, respondents indicated higher dependency on manufactured fertilisers than for other items.

Consumer demand for envonmentally friendly production was moderately influential on farming practices. Consumer demand for produce with less chemical residues was also moderately influential on farming practices.

Frequency measures for remaining items are presented in Table 4 (see over next page). The most common practices undertaken to reduce or replace the use of chemicals was monitoring the use of manufactured fertilisers. Other common practices in order of highest frequency were: the use of animals to manage pest or weed problems, being selective over treatments for

animals and avoiding the use of certain herbicides. The least common practice was monitoring water for chemical residues.

Sixty-four (ten per cent) of respondents indicated they were involved in organic production. Six of these (just under one per cent of respondents) had certification of their organic status, which is in correspondence with estimates of farmer and grower involvement based on certification (one percent of farmers and growers). There were 111 (17 per cent) who indicated involvement in 'green' production and 317 respondents (48 per cent) who were involved in a quality assurance scheme or programme. Two hundred and fifty four (43 per cent) respondents indicated they had seriously considered organic production. Respondents believed that the single biggest barrier to their producing organic or 'green' produce was that it was not economically feasible. Most respondents were either farm owners or shared in the ownership of a farm. Only 25 respondents (4.4 per cent) were not involved in ownership of the farm.

The predominant farming activity is presented in Table 5 (next page). Dairy-factory supply and pastoral-fattening were the most commonly indicated predominant activities, followed by pastoral-grazing and kiwifruit. Interpretation of these responses, however, needs to account for a large number of incorrect responses to this item. One hundred and forty respondents (22.3 per cent) indicated more than one activity when asked to indicate their single most predominant farming activity. These responses, which should technically be excluded from consideration, are presented though the inability of respondents to clearly indicate their predominant farm activity impedes examination of this item.

4.4 Analysis of Intention Models

Regression analysis was undertaken to investigate the relationships between intentions and components hypothesised as determinants of intention. Self-identity, environmental norm and requisite measures of attitude, subjective norm and PBC were regressed onto intentions to use gene technology, purchase GM food and intention to use organic methods. The regression on intention to use organic methods included involvement in organic practices, which because of its categorical nature, was included as a dummy variable. The consequences of performing each behaviour were analysed individually and the relationship between the summation of these consequences and each attitude was analysed using correlation analysis. Relationships between external components and components of the intention models were analysed using either correlation, t-tests or chi square. These relationships are discussed in relation to intention.

Prior to undertaking analysis of these models, the environmental norm that was most closely related to each intention was selected. Interpretation of the relative importance from the coefficients of these variables in regression analysis on intention to use gene technology found that: eco-feminism (β -0.25 $p < 0.001$) was more important than deep ecology (β -0.11, $p < 0.001$) with anthropocentrism and eco-centrism being non-significant ($p < 0.05$). Eco-feminism was also most important (β -0.23, $p < 0.001$) when compared with deep ecology (β -0.12, $p < 0.001$) and anthropocentrism and eco-centrism being non-significant ($p < 0.05$) in a regression model on intention to purchase GM food. In a regression model on intentions to use organic methods eco-feminism was also most important (β 0.16, $p < 0.001$) when compared with eco-centrism (β 0.12, $p < 0.01$), deep ecology (β 0.09, $p < 0.01$) and anthropocentrism (β -0.07, $p < 0.05$). Eco-feminism was therefore used to represent personal environmental norm in the analysis of the three intention models.

Table 4: Frequency Measures for Nominal-level Variables

Item	Freq.	%	Item	Freq.	%
Practices to reduce or replace the use of chemicals (N=656)			**Involved in production of organic produce (N=656)**	64	10
Received professional advice on either the use, storage or disposal of chemicals.	215	33	**Involved in production of 'green' produce (N=656)**	111	17
Monitored the use of chemicals or fertilisers.	299	46			
Monitored the soil for levels of chemical residues.	102	16	**Quality assurance scheme or programme (N=425)**	317	48
Monitored water for levels of chemical residues.	88	13			
Adopted practices or treatments to avoid or replace the use of certain insecticides.	228	35	**Certification (N=656)**	132	20
Adopted practices or treatments to avoid or replace the use of certain herbicides.	231	35	**Seriously considered organic production (N=584)**	254	43
Applied manure to improve the soil to avoid or replace the use of manufactured fertilisers.	196	30			
Grown legumes to improve the soil to avoid or replace the use of manufactured fertilisers.	120	18	**Single biggest barrier to organic production (N=308)**		
Adopted practices to encourage natural insect predators.	156	24	Not economically feasible	121	39
			Not technically feasible	90	29
Used crop rotation to manage pest or weed problems.	141	23	Not compatible	97	31
Used cultivation methods to manage pest or weed problems.	197	29	**Parents farmers (N=650)**	495	76
Used animals to manage pest or weed problems.	294	45			
			Position (N=649)		
Been selective over food or food additives for animals.	193	29	Owner	388	60
			Shared owner	236	36
Been selective over pharmaceutical treatments for animals.	268	41	Paid manager	8	1
			Paid farm worker	10	2
Been selective over treatments for pests or disease control for animals.	268	41	Member of family	1	0
			Paid spouse	4	1
			Other	2	0

Table 5: Predominant Farming Activity

Predominant Activity	Freq.	%	Prominent Activity	Freq.	%
Dairy- factory supply	158	25	**Pastoral –** fattening	155	25
- Town supply	6	1	- grazing	78	12
			- high country	11	2
Arable – irrigated	7	1	- stud	8	1
- Not irrigated	5	1			
Horticulture - berry fruit	2	0	**Others** - Dairy more than one	2	0
- citrus	2	0	Pastoral more than one	70	11
- flowers	5	1	Arable more than one	1	0
- glasshouse	7	1	Horticulture more than one	22	4
- kiwifruit	17	3	Pastoral and arable	22	4
- market gardening	5	1	Dairy and pastoral	12	2
- pip fruit	9	1	Dairy and horticulture	5	1
- stone fruit	4	1	Horticulture and pastoral	6	1
- vineyards	5	1	Dairy and arable	4	1

4.4.1 Intention to use Gene Technology

Means and standard deviations for model components are provided in Table 6. The result of the regression analysis for the model of intention to use gene technology is provided in Table 7. As is evident from Table 7, significant ($p < 0.05$) independent effects were found for environmental norm, attitude, SN and PBC. The independent effect of self-identity on intention was non-significant ($p > 0.05$). Attitude ($\beta = 0.451$, $p < 0.001$) had the most influence on intention followed by SN ($\beta = 0.13$, $p < 0.001$), environmental norm ($\beta = -0.07$, $p < 0.001$) and PBC ($\beta = 0.06$, $p < 0.001$). The analysis therefore supports the assertion that attitude is an important influence on intention to use gene technology, while subject to the perceived views of important others. Support is also given to the proposal that intention is also influenced by an environmental norm, which favours coexistence with the natural environment. The degree of control a person has over whether or not they can use gene technology also has a small influence on intention.

Table 6: Means and Standard Deviations for Model Components

Item	Range	Mean	Std. Dev.
Attitude towards using gene technology	-3 to 3	-0.58	1.77
Subjective norm for using gene technology	-6 to 6	-0.89	2.91
PBC for using gene technology	2 to 14	11.82	2.19
Intention to use gene technology	1 to 7	-0.54	1.51
Self-identity	-3 to 3	1.83	0.99
Environmental norm (Eco-feminism)	-3 to 3	1.31	1.35

Note: n = 619 for all components.

Table 7: Regression on Intentions to use Gene Technology

R^2 0.59, df 5, F = 173.61, Sign. of F = 0.0000, n = 619			
Variable	β	**T**	**Sig T**
Environmental norm	–0.079	–0.071	.0128
Attitude	0.451	14.306	.0000
SN	0.132	7.046	.0000
Self-identity	0.008	0.005	.8452
PBC	0.061	–2.168	.0305

A strong positive relationship was found between attitude and the sum of consequences of using gene technology ($r = 0.63$, $p < 0.001$, $n = 616$). Thus, those who intend to use gene technology are more likely to perceive positively the consequences of using gene technology. Mean scores and standard deviations for the likelihood and desirability items that comprise these consequences are provided in Table 8. These results show that, overall, nearly all perceived consequences were generally held to be likely to occur, with the exception of consumer acceptance. The most likely perceived consequence was increased food production. New risks to public health, adverse effects for future generations, damage to ecological systems and personal risk, were generally considered undesirable consequences. The most desirable consequence was enhanced economic growth, though this consequence had the smallest likelihood.

Table 8: Means and Standard Deviations For Likelihood and Desirability of Consequences of Gene Technology

		Likelihood	Desirability
Better quality food	Mean	0.16	0.57
	Std dev	1.72	1.57
New risks to public health	Mean	0.52	-1.61
	Std dev	1.58	1.37
Enhanced economic growth	Mean	0.02	0.8
	Std dev	1.56	1.49
Consumer acceptance	Mean	-0.32	-0.14
	Std dev	1.39	1.62
Adverse effects for future generations	Mean	0.43	-1.73
	Std dev	1.59	1.39
Damage to ecological systems	Mean	0.60	-1.76
	Std dev	1.59	1.32
Increased food production	Mean	1.14	0.66
	Std dev	1.31	1.53
Personal risk	Mean	0.57	-1.81
	Std dev	1.58	1.38

Note: Desirability and likelihood range = -3 to 3, n = 616 for all items.

Table 9 provides a summary of the analysis of the relationships between external components and model components (see Appendix 2 for the relevant statistical data). This analysis shows that most of the external components had significant relationships (correlation analysis or t-tests, $p < 0.05$) with intention and one or more than one determinant of intention (environmental norm, attitude, SN and PBC).

Interpretation of the analysis summarised in Table 9 (next page) shows 15 components identified as being associated with intention to use gene technology. All components, that are associated with intention, are identified as having associations with one or more than one of the immediate determinants of intention (environmental norm, attitude, SN and PBC). Income, change in expenditure on chemicals, age and whether the respondents parents were farmers were not identified as associated with intention, however, their association with the determinants of intention indicates they are nevertheless influential on intention. No external component had a significant association with PBC, which was the least important determinant of intention.

It is evident from this analysis that positive intentions towards using gene technology are associated with: greater dependency on agrochemicals for pest and weed control, greater dependency on manufactured fertilisers, increased expenditure on chemicals, the opinion that New Zealand should not try and become GE free, and higher gross farm income. The analysis also shows that males were more likely to intend to use gene technology than females. In addition, respondents who were involved in organic production were less likely to intend to use gene technology, as were respondents who were involved in 'green' production. Those who had seriously considered organic production were also less likely to intend to use gene technology.

4.4.2 Intention to Purchase GM food

Means and standard deviations for components of the model of intention to purchase GM food are provided in Table 10. Results of the regression analysis for intention to use gene technology are provided in Table 11. Overall, these results are similar to those just presented for intention to use gene technology in terms of relative importance and significance of respective components, though PBC was found to non-significant in this analysis. As is evident from the table, significant ($p < 0.05$) independent effects were found for environmental norm, attitude and SN. The independent effects of self-identity and PBC on intention were non-significant ($p > 0.05$). Attitude ($\beta = 0.45$, $p < 0.001$) has the most influence on intention followed by SN ($\beta = 0.23$, $p < 0.001$) and environmental norm ($\beta = -0.08$, $p < 0.01$). The analysis therefore supports the assertion that attitude is an important influence on intention, while subject to the perceived views of important others. Support is also given to the proposal that intention is also influenced by an environmental norm.

Table 9: Relationships Between External Components and Components of the Model of Intention to use Gene Technology

	Env. norm	Attitude	SN	PBC	Intention
Try to achieve GE free status	+ve	-ve	-ve		-ve
Try not to achieve GE free status	-ve	+ve	+ve		+ve
Gross farm income	-ve	+ve			+ve
Income		+ve			
Influence of demand for produce with less chemicals	+ve	-ve	-ve		+ve
Dependency on chemicals for pest control	-ve	+ve	+ve		+ve
Dependency on chemicals for weed control	-ve	+ve	+ve		+ve
Dependency on manufactured fertilisers	-ve	+ve	+ve		+ve
Influence of demand for environmentally friendly production	+ve	-ve	-ve		-ve
Increase in expenditure on chemicals	-ve		+ve		+ive
Age			+ve		
Sex	* Mean higher for females	*Mean higher for males	*Mean higher for males		*Mean higher for males
Parents farmers	* Mean higher for parents not farmers	* Mean higher for parents farmers			
Considered organic production		* Mean higher for not considered	* Mean higher for considered		* Mean higher for not considered
Involved in organic production	* Mean higher for not involved		* Mean higher for not involved		* Mean higher for not involved

Note: +ve = positive relationship, -ve = negative relationship, * = difference between means. Significant relationships ($p < 0.05$) established through either correlation or t-tests

Table 10: Means and Standard Deviations for Model Components

Item	Range	Mean	Std. Dev.
Attitude towards using gene technology	-3 to 3	-0.99	1.61
Subjective norm for using gene technology	-6 to 6	-0.81	1.45
PBC for using gene technology	1 to 7	5.51	1.64
Intention to use gene technology	-3 to 3	-0.86	1.64
Self-identity	-3 to 3	1.82	0.99
Environmental norm (Eco-feminism)	-3 to 3	1.31	1.34

Note: n = 632 for all components.

Table 11: Regression on Intentions to Purchase GM food

R^2 **0.54, df 5, F = 147.7, Sign. Of F = 0.0000, n = 632**			
Variable	β	**T**	**Sig T**
Environmental norm	–0.081	–2.684	.0075
Attitude	0.450	16.102	.0000
SN	0.230	7.483	.0000
Self-identity	0.048	–1.224	.2214
PBC	0.021	–0.929	.3532

Consequences of using the technology were found to have a significant correlation with attitudes towards purchasing GM food ($r = 0.6$, $p < 0.001$, $n = 616$). A summary of the results of the analysis of the relationship between external components and model components is provided in Table 12. Twelve external components were identified as having being related to intention. In addition, respondents whose parents were farmers were related to environmental norm and attitude, which would ultimately affect intention. As found for the model of intention to use gene technology, external components identified as associated with intention were also found to be associated with one or more than one of the determinants of intention. This indicates that the effect of external components on intention was being mediated by the three determinants.

The analysis shows positive relationships between intention and a number of external components. Positive intentions were associated with: greater dependency on agrochemicals for pest and weed control, greater dependency on manufactured fertilisers, increased expenditure on chemicals, the opinion that New Zealand should not try to become GE free and higher personal income. The analysis also shows negative relationships between intention and a number of external variables including the influence of consumer demand for produce with less chemicals and demand for environmentally friendly production. Positive intentions were also associated with an increase in expenditure on chemicals. The analysis also found that males were more likely to intend to use purchase GM food than females. Respondents who were involved in organic production were unlikely to intend to purchase GM food as were respondents who were involved in green production. Those who had seriously considered organic production also indicated they were less likely to intend to purchase GM food.

Table 12: Relationships between External Components and Components of the Model of Intention to Purchase GM food

	Env. norm	Attitude	SN	Intention
Try to achieve GE free status	+ve	-ve	-ve	-ve
Try not to achieve GE free status	-ve	+ve	+ve	+ve
Income		+ve		+ve
Influence of demand for produce with less chemicals		-ve	-ve	-ve
Dependency on chemicals for pest control	-ve	+ve	+ve	+ve
Dependency on chemicals for weed control	-ve	+ve	+ve	+ve
Dependency on manufactured fertilisers	-ve	+ve	+ve	+ve
Influence of demand for environmentally friendly production	+ve	-ve	-ve	-ve
Increase in expenditure on chemicals	-ve	+ve	-ve	+ve
Sex	* Mean higher for females	*Mean higher for males	*Mean higher for males	*Mean higher for males
Parents farmers	* Mean higher for parents not farmers	* Mean higher for parents farmers		
Considered organic production		* Mean higher for not considered	* Mean higher for considered	* Mean higher for not considered
Involved in organic production	* Mean higher for not involved		* Mean higher for not involved	* Mean higher for not involved

Note: +ve = positive relationship, -ve = negative relationship, * = difference between means. Significant relationships ($p < 0.05$) established through either correlation or t-tests

4.4.3 Intention to use Organic Methods

Means and standard deviations for components of the model of intentions to use organic methods are provided in Table 13. The result of the regression analysis for intention to use organic methods is provided in Table 14. As is evident from the table, significant ($p < 0.05$) independent effects were found for environmental norm, attitude and involvement in organic production. The independent effects for SN, self-identity and PBC on intention were non-significant ($p > 0.05$). Involvement in organic production ($\beta = 0.68$, $p < 0.001$) had the most influence on intention, followed by attitude ($\beta = 0.37$, $p < 0.001$) and environmental norm ($\beta = 0.14$, $p < 0.001$). The analysis therefore supports the assertion that current involvement in organic production influences intention to use organic methods. Attitude influences intention, though this component was not subject to the perceived views of important others. Support is given to the proposal that intention is influenced by an environmental norm, which favours coexistence with the natural environment.

Table 13: Means and Standard Deviations

Item	Range	Mean	Std. Dev.
Attitude towards using organic methods	-3 to 3	.73	1.45
Subjective norm for using organic methods	-6 to 6	.98	2.47
PBC for using organic methods	1 to 14	4.29	1.42
Intention to use organic methods	-3 to 3	.29	1.24
Self-identity	-3 to 3	1.82	0.99
Environmental norm (Eco-feminism)	-3 to 3	1.32	1.32

Note: n = 627 for all components.

Table 14: Regression on Intentions to Use Organic Methods

R^2 **0.31, df 6, F = 46.2, Sig of F = 0.0000, n = 627**			
Variable	β	**T**	**Sig T**
Environmental norm	0.138	4.090	.0000
Attitude	0.370	12.021	.0000
SN	0.003	0.090	.9280
Self-identity	0.187	0.414	.6793
PBC	0.023	0.678	.4930
Involvement in organic production	0.676	4.669	.0000

Perceived consequences of using organic methods correlated significantly with attitude towards using organic methods ($r = 0.38$, $p < 0.001$). Mean scores and standard deviations for the desirability and likelihood items that comprise these consequences are provided in Table 15. These results show that all consequences were generally held to be likely to occur. Among the most likely consequences of using organic methods were: increased workloads, reduced chemicals in food and reduced reliance on chemicals. Increased production costs and increased workload for farmers, were generally considered undesirable consequences. The remaining consequences were desirable. Among the most desirable consequences were: better community health, reduced chemicals in food, reduced risks to farmers and improved economical viability for farmers.

Table 15: Means and Standard Deviations For Likelihood and Desirability of Consequences of Using Organic Methods

		Likelihood	Desirability
Increased production costs	Mean	0.78	-1.02
	Std dev	1.59	1.36
Better premiums for produce	Mean	0.94	1.49
	Std dev	1.37	1.21
Increased workload for farmers	Mean	1.23	-0.90
	Std dev	1.35	1.25
Reduced damage to ecological systems	Mean	0.99	1.50
	Std dev	1.49	1.29
Improved economic viability for farmers	Mean	0.02	1.64
	Std dev	1.50	1.17
Reduced health risk for farmers	Mean	0.96	1.79
	Std dev	1.51	1.13
Reduced chemicals in food	Mean	1.47	1.82
	Std dev	1.41	1.13
Avoidance of problems of conventional production	Mean	0.30	1.33
	Std dev	1.45	1.13
Reduced reliance on expensive and/or inefficient chemicals	Mean	1.12	1.69
	Std dev	1.44	1.12
Better community health	Mean	0.83	1.93
	Std dev	1.55	1.02

Note: Desirability and likelihood range = -3 to 3, n = 612 for all items.

Summary results of the analysis of relationships between external components and model components are provided in Table 16. Twelve external components were identified as being associated with intention and two further external components were identified as associated with determinants of intention and thus also associated with intention. All external components associated with intention were also associated with the determinants of intention and do not challenge the assertion that the three determinants (environmental norm, attitude and involvement in organic production) are proximal determinants of intention.

In terms of associations between external components and intention, those with positive intentions towards using organic methods also consider New Zealand should become GE free. Intentions were associated with consumer demand for products with less chemical residues, consumer demand for environmentally friendly products and a change in expenditure on agrochemicals. Positive intentions were associated with less dependency on chemicals for pest or weed control and less dependency on manufactured fertilisers. Positive intentions were also associated with lower personal income and increased expenditure on chemicals. Females tended to have more positive intentions, as did those who are involved in ‘green’ production and those who had seriously considered organic production.

Table 16: Relationships between External Components on Components of the Model of Intentions to use Organic Methods

	Env. norm	Attitude	Involvement in organic production	Intention
Try to achieve GE free status	+ve	+ve	*Mean higher for involvement	+ve
Try not to achieve GE free status	-ve	-ve	*Mean higher for non-involvement	-ve
Gross farm income			*Mean higher for non-involvement	
Income	-ve			-ve
Influence of demand for produce with less chemicals	+ve	+ve	*Mean higher for involvement	+ve
Dependency on chemicals for pest control	-ve	-ve	*Mean higher for non-involvement	-ve
Dependency on chemicals for weed control	-ve	-ve		-ve
Dependency on manufactured fertilisers	-ve	-ve	*Mean higher for non-involvement	-ve
Influence of demand for environmentally friendly production	+ve	+ve	*Mean higher for involvement	+ve
Increase in expenditure on chemicals	-ve	-ve	*Mean higher for involvement	-ve
Sex	* Mean higher for females			*Mean higher for females
Parents farmers	* Mean higher for parents not farmers	* Mean higher for parents farmers	#Less involvement if parents farmers	
Considered organic production		* Mean higher for considered	#More involvement if involved if considered	* Mean higher for considered
Involved in green production		* Mean higher for involved	#More involvement if involved	* Mean higher for involved

Note: +ve = positive relationship, -ve = negative relationship, * = difference between means, # = chi square test. Significant relationships ($p < 0.05$) established through either correlation, t-tests or chi square.

Chapter 5
Discussion and Conclusion

5.1 Introduction

This study set out to understand the reasons for New Zealand farmer and grower intentions to (i) use gene technology, (ii) to purchase GM food and (iii) to use organic methods. Through developing and applying a contemporary attitude-behaviour model, intentions serve as a useful predictor of behaviour, and important reasons for these intentions have been identified. This chapter discusses the performance of the models, provides summary results and discusses factors that have a bearing on farmer and grower decision making. Prospects for change in farmer and grower decisions given the dynamic nature of model components are identified and discussed in the subsequent section. Finally, general policy implications are discussed and agricultural development scenarios are considered.

5.2 Discussion of Results

Table 17 summarises the key results.

Table 17: Summary of Key Results

	Gene Technology	G M Food	Organic Methods
	%		
Negative intention	44	49	19
No intention	35	39	44
Positive intention	21	12	37
R^2 for intention model	0.59	0.54	0.31
	Betas		
Determinants			
Environmental norm	-0.079	-0.081	0.138
Attitude	0.451	0.450	0.370
SN	0.132	0.230	(0.003)
Self-identity	(0.008)	(0.049)	(0.187)
PBC	0.062	(0.021)	(0.023)
Involvement in organic production	-	-	0.676
r between attitude and sum of perceived consequences	0.63	0.60	0.38

Note: numbers in parentheses indicate non-significant ($p > 0.05$) results.

The R^2 for gene technology (0.59) and GM food (0.54) indicate a good model fit in comparison with published attitude-behaviour research (Sheppard et al. (1988) found a mean R^2 of 0.66 for 87 studies). The R^2 for organic methods (0.31) was low in comparison, however, a low result was not unexpected. Bennett et al. (1999) presents a number of cases where contemporary attitude-behaviour studies of decisions to use organic methods have produced a low R^2. Bennett et al. (1999) conclude that decisions to undertake an organic practice are often complex involving detailed assessments of cost, management experience, institutional support and productivity potential. They then demonstrate that accounting for

these factors with regard to a specific activity (sustainable soil management), improves performance of the model. In this research, intentions to use organic methods did not refer to a specific activity, though it is clear from the results that the determinants posed are important components of this general intention. Therefore, in light of other research on the topic area, the model performed well and was successful in identifying important determinants of intention to use organic methods.

The statistical analyses identified important determinants of the three intentions. In addition, other characteristics, defined in this study as external components, were also identified as having relationships with these intentions. Self-identity was, however, not found to be a determinant of any of the three intentions, and subjective norm and PBC were not identified as significant determinants in all of the intention models. Self-identity has been found to be non-significant in other attitude-behaviour studies (e.g., Sparks, Shepherd and Frewer, 1995). This finding has, however, little effect on understanding intention other than suggesting that for farmers and growers their sense of self-identity is ineffectual in relation to the other determinants of intention. Concern for the environment may well be encapsulated within the environmental norm and possibly attitude, to the extent that evidence of an independent effect cannot be found. Farmers and growers do not necessarily see themselves as being unconcerned for the environment, but rather the testing of other determinants obscures evidence of this relationship. Subjective norm can be unimportant where the person does not agree with the opinion of others, or where the opinion of others is considered by the person to be unimportant (Ajzen and Fishbein, 1980). It is possible that farmers and growers are used to making their decisions relatively independently and if this were so then subjective norm would not be an important component of the model. PBC can be unimportant where personal control is believed by the individual to have little or no effect on their performance of the behaviour (Ajzen, 1991). PBC can be unimportant where it is believed that there are no immediate barriers or impediments to performance of the behaviour, or where the person believes they have the ability to overcome these obstacles with ease. In addition, regardless of the possible causes for non-significant components, there is an expectation that for some behaviours all proposed determinants may not be applicable, in which case determinants that are found to be significant stand as important determinants of intention (Eagly and Chiaken, 1993).

Table 17 shows that the number of farmers and growers intending to use organic methods is nearly double that of the number intending to use gene technology. A large proportion (44 per cent) clearly indicated they did not intend to use the technology, whereas fewer farmers and growers (19 per cent) were against the use of organic methods. The R^2 data show that the components of the gene technology and GM food models explained over 50 per cent of the model for each intention. The Betas indicate that attitude towards using gene technology or purchasing GM food had the most influence on intention to use gene technology and purchasing GM food, while involvement in organic production and attitude had most influence on intention to use organic methods.

The results identify important reasons for the intentions of farmers and growers and their subsequent behaviour. The farmers and growers who intend to use gene technology have positive attitudes and take notice of the views of family and friends and business associates who are seen to support their views about using the technology. They do not believe that it is necessary to learn to coexist with the natural environment. They also believe that they have control over whether or not they can use the technology, which incorporates control over the business decisions on their farm or orchard. They are then likely to have the final say in

whether they can use the technology and, given the future availability of the technology, believe there is little or no impediment to their using it. Salient beliefs about the consequences of using gene technology have a substantial influence on the attitudes and intentions of all farmer and growers. For farmers and growers who intend to use the technology, undesirable consequences are judged as less undesirable and less likely, while desirable consequences are more highly valued and considered more likely. In general, these consequences are held by all farmers and growers as the most important specific reasons for their decision to use or not use the technology through their being judged either favourably or unfavourably.

Characteristics and preferences of farmers and growers, derived from relationships with external components, provide a useful profile of those who intend to use the technology. This group comprises more males than females and their farms have higher gross income than other farms. Their farms are also more dependent on agrochemicals and manufactured fertilisers than other farms. Farmers and growers who intend to use gene technology are also less influenced by consumer demand for produce with less chemical residues and demand for environmentally friendly production. In general, they have not seriously considered organic production and are not presently involved in 'green' production. They are also opposed to the proposal that New Zealand should become GE free.

The reasons for decisions to purchase GM food have many characteristics in common with decisions to use gene technology. Attitude was most important in the decision to purchase or not purchase followed by subjective norm and environmental norm. Farmers and growers who would purchase, believe they have the support of other people whose views are important to them. Consequences of using the technology that are salient in decisions to use the technology are also salient in decisions to purchase GM food. Some differences were found between characteristics associated with the two decisions. Those who intend to purchase GM food were found to have a higher personal income, though no difference in gross farm income was found between this group and other farmers and growers. Common characteristics included greater expenditure on agrochemicals as well as high levels of dependency on these chemicals in comparison with other farmers and growers. Farmers and growers in this group were also influenced by consumer demand for produce with less chemicals, whereas this influence was not found for farmers and growers who intend to use gene technology.

Involvement in organic production, attitude and environmental norm are important influences on intention to use organic methods. Of the three influences, involvement in organic production is the most important followed by attitude and environmental norm. Unlike the other two models, intention has a positive relationship with environmental norm so that those who believe that they have to learn to coexist with the natural environment are more likely to have positive intentions. Salient beliefs about consequences of using the methods were influential on attitude. Therefore a favourable or unfavourable change in any of these beliefs will subsequently have a corresponding effect on intentions to use organic methods.

Farmers and growers who intend to use organic methods have a lower personal income, and the group contains proportionally more women. Members of the group have given more serious consideration to undertaking organic production than other farmers and growers and are also more likely to be involved in 'green' production. In comparison with other farmers and growers they are also: more influenced by consumer demand for environmentally friendly production and demand for food with less chemical residues, are less dependant on

agrochemicals and manufactured fertilisers, have recently reduced their expenditure on agrochemicals and believe that New Zealand should become GE free.

Overall, farmers and growers predominantly supported New Zealand becoming GE free and were opposed to the use of gene technology in New Zealand. Farmers and growers agreed (49 per cent) rather than disagreed (32 percent) that New Zealand should try to become GE free. In addition only 21 per cent had positive intentions towards using gene technology and many (44 per cent) had negative intentions towards using the technology. The results show some similarity with other research both in New Zealand and overseas. Overall, farmers and growers in New Zealand are not keen on gene technology with the proportion of farmers and growers who are supportive of gene technology being similar to that found in Australia (26 per cent) (Reuters News Service, 1999), and the by Affco (15 per cent) (Affco, 2000). While taking into account that the questions in each study were not identically worded, based on current information a prediction of 21 percent of farmers and growers using the technology within the next ten years is supported by other research.

In general a large number of farmers and growers have an aversion to purchasing GM food. In terms of three groupings of the responses, 49 per cent intended not to purchase the food, 39 per cent were undecided with no intention to either purchase or not purchase and only 12 per cent had a positive intention to purchase. Cook (2000) found in the study of Canterbury residents that 60 per cent intended not to purchase the food, 30 per cent were undecided with no intention to either purchase or not purchase and only ten per cent had a positive intention to purchase. In comparison farmers and growers are slightly more in favour of purchasing the food, though in both studies only a small proportion positively intend to purchase. Research by Gamble et al. (2000) found a larger proportion of positive intentions to purchase GM tomatoes (28 per cent), though these intentions relate this specific item and not to purchases of GM food in general.

The results are also supported previous studies of farmer and grower decisions to use organic methods (e.g., Fairweather, 1999), which formed the basis for the development of questionnaire items. The prospect of increased production costs and increased workload are seen by many framers and growers as significant impediments to their undertaking organic production. Those who intend to use organic methods agree they are important concerns, but do not believe they are as big an impediment as other farmer and growers. In addition, the range of positive outcomes including community and personal health concerns and improvements in production methods are important components in the decisions of all farmers and growers. Positive outcomes were rated as desirable and likely by those who presently use the methods and those intending to use the methods. It is therefore evident from this study, and from previous research, that these items are central to the decisions of farmers and growers regarding their use of organic methods.

In summation, the results clearly show a divergence between preferences, characteristics, attitudes and intended actions of farmers and growers in terms of their decisions to use organic methods and decisions to use gene technology or purchase GM food. However, while it can be argued that the use of gene technology and organic methods are mutually exclusive, a small number (41 or six per cent) of farmers and growers intended to use both organic methods and use gene technology on their farms. Given that the questionnaire did not take an ‘either/or’ approach it is possible that this small group of farmers and growers may be leaving their options open while awaiting for more detailed information as to the feasibility of either alternative, or they are responding to recent media statements by a small group of New

Zealand scientists claiming that the two systems will eventually become compatible. At present, it is nevertheless clear that there is greater support for organic methods than for the use of gene technology. The proportion positively intending to use organic methods (37 per cent) is nearly twice the proportion intending to use gene technology (21 per cent) with 44 per cent having a negative intention towards using gene technology. It is also clear that farmers and growers support the proposal that New Zealand should become GE free.

5.3 Participation Projections and Prospects for Change

Attitude-behaviour studies are undertaken not only to understand or predict behaviour but also to assist in the development of effective policies for the encouragement or discouragement of a particular behaviour. Ajzen and Fishbein (1980) stress that the ability to understand behaviour to the extent that behaviour can be changed is an important feature of attitude-behaviour modelling. Predictions of participation can simply be made from a person's stated intention. The review by Sheppard et al. (1988) of 87 attitude-behaviour studies found an average r of 0.51 for the correspondence between intention and behaviour. Given that intentions do not change, a similar level of correspondence should be found between the intentions in this study and actual behaviour. However, attitudes and intentions are dynamic and identifying the nature and relative importance of key determinants in an attitude-behaviour model provides an understanding of how intention and behaviour can change. This facilitates more accurate forecasting of these changes to the extent that a change in behaviour can be induced thorough the introduction of appropriately targeted policy initiatives. In this study there is no imperative to develop policies to promote acceptance or avoidance of the use of gene technology, purchase of GM food or use of organic methods. However, predicting the effects of various policy initiatives on the performance of these behaviours is provided as a useful way of understanding the effects of actions that may arise from the present policy debate.

The intentions of farmers and growers towards using gene technology are predicted to be reflective of actual behaviour. Twenty one per cent of farmers and growers can therefore be expected to use the technology if it were available, and 37 per cent are expected to use organic methods. For GM food it is likely that purchasing will occur for farmers and growers who have no intention, in addition to those who have a positive intention. There was a total of 51 per cent of farmers and growers in these two categories.

Gene Technology

The intentions of farmers and growers to use gene technology was influenced by attitude, subjective norm, environmental norm and PBC. A change in any of these four determinants is therefore predicted to alter intention. Attitude was the most important determinant followed by subjective norm with environmental norm and PBC having only comparatively small influences on intention. A modest change in attitude will then have the most effect on intention, followed by a change in subjective norm. A large change in environmental norm and PBC will have to occur before intention changes.

Changes to the intentions of farmers and growers to use gene technology could occur in a number of ways. For attitude, its strong association with beliefs about the consequences of using gene technology indicates that these are very important in decisions regarding the use of the technology. Therefore, a positive or negative change in any of these beliefs will effect a corresponding change in attitude and a corresponding change in intention. These changes can occur through either a change in the perceived likelihood or desirability of these beliefs. A more positive attitude will arise through farmers and growers determining that harmful

consequences are less likely. Attitude would improve with evidence that the perceived benefits of better quality food, economic growth and increased food production would be realised. Farmers and growers deciding that risks to public health or personal health, damage to ecological systems and adverse effects on future generations were unlikely would also have a direct result in producing more favourable attitudes and intentions. In addition, reducing the uncertainty of the positive consequences will also have a positive effect on attitude, because reduced uncertainty would cause them to be judged more likely. Having specified how attitude may change, it is important to note that is also possible that other salient consequences may arise and therefore alter attitudes towards using the technology.

Subjective norm had an independent effect on intention, indicating that the views of people who influence business decisions and the views of other people of importance were generally aligned to the intentions of farmers and growers. Therefore, if either the views of these referents, the perceptions of these views, or the degree of adherence to these views changed, intentions would also change. A change in environmental norm would occur if farmers and growers changed their belief in the need to learn to coexist with the natural environment. As an increase in the strength of this belief is negatively related to intention, if it were less strongly held, intentions would become more favourable. Favourable intentions would also result if the environmental norm ceased to influence intentions, through the technology being disassociated with the need to learn to coexist with the environment. An increase or decrease in PBC would influence intention though this influence would only be minor.

It can therefore be surmised that any positive policy initiative whether of an educational or promotional nature will more easily encourage members of this group to use the technology than other farmers and growers to use the technology. Providing evidence of, or giving emphasis to, the realisation of positive consequences and the negation of negative consequences identified in this study will have the effect of promoting acceptance of the technology. In addition, reducing uncertainty and identifying and addressing further salient consequences would also promote acceptance. Use of the technology would also be promoted by reducing the impact of environmental norm on intention, possibly through disassociation, and by emphasising the requisite views of others, or the need to adhere to the these views.

G M Food

Intentions to purchase GM food were related to intentions to use gene technology, because consequences of using gene technology were important in the formation of the attitudes and subsequently the intentions for both considerations. The two intentions were, however, only moderately correspondent indicating that, while there are common evaluations underlying attitudes, use of the technology and purchasing GM food are separate considerations for farmers and growers. Intentions to purchase GM food were positively influenced by three of the proposed determinants. Attitude had the most important influence followed by subjective norm with environmental norm having a minor role in determining intention. The amount of control held by farmers and growers over purchasing had no bearing on their intention. A change in each of the three significant determinants is therefore expected to produce a corresponding change in intention, with the magnitude of change indicated by their relative importance. Changes in environmental norm will, however, have an inverse effect on intention because of the negative effect this component has on intention.

Farmer and grower beliefs about the consequences of using gene technology will affect attitudes and intentions towards purchasing GM food in the same manner and with similar degree of importance as they effect their decisions about using gene technology. The

intentions of these farmers and growers are also influenced by the views of important others. The imperative to learn to coexist with the natural environment has a negative effect on their intentions, though this effect is only minor in relation to their attitude and motivations to conform to the views of others.

The information about the characteristics of those who intend to purchase GM food could be used for an effective promotional strategy for the food. These efforts would be best directed at improving the favourability of the consequences of using gene technology. Policy initiatives that similarly alter the assessment of these consequences can therefore be expected to have the same effect. While these initiatives may not necessarily be directed at a particular group of farmers and growers, those with the characteristics associated with positive intentions will more readily accept and can be more readily persuaded to purchase GM food. In addition, increasing aversion to purchasing the food would have a noticeable effect on sales to farmers and growers, through a change in the attitudes and intentions of this group. Change could also be brought about by emphasising the requisite views of important others and encouraging compliance with these views.

Organic Methods

Intentions to use organic methods can be assumed to be reflective of farmer and grower use of organic methods within the next ten years. Of the three influences on intention, involvement in organic production was the most important influence followed by attitude and environmental norm. Whether or not farmers or growers change their involvement in organic production will then have the most influence on intention, followed by a change in attitude and a change in environmental norm. Attitude will change with a change in evaluations of the consequences of using organic methods. For example, attitudes will become more positive with evidence that increases the likelihood of: better premiums for produce, reduced damage to ecological systems, improved economic viability, reduced health risk for farmers, a reduction in the amount of chemicals in food and the avoidance of problems of conventional production. Attitude would also improve with the reduced likelihood of increased production costs and increased workload for farmers. These changes will have a bearing on intention and thus foster the use of organic methods. In general, a stronger belief in the need to coexist with the natural environment, or more farmers and growers agreeing with this view, will also produce more positive intentions and have a positive effect on the use of organic methods.

To examine farmer and grower decisions more closely, farmers and growers in general consider higher costs are incurred with organic production, though the results suggest that those already involved reported lower costs based on their experience. Those not intending to use the methods are therefore making a judgement that is unfounded when compared to actual practice. Similarly, better premiums for produce are considered less likely by non-organic farmers, though the results suggest those involved are reporting better returns. Those not intending to undertake organic production can then be said to have made an uninformed or incorrect assessment of the economic viability of organic production. Estimating economic viability and informing farmers and growers will then have a positive effect on their intentions and increase their use of organic methods. Similarly, workload was generally judged to increase with organic production, though the results suggest those experienced in this production did not agree to the same extent. Factoring workload in the assessment of viability would also provide a more realistic assessment for farmers and growers and promote use of the methods. In addition, while environmental concern can have a moral or ethical basis, sustainable use of the natural environment is a real concern for agricultural production. In this sense reduced damage to ecological systems has practical implications over time and

also becomes a part of long-term economic viability. Evidence of more sustainable use of ecological systems though organic production would therefore encourage use of organic methods. If economic viability improves, and with a positive shift in five of the ten consequences of importance to farmer and grower decisions, increased participation in organic production would be very likely.

Three of the remaining ten important consequences are health concerns. Reduced chemicals in food was the most likely outcome of organic production and was generally considered highly desirable. Better community health was, in comparison, less likely, but was nevertheless considered the most desirable outcome of organic production. Given that 'less chemicals' is moderated in its effect on community health, reduced chemical use is still seen as affecting community health. Reduced health risk for farmers can also be associated with less use of chemicals in production which was considered likely and generally very desirable. Given that these outcomes are important concerns of farmers and growers, providing them with health statistics comparing organic with conventional farming and the effects of chemicals in food, if favourable, would improve participation in organic production. Chemical issues are important to farmers and growers but information about these issues may not readily influence them as effectively as information on costs, returns and workload because they are not so easily quantified.

5.4 Policy Implications

As a baseline study this research offers a wealth of information for the policy analyst. Information about the characteristics, preferences, attitudes and intentions of farmers and growers also provides for clear indications of the effects of possible policy initiatives. Farmer and grower use of gene technology is particularly dependent upon availability of the technology. Policy initiatives of an educational or persuasive nature apply to all three decisions.

Farmer and grower use of gene technology is dependent on the introduction of gene technology. Farmers and growers have provided an indication of their intended use of the technology with approximately one fifth being predicted as users. This prediction is accurate in terms of the foreseeable future, from the perspective of farmers and growers, given availability and free access to use of the technology. Any policy that reduces availability or inhibits free access will therefore lower use of the technology. The present perceptions of farmers and growers are also influenced by the amount of control they have over being able to use technology. Specific control factors are not identified in this study, however, regulatory measures that constrain free use of the technology will affect perceived control and subsequent use of the technology. Availability is also a factor for the purchase of GM food, especially in relation to the public's ability to identify these foods. Current indications are that GM food will be labelled, however, it is possible that only a proportion of the food will be labelled. Any impediment to purchasing or not purchasing will be perceived as a barrier to intended action and reduce the number of people intending to purchase and those who will avoid purchasing.

In light of the findings of this study the effects of policies to educate or persuade farmers and growers centres on the provision of information that alters their assessments of the perceived consequences of importance to their decisions. For gene technology, the provision of information that emphasises that harmful consequences are of lower magnitude and less likely than people normally believe, will produce more positive attitudes and encourage use of the technology. In addition, as uncertainty affects the likelihood of outcomes, reducing the

perception of uncertainty would have a positive effect on the evaluation of positive outcomes, while making negative outcomes seem less likely. Attitudes and intentions towards gene technology would improve with evidence that the perceived benefits of better quality food, consumer acceptance, enhanced economic growth and increased food production would be realised. In addition, because the outcomes identified in this study are also central to decisions regarding the purchase of GM food, changes in the evaluation of these outcomes will also have a direct influence on purchases of the food.

If policies were adopted to encourage the use of gene technology, to be initially effective these policies would be best directed at farmers and growers with characteristics and preferences associated with intentions to use the technology. Farmers and growers with higher gross farm income, who are male, having high dependency on agrochemicals and manufactured fertilisers, and low involvement in organic or green production would be the best to target. In terms of farmers and growers who will be most active in promoting the introduction of the technology, it is farmers and growers of this group who believe using gene technology will be worthwhile that are more likely to lobby for its introduction. Promotion of GM food would also best target a similar group with the additional characteristic of higher personal income. In addition, where the views of others are found to be predominantly against using gene technology or purchasing GM food, emphasising the importance of individuals making their own decisions will promote positive intentions towards using the technology.

Providing encouragement for farmers and growers to use organic methods will be best made through the promotion of desirable consequences tested in this study. Indications from this study are that those already with some involvement in the use of organic methods consider the activities worthwhile and are likely to be providing more realistic evaluations of prospective outcomes of using the methods. These evaluations are more favourable than those made by other farmers and growers, implying that evaluations made by those not presently using organic methods are poorly informed. Informing farmers and growers of the merits of using the methods would then lead to more positive intentions and wider use of organic methods. Projections of economic viability including production costs, premiums for produce and workload should be reasonably easy to provide and would markedly increase the use of organic methods.

5.5 Conclusion

This study has focused on the intentions of farmers and growers and has found influences and relationships that have a direct bearing on their use of gene technology, purchases of GM food and use of organic methods. While the main objective of this study has been met, there remains a good deal of information which warrants further analysis. As suggested in this report, it is likely that there are two quite contrasting groups of farmers, those who intend to use gene technology and those who intend to use organic methods. Analysis of the profile of these groups and other related sub groups will be provided in a second publication in which it is planned to analyse for each group their industry affiliation, characteristics and preferences in detail. Together these publications will represent the results of a comprehensive investigation which extends existing studies of organic and conventional farmers and growers, while providing a benchmark for studies of farmers and growers' use of gene technology.

While the decision to allow the widespread use of gene technology in New Zealand is largely beyond the control of farmers and growers, they nevertheless have a pivotal role through their decisions to use or not use the technology. Their personal decisions will determine whether or

not they use the technology, and ultimately determine the extent to which the technology is used in agricultural production. The importance of the role of individual decisions in the adoption of this new technology was generally unrecognised in countries like the US until this past growing season began (Reuters news service, 13/1/2000; Benbrook, 2000). Only now have farm organisations, companies and politicians recognised that farmers have a dynamic role to play in determining the rate and style of gene technology adoption.

The following four development scenarios provide a framework for consideration of the results of this study:

> Scenario 1: Broad gene technology development with a very small organic sector developing by default without significant encouragement.
>
> Scenario 2: Broad gene technology development with a small organic sector encouraged as a minority niche aspect of New Zealand production.
>
> Scenario 3: Broad organic-based development with a small gene technology sector encouraged as a minority niche aspect of New Zealand production.
>
> Scenario 4: Broad organic-based development with a total rejection of any gene technology sector.

Scenario 1 appears to be the direction adopted by the previous government. Funding priorities through the PGSF (see Saunders et al., 1997) suggested a very low value assigned to specifically organic research which had resultant effects on the composition and strategic direction of the Crown Research Institutes (CRI's). This also reflects the position of Federated Farmers prior to 1999 at which time there were with several public statements by their president advising against government interest in organic production (Campbell, 1996: 161-162).

Scenario 2 reflects the current position of several CRIs, and Federated Farmers[2].

Scenario 3 is not openly proposed by any interest group, yet reflects the findings of this survey.

Scenario 4 is supported by the Green Party, various environmental groups, numerous anti-gene technology groups, and most of the organic agriculture industry.

The relevant findings of this study show that the majority of farmers and growers indicated a desire for New Zealand becoming gene technology free and they clearly favour using organic methods. Against this, a smaller group expressed a desire to use gene technology. These results place the farmers and growers in our sample within Scenario 3 and with some sympathy for Scenario 4. This location of farmers and growers within these scenarios has profound implications for New Zealand's science institutions, lobby groups and politicians. The evidence presented here suggests that some of these bodies have lost touch with the grassroots sentiments of the industry they purport to serve. The sources cited above suggest that most institutions have, if anything, only shifted from Scenario 1 to Scenario 2 over the

[2] The current position of Federated Farmers is somewhat contradictory. Public statements in support of an organic niche must be considered alongside the fact that the Federated Farmers website carries a version of a speech by leading anti-organic activist Dennis Avery (http://www.fedfarm.org.nz/).

last 18 months. Policymakers, scientists, and industry planners need to factor in the possibility that should they adopt gene technology it may not be adopted by the majority of New Zealand farmers and growers. This situation parallels events that have just emerged in the US (Benbrook, 2000).

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Appendix 1
The Questionnaire

Dear Farmer or Grower**,**

The use of genetic engineering in agriculture is presently an issue of debate in New Zealand society. This debate has recently extended a Royal Commission of Enquiry. As a researcher in the agricultural sector I know that little has been done to record the views of farmers and growers. I also believe little is know about farmer and grower views on organic production

I need your help to record the views of farmers and growers. Please fill out the enclosed questionnaire at your earliest convenience. The questions are not complicated and ask for general information and opinion only. The questionnaire is designed to be completed by any adult member of your household who has some involvement with, or an influence on, the decisions made for your farm or orchard.

Please fill out the questionnaire and post it back to me (free of charge). It is important for the success of this study that as many people as possible respond promptly. Please note that all responses are confidential to me.

Your response is appreciated and will ensure that farmers and growers are represented in the debate about genetic engineering. The survey results will be communicated to the Royal Commission.

Yours sincerely,

John Fairweather (Ph.D)
(Research Sociologist)

Introduction

An objective of this study is to understand the attitudes and intentions of farmers and growers towards using genetic engineering technology. This technology is not presently available to farmers and growers in New Zealand. For the purpose of this study I ask that you assume that plants and animals produced using genetic engineering may potentially be available to farmers and growers within the next ten years.

Please note that in this study I have chosen to use the term ‘gene technology’ when referring to the process of genetic engineering. You may also have heard this technology being described as biotechnology, with the food products described as genetically modified (GM) food. Also note that I use the term ‘farm’ as an easy way of referring to either a farm or an orchard.

Please indicate your answer to each question by writing a number in the box to indicate your response. Space is provided at the end for any comments you may wish to make.

1. Using the seven point scale below, how favourable or unfavourable is your general attitude towards the following three items?

1 = Extremely unfavourable
2 = Very unfavourable
3 = Unfavourable
4 = Neither unfavourable nor favourable
5 = Favourable
6 = Very favourable
7 = Extremely favourable

Using gene technology on your farm	
Using organic methods on your farm	
Purchasing GM food	

2. Please indicate your level of agreement or disagreement with the following statements.

1 = Very strongly agree
2 = Strongly agree
3 = Agree
4 = Neither agree nor disagree
5 = Disagree
6 = Strongly disagree
7 = Very strongly disagree

Most people whose views are important to me would approve of the use of gene technology on my farm.	
Most people who influence my business decisions would approve of the use of gene technology on my farm.	
Most people whose views are important to me would approve of my using organic methods on my farm	
Most people who influence my business decisions would approve of my using organic methods on my farm	
Most people whose views are important to me would approve of my purchasing GM food	

2. How much personal control you think you have over the following decisions?

1 = No control at all
2 = Almost no control
3 = Less than moderate control
4 = Moderate control
5 = More than moderate control
6 = Almost complete control
7 = Complete control

The business decisions for your farm	
Using or not using of gene technology on your farm	
Using or not using of organic methods on your farm	
Purchasing or not purchasing GM food	

4. Please indicate your level of agreement or disagreement with each of the following statements.

1 = Very strongly disagree
2 = Strongly disagree
3 = Disagree
4 = Neither disagree nor agree
5 = Agree
6 = Strongly agree
7 = Very strongly agree

I think of myself as someone who is concerned about the environment	
I believe nature exists primarily for human use	
I believe all life forms (including humans) are equal and need to be accorded equal moral weight	
I believe that rather than controlling nature we need to learn to co-exist with the natural environment	
I believe all of nature possesses intrinsic values which are independent of human valuation	

5. Please indicate your level of agreement of disagreement with the following statements.

1 = Very strongly disagree
2 = Strongly disagree
3 = Disagree
4 = Neither disagree nor agree
5 = Agree
6 = Strongly agree
7 = Very strongly agree

New Zealand should try and achieve GE free status	
New Zealand should <u>not</u> try and achieve GE free status	

6. Please indicate how <u>likely or unlikely</u> you think it is that each of the following consequences of gene technology will occur.

1 = Extremely unlikely
2 = Very unlikely
3 = Unlikely
4 = Neither likely nor unlikely
5 = Likely
6 = Very likely
7 = Extremely likely

Better quality food	
New risks to public health	
Enhanced economic growth for New Zealand	
Consumer acceptance of food produced using gene technology	
Adverse effects on future generations	
Damage to ecological systems	
Increased food production	
Placing your own health at risk	

7. Please indicate how <u>desirable or undesirable</u> you think it will be for each of the following consequences of gene technology to occur.

1 = Extremely undesirable
2 = Very undesirable
3 = Undesirable
4 = Neither undesirable nor desirable
5 = Desirable
6 = Very desirable
7 = Extremely desirable

Better quality food	
New risks to public health	
Enhanced economic growth for New Zealand	

Consumer acceptance of foods produced using gene technology

Adverse effects on future generations	
Damage to ecological systems	
Increased food production	
Placing your own health at risk	

8. Please indicate how <u>likely or unlikely</u> you think it is that each of the following consequences of organic production will occur.

1 = Extremely unlikely
2 = Very unlikely
3 = Unlikely
4 = Neither likely nor unlikely
5 = Likely
6 = Very likely
7 = Extremely likely

Increased production costs	
Better premiums for produce	
Increased workload for farmers	
Reduced damage to ecological systems	
Improved economic viability for farmers	
Reduced health risk for farmers	
Reduced chemicals in food	
Avoidance of problems of conventional production	
Reduced reliance on expensive and/or inefficient chemicals	
Better community health	

9. Please indicate how <u>desirable or undesirable</u> you think it will be for each of these consequences of organic production to occur.

1 = Extremely undesirable
2 = Very undesirable
3 = Undesirable
4 = Neither undesirable nor desirable
5 = Desirable
6 = Very desirable
7 = Extremely desirable

Increased production costs	
Better premiums for produce	
Increased workload for farmers	
Reduced damage to ecological systems	
Improved economic viability for farmers	
Reduced health risk for farmers	
Reduced chemicals in food	
Avoidance of problems of conventional production	
Reduced reliance on expensive and/or inefficient chemicals	
Better community health	

10. Which one of the following statements best represents your intention to either use or not use gene technology on your farm within the next ten years?

1 = I have a very strong intention to use gene technology

2 = I have a strong intention to use gene technology

3 = I intend to use gene technology

4 = I have no intention to either use gene technology or not to use gene technology

5 = I intend not to use gene technology

6 = I have a strong intention not to use gene technology

7 = I have a very strong intention not to use gene technology

11. Which one of the following statements best represents your intention to either use or not use organic methods on your farm within the next ten years?

1 = I have a very strong intention to use organic methods

2 = I have a strong intention to use organic methods

3 = I intend to use organic methods

4 = I have no intention to either use organic methods or not to use using organic methods

5 = I intend not to use organic methods

6 = I have a strong intention not to use organic methods

7 = I have a very strong intention not to use organic methods

12. Which one of the following statements best represents your intention to either purchase or not purchase GM food?

1 = I have a very strong intention to purchase GM food

2 = I have a strong intention to purchase GM food

3 = I intend to purchase GM food

4 = I have no intention to either purchase GM food or not to purchase GM food

5 = I intend not to purchase GM food

6 = I have a strong intention not to purchase GM food

7 = I have a very strong intention not to purchase GM food

Please provide some information about your farm

1. Please tick the box or boxes to indicate which, if any, of the following are undertaken on your farm.

☐ The production of organic produce

☐ The production of 'green' produce (eg., using integrated pest management)

☐ Production to meet the requirements of a quality assurance scheme or programme

- **If you ticked any of the above, do you have registration or certification of your organic, 'green' or quality assurance status?**

1 = Yes, I have registration or certification *
2 = No, I don't have registration or certification

* If you answered yes, please state the type, or types, of registration or certification

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2. If you are presently <u>not</u> an organic or 'green' farmer, have you seriously considered organic production?

1 = Yes
2 = No

- **If yes, please indicate which of the following is the single biggest barrier to you producing organic or 'green' produce.**

1 = It is not economically feasible
2 = It is not technically feasible
3 = It is not compatible with my current high production, low cost farming

3. Which of the following have been done on your farm to either reduce or replace the use of chemicals? (Please tick <u>any</u> of the following boxes)

- ☐ Received professional advice on either the use, storage or disposal of chemicals
- ☐ Monitored the use of chemicals or fertilisers
- ☐ Monitored the soil for levels of chemical residues
- ☐ Monitored water for levels of chemical residues
- ☐ Adopted practices or treatments to avoid or replace the use of certain insecticides
- ☐ Adopted practices or treatments to avoid or replace the use of certain herbicides

- ☐ Applied manure to improve the soil to avoid or replace the use of manufactured fertilisers
- ☐ Grown legumes to improve the soil to avoid or replace the use of manufactured fertilisers
- ☐ Adopted practices to encourage natural insect predators
- ☐ Used crop rotation to manage pest or weed problems
- ☐ Used cultivation methods to manage pest or weed problems
- ☐ Used animals to manage pest or weed problems
- ☐ Been selective over food or food additives for animals
- ☐ Been selective over pharmaceutical treatments for animals
- ☐ Been selective over treatments for pests or disease control for animals

4. How influential are the following on your farming practices?

1 = Not at all influential
2 = Not very influential
3 = Less than moderately influential
4 = Moderately influential
5 = More than moderately influential
6 = Very influential
7 = Extremely influential

Consumer demand for environmentally friendly production	
Consumer demand for produce with less chemical residues	

5. Which one of the following best describes your change in expenditure on agrochemicals over the last five years?

1 = A very large reduction in expenditure
2 = A large reduction in expenditure
3 = A reduction in expenditure
4 = No reduction or increase in expenditure
5 = An increase in expenditure
6 = A large increase in expenditure
7 = A very large increase in expenditure

6. How dependant is your farm on the following?

1 = Not dependant at all
2 = Less than moderately dependant
3 = Moderately dependent
4 = More than moderately dependant
5 = Very dependant
6 = More than very dependant
7 = Extremely dependant

Agrochemicals for the management of pests	
Agrochemicals for the management of weeds	
Manufactured fertilisers	

7. Which of the following best describes your position in relation to your farm?

- ☐ Owner
- ☐ Shared owner
- ☐ Paid manager
- ☐ Paid farm worker
- ☐ Member of farming family (and not an owner)
- ☐ Paid spouse (and not an owner)
- ☐ Unpaid spouse (and not an owner)
- ☐ Other -Please specify _____

8. As an indication of your farming background:

- **Approximately how many years have you lived in a farming community?**

  _____ years

- **Were your parents farmers?** ☐ Yes ☐ No

9. Approximately how many hectares is the size of your farm?

10. Please tick <u>one</u> of the following boxes to indicate your most prominent farming activity.

Dairy- factory supply	☐	Horticulture - berry fruit	☐
- town supply	☐	- citrus	☐
		- flowers	☐
Pastoral - fattening	☐	- glasshouse	☐
- grazing	☐	- kiwifruit	☐
- high country	☐	- market gardening	☐
- stud	☐	- pip fruit	☐
		- stone fruit	☐
Arable - irrigated	☐	- vineyards	☐
- not irrigated	☐		

Other ☐ - please specify

_____

Please provide some information about yourself. We need this information to check whether our sample is representative of the farming community.

1. Sex: ☐ Male ☐ Female

2. Age: _____ years

3. What was your personal income over the past twelve months?

	(Approximate figures only)
Personal income from your farm	
Personal income from other sources	

4. What is the annual gross income from your farm? *(Approximate figures only)*

5. Please tick a box to indicate your highest qualification either in New Zealand or the equivalent overseas.

- ☐ Primary school to standard six
- ☐ High school without qualifications
- ☐ School certificate
- ☐ UE or 6th form certificate
- ☐ Higher school certificate, bursary or scholarship
- ☐ Diploma or trade certificate qualification from at least three months full time, or part time equivalent study
- ☐ Bachelors degree
- ☐ Postgraduate qualification

Appendix 2
Supplementary Statistical Data

Correlations Between External Components and Model Components of the Intention to use Gene Technology

		Intention	Attitude	SN	PBC	Env' norm
Try to achieve GE free status	r	-0.66***	-0.67***	-0.63***	0.03	0.26***
	n	607	607	607	606	607
Try not to and achieve GE free status	r	0.57***	0.58***	0.54***	-0.05	-0.17***
	n	608	608	608	607	608
Gross farm income	r	0.16**	0.13**	0.06	0.03	-0.08
	n	469	469	469	468	469
Income	r	0.08	0.13*	0.08	0.04	-0.11*
	n	466	466	466	465	466
Influence of demand for produce with less chemicals	r	-0.14*	-0.15***	-0.13**	-0.01	0.12**
	n	582	582	582	581	582
Dependency on chemicals for pest control	r	0.2***	0.22***	0.17***	-0.06	-0.18***
	n	587	587	587	586	587
Dependency on chemicals for weed control	r	0.24***	0.22***	0.17***	-0.06	-0.18***
	n	598	598	598	586	597
Dependency on manufactured fertilisers	r	0.35***	0.33***	0.27***	-0.01	-0.18***
	n	604	604	604	603	604
Influence of demand for environmentally friendly production	r	-0.21***	-0.19***	-0.20***	-0.09	0.13*
	n	585	585	585	584	585
Increase in expenditure on chemicals	r	0.23***	0.21	0.17***	-0.01	-0.17***
	n	596	596	596	595	596
Age	r	0.06	0.07	0.12*	0.01	0.04
	n	594	594	594	593	594

Note: * = p <0.05¸ ** = p < 0.01, *** = p < 0.001

External Components by Intention to use Gene Technology

Variable	Number of cases	Mean	Std. Dev.	Means with significant differences (t-tests, p< 0.05)
Sex	610			
1 Male	480	3.46	1.49	1-2
2 Female	130	2.96	1.55	
Qualification	599			
1 Primary school	17	3.23	1.30	
2 Secondary school	148	3.14	1.45	
3 School certificate	92	3.43	1.46	
4 Sixth form certificate or UE	85	3.53	1.50	
5 Higher school qualification	19	3.05	1.8	
6 Trade certificate or equivalent	150	3.48	1.58	
7 Bachelors degree	58	3.2	1.47	
8 Postgraduate	27	3.70	1.72	
Position	613			
1 Owner	367	3.35	1.6	
2 Shared owner	221	3.39	1.5	
3 Paid farm manager	8	3.5	1.53	
4 Member of family	10	2.7	1.33	
5 Unpaid spouse	4	4	1.73	
6 Other	2	2.5	2.12	
Parents farmers	614			
1 Yes	469	3.31	1.51	
2 No	145	3.38	1.53	
Involved in organic production	619			
1 Yes	57	2.35	1.45	1-2
2 No	562	3.45	1.48	
Involved in 'green' production	619			
1 Yes	108	3	1.59	1-2
2 No	511	3.43	1.48	
Considered organic production	555			
1 Yes	244	3.55	1.39	1-2
2 No	311	3.25	1.61	
Type	613			
1 Horticulture	86	3.5	1.62	1-3, 2-4, 3-4
2 Pastoral	324	3.25	1.52	
3 Specialist livestock	28	2.75	1.37	
4 Dairy	154	3.63	1.38	
5 Arable	21	3.28	1.79	

External Components by Attitude towards using Gene Technology

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	610			
1 Male	480	-0.40	1.77	1-2
2 Female	130	-1.17	1.73	
Qualification	599			
1 Primary school	17	-1	1.93	
2 Secondary school	148	-0.65	1.8	
3 School certificate	92	-0.54	1.62	
4 Sixth form certificate or UE	85	-0.34	1.66	
5 Higher school qualification	19	-0.92	2.01	
6 Trade certificate or equivalent	150	-0.4	1.73	
7 Bachelors degree	58	-0.35	1.75	
8 Postgraduate	27	0.2	2.23	
Position	613			
1 Owner	367	-0.49	1.78	1-5
2 Shared owner	221	-0.60	1.79	
3 Paid farm manager	8	-0.75	2.43	
4 Member of family	10	-1.8	1.22	
5 Unpaid spouse	4	-1	1.73	
6 Other	2	-1	2.82	
Parents farmers	614			
1 Yes	469	-0.51	1.78	1-2
2 No	145	-0.75	1.79	
Involved in organic production	619			
1 Yes	57	-0.57	1.8	
2 No	562	-0.47	1.76	
Involved in ‘green’ production	619			
1 Yes	108	-0.81	1.86	
2 No	511	0.51	1.77	
Considered organic production	555			
1 Yes	244	-0.64	1.86	1-2
2 No	311	-0.35	1.67	
Type	613			
1 Horticulture	86	-0.37	1.94	1-3, 3-4
2 Pastoral	324	-0.63	1.76	
3 Specialist livestock	28	-1.18	1.75	
4 Dairy	154	-0.44	1.71	
5 Arable	21	-0.47	2.01	

External Components by Subjective Norm for using Gene Technology

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	610			
1 Male	480	-0.52	2.84	1-2
2 Female	130	-1.38	2.97	
Qualification	599			
1 Primary school	17	-1.82	2.81	1-8, 5-8
2 Secondary school	148	-1.18	2.9	
3 School certificate	92	-0.48	2.92	
4 Sixth form certificate or UE	85	-0.31	2.91	
5 Higher school qualification	19	-1.12	2.5	
6 Trade certificate or	150	-0.6	2.9	
equivalent	58	-0.77	2.81	
7 Bachelors degree	27	0.55	2.58	
8 Postgraduate				
Position	613			
1 Owner	367	-0.65	2.88	
2 Shared owner	221	-0.82	2.87	
3 Paid farm manager	8	0.83	2.78	
4 Member of family	10	-1.11	3.82	
5 Unpaid spouse	4	0	1	
6 Other	2	-1	4.24	
Parents farmers	614			
1 Yes	469	-0.69	2.9	
2 No	145	-0.74	2.85	
Involved in organic	619			
production	57	-1.62	3.1	1-2
1 Yes	562	-0.64	2.86	
2 No				
Involved in ‘green’ production	619			
1 Yes	108	-0.93	3.13	
2 No	511	-0.66	2.84	
Considered organic production	555			
1 Yes	244	-1.09	2.99	1-2
2 No	311	-0.39	2.77	
Type	613			
1 Horticulture	86	-0.63	2.99	1-3, 2-3,
2 Pastoral	324	-0.66	2.9	3-4, 3-5
3 Specialist livestock	28	-2.34	2.87	
4 Dairy	154	0.61	2.8	
5 Arable	21	-.3	2.73	

External Components by Environmental Norm for Intention to use Gene Technology

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, $p < .05$)
Sex	610			
1 Male	480	1.18	1.37	1-2
2 Female	130	1.48	1.24	
Qualification	599			
1 Primary school	17	2.06	0.92	1-6
2 Secondary school	148	1.13	1.44	
3 School certificate	92	1.24	1.5	
4 Sixth form certificate or UE	85	1.34	1.20	
5 Higher school qualification	19	1.57	1.28	
6 Trade certificate or equivalent	150	1.07	1.26	
7 Bachelors degree	58	1.43	1.26	
8 Postgraduate	27	1.25	1.65	
Position	613			
1 Owner	367	1.25	1.36	
2 Shared owner	221	1.21	1.38	
3 Paid farm manager	8	1	1.26	
4 Member of family	10	1.77	0.97	
5 Unpaid spouse	4	0.33	1.15	
6 Other	2	1.5	2.12	
Parents farmers	614			
1 Yes	469	1.18	1.37	1-2
2 No	145	1.46	1.26	
Involved in organic production	619			
1 Yes	57	1.42	1.53	1-2
2 No	562	1.23	1.34	
Involved in ‘green’ production	619			
1 Yes	108	1.35	1.34	
2 No	511	1.22	1.35	
Considered organic production	555			
1 Yes	244	1.22	1.44	
2 No	311	1.26	1.28	
Type	613			
1 Horticulture	86	1.11	1.39	
2 Pastoral	324	1.23	1.37	
3 Specialist livestock	28	1.59	.95	
4 Dairy	154	1.25	1.37	
5 Arable	21	1.4	1.27	

Correlations between External Components and model components of the model of Intention to Purchase GM food

		Intention	Attitude	SN	Env' norm
Try to achieve GE free status	r	-0.66***	-0.63***	-0.5***	0.28***
	n	614	620	620	620
Try not to and achieve GE free status	r	0.57**	0.55***	0.44***	-0.18***
	n	613	619	619	619
Gross farm income	r	0.07	0.09	0.07	-0.09
	n	473	477	477	477
Income	r	0.16**	0.1*	0.08	-0.12
	n	470	474	474	474
Influence of demand for produce with less chemicals	r	-0.16***	-0.1*	-0.09*	0.11**
	n	589	595	595	596
Dependency on chemicals for pest control	r	0.22***	0.21***	0.19***	-0.2***
	n	593	599	599	616
Dependency on chemicals for weed control	r	0.21***	0.17***	0.15***	-0.16***
	n	605	611	611	611
Dependency on manufactured fertilisers	r	0.33***	0.29***	0.26***	-0.18***
	n	610	616	616	616
Influence of demand for environmentally friendly production	r	-0.20***	-0.16***	-0.14***	0.13**
	n	591	596	596	595
Increase in expenditure on chemicals	r	0.25***	0.15***	-0.16***	-0.18***
	n	603	609	609	609
Age	r	0.07	0.07	0.07	0.04
	n	602	607	607	607

Note: * = p <0.05¸ ** = p < 0.01, *** = p < 0.001

External Components by Intention to Purchase GM food

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	616			
1 Male	484	3.27	1.36	1-2
2 Female	132	2.68	1.36	
Qualification	605			
1 Primary school	16	2.8	1.36	
2 Secondary school	151	3.07	1.36	
3 School certificate	94	3.19	1.41	
4 Sixth form certificate or UE	88	3.21	1.32	
5 Higher school qualification	21	2.9	1.44	
6 Trade certificate or equivalent	150	3.23	1.32	
7 Bachelors degree	59	3	1.39	
8 Postgraduate	26	3.42	1.69	
Position	619			
1 Owner	370	3.24	1.34	
2 Shared owner	224	3.23	1.35	
3 Paid farm manager	8	3.33	1.63	
4 Member of family	10	2.44	1.32	
5 Unpaid spouse	4	3.33	1.52	
6 Other	2	2.5	2.12	
Parents farmers	620			
1 Yes	473	3.22	1.33	
2 No	147	3.24	1.41	
Involved in organic production	626			
1 Yes	61	2.55	1.57	1-2
2 No	565	3.28	1.31	
Involved in ‘green’ production	626			
1 Yes	105	2.86	1.5	1-2
2 No	521	3.28	1.31	
Considered organic production	561			
1 Yes	247	2.93	1.47	1-2
2 No	314	3.46	1.18	
Type	619			
1 Horticulture	87	3.37	1.47	1-3, 2-4,
2 Pastoral	328	3.11	1.32	3-4
3 Specialist livestock	29	2.73	0.91	
4 Dairy	155	3.49	1.3	
5 Arable	20	3.05	1.64	

External Components by Attitude towards Purchasing GM food

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	616			
1 Male	484	-0.73	1.59	1-2
2 Female	132	-1.58	1.46	
Qualification	605			
1 Primary school	16	-1.73	1.53	
2 Secondary school	151	-1.01	1.59	
3 School certificate	94	-0.83	1.63	
4 Sixth form certificate or UE	88	-0.80	1.62	
5 Higher school qualification	21	-1	1.51	
6 Trade certificate or equivalent	150	-0.86	1.56	
7 Bachelors degree	59	-0.92	1.6	
8 Postgraduate	26	-0.6	1.90	
Position	619			
1 Owner	370	-0.88	1.59	1-5
2 Shared owner	224	-0.90	1.62	
3 Paid farm manager	8	-0.83	2.48	
4 Member of family	10	-1.66	1.11	
5 Unpaid spouse	4	-1	1.73	
6 Other	2	-1.5	2.12	
Parents farmers	647			
1 Yes	473	-0.88	1.56	
2 No	147	-1	1.72	
Involved in organic production	626			
1 Yes	61	-1.26	1.82	1-2
2 No	565	-0.88	1.58	
Involved in ‘green’ production	626			
1 Yes	105	-1.07	1.76	
2 No	521	-0.88	1.57	
Considered organic production	561			
1 Yes	247	-1.12	1.68	1-2
2 No	314	-0.74	1.52	
Type	619			
1 Horticulture	87	-0.79	1.71	1-3, 3-4
2 Pastoral	328	-0.99	1.54	
3 Specialist livestock	29	-1.26	1.42	
4 Dairy	155	-0.73	1.16	
5 Arable	20	-0.94	2.17	

External Components by Subjective Norm for Purchasing GM food

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	616			
1 Male	484	-0.71	1.39	
2 Female	132	-0.93	1.59	
Qualification	605			
1 Primary school	16	-1.33	1.75	
2 Secondary school	151	-0.85	1.45	
3 School certificate	94	-0.74	1.51	
4 Sixth form certificate or UE	88	-0.65	1.36	
5 Higher school qualification	21	-0.73	1.48	
6 Trade certificate or	150	-0.77	1.36	
equivalent	59	-0.72	1.49	
7 Bachelors degree	26	3	1.41	
8 Postgraduate				
Position	619			
1 Owner	370	-0.78	1.43	
2 Shared owner	224	-0.69	1.43	
3 Paid farm manager	8	-1.16	1.6	
4 Member of family	10	-0.77	1.85	
5 Unpaid spouse	4	-0.66	1.15	
6 Other	2	-1	2.82	
Parents farmers	620			
1 Yes	473	-0.74	1.42	
2 No	147	-1.81	1.51	
Involved in organic	626			
production	61	-1.5	1.37	1-2
1 Yes	565	-0.7	1.43	
2 No				
Involved in ‘green’ production	626			
1 Yes	105	-0.75	1.56	
2 No	521	-0.76	1.42	
Considered organic production	561			
1 Yes	247	-1.02	1.49	1-2
2 No	314	-0.54	1.36	
Type	619			
1 Horticulture	87	-0.75	1.41	1-3, 2-3, 2-
2 Pastoral	328	-0.74	1.44	4,
3 Specialist livestock	29	-1.26	1.32	3-5
4 Dairy	155	-0.75	1.40	
5 Arable	20	0.47	1.86	

External Components by PBC for Intention to Purchase GM food

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	609			
1 Male	479	11.9	2.07	
2 Female	130	11.42	2.61	
Qualification	598			
1 Primary school	17	12.58	1.97	1-8, 2-8,
2 Secondary school	147	12.04	2.09	3-8, 4-8
3 School certificate	92	11.97	2.14	
4 Sixth form certificate or UE	88	12.17	1.76	
5 Higher school qualification	19	11.74	1.85	
6 Trade certificate or equivalent	150	11.43	2.56	
7 Bachelors degree	58	11.53	1.96	
8 Postgraduate	27	10.66	2.77	
Position	612			
1 Owner	366	12.05	2.14	1-2
2 Shared owner	221	11.53	2.1	
3 Paid farm manager	8	10.12	3.09	
4 Member of family	10	12.10	2.28	
5 Unpaid spouse	4	9	5.29	
6 Other	2	12.5	2.12	
Parents farmers	613			
1 Yes	468	11.78	2.13	
2 No	145	11.81	2.44	
Involved in organic production	561			
1 Yes	57	12.26	1.97	
2 No	561	11.76	2.22	
Involved in ‘green’ production	618			
1 Yes	108	11.51	2.33	
2 No	510	11.81	2.17	
Considered organic production	554			
1 Yes	244	11.78	2.23	
2 No	310	11.84	2.16	
Type	612			
1 Horticulture	86	12.1	2.17	
2 Pastoral	323	11.82	2.12	
3 Specialist livestock	28	12.35	2.45	
4 Dairy	154	11.51	2.34	
5 Arable	21	11.71	2.31	

Correlations between External Components and Components of the Model of Intention to use Organic Methods

		Intention	Attitude	Env norm
Try to achieve GE free status	r	0.29***	0.26***	0.27***
	n	616	616	616
Try not to and achieve GE free status	r	-0.18***	-0.24***	-0.17***
	n	617	617	617
Gross farm income	r	-0.08	-0.04	0.09
	n	472	472	472
Income	r	-0.11*	0.01	-0.07*
	n	472	472	472
Influence of demand for produce with less chemicals	r	0.1*	0.18***	0.2***
	n	591	591	587
Dependency on chemicals for pest control	r	-0.18***	-0.12**	-0.11**
	n	596	596	591
Dependency on chemicals for weed control	r	-0.14***	-0.21***	-0.23***
	n	607	607	602
Dependency on manufactured fertilisers	r	-0.17***	-0.3***	-0.37***
	n	613	613	608
Influence of demand for environmentally friendly production	r	0.12**	0.22***	0.22***
	n	592	592	588
Increase in expenditure on chemicals	r	-0.15***	-0.21***	-0.23***
	n	605	605	600
Age	r	0.04	0.07	0.07
	n	605	602	597

Note: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$

External Components by Intention to use Organic Methods

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, $p < 0.05$)
Sex	613			
1 Male	482	4.13	1.18	1-2
2 Female	131	4.25	0.99	
Qualification	601			
1 Primary school	16	4.6	1.12	2-4, 2-8
2 Secondary school	149	4.02	1.05	
3 School certificate	93	4.25	1.21	
4 Sixth form certificate or UE	87	4.29	0.98	
5 Higher school qualification	22	4.25	1.52	
6 Trade certificate or equivalent	149	4.16	1.2	
7 Bachelors degree	59	4.35	1.23	
8 Postgraduate	26	4.63	1.16	
Position	622			
1 Owner	367	4.15	1.17	1-5
2 Shared owner	224	4.27	1.1	
3 Paid farm manager	8	4	1.09	
4 Member of family	10	4.88	1.05	
5 Unpaid spouse	4	5	1	
6 Other	2	4.5	0.70	
Parents farmers	617			
1 Yes	470	4.19	1.19	
2 No	147	4.29	1.02	
Involved in ‘green’ production	622			
1 Yes	106	4.25	1.28	1-2
2 No	516	4.16	1.12	
Considered organic production	557			
1 Yes	245	4.72	1.18	1-2
2 No	312	3.8	0.94	
Type	615			
1 Horticulture	88	4.2	1.17	
2 Pastoral	327	4.32	1.20	
3 Specialist livestock	28	4.31	1.04	
4 Dairy	152	4.17	1.05	
5 Arable	20	4.15	1.25	

External Components by Attitude towards using Organic Methods

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	613			
1 Male	482	0.54	1.44	
2 Female	131	0.09	1.42	
Qualification	601			
1 Primary school	16	0.53	1.8	2-4
2 Secondary school	149	0.37	1.45	
3 School certificate	93	0.70	1.37	
4 Sixth form certificate or UE	87	0.81	1.32	
5 Higher school qualification	22	0.5	1.75	
6 Trade certificate or equivalent	149	0.6	1.46	
7 Bachelors degree	59	0.79	1.40	
8 Postgraduate	26	0.73	1.55	
Position	622			
1 Owner	367	0.52	1.47	1-5
2 Shared owner	224	0.72	1.39	
3 Paid farm manager	8	0.16	1.83	
4 Member of family	10	1.22	.83	
5 Unpaid spouse	4	1.66	1.52	
6 Other	2	2	1.41	
Parents farmers	617			
1 Yes	470	0.56	1.45	1-2
2 No	147	0.77	1.39	
Involved in ‘green’ production	622			
1 Yes	106	1	1.34	1-2
2 No	516	0.55	1.45	
Considered organic production	557			
1 Yes	245	1.15	1.34	1-2
2 No	312	0.17	1.37	
Type	615			
1 Horticulture	88	0.71	1.61	
2 Pastoral	327	0.59	1.43	
3 Specialist livestock	28	0.63	1.55	
4 Dairy	152	0.61	1.35	
5 Arable	20	0.52	1.71	

External Components by Environmental Norm for using Organic Methods

Variable	Number of cases	Mean	Std dev	Means with significant differences (t-tests, p< 0.05)
Sex	618			1-2
1 Male	486	1.23	1.35	
2 Female	132	1.61	1.17	
Qualification	606			
1 Primary school	18	1.83	1.09	
2 Secondary school	149	1.28	1.38	
3 School certificate	94	1.28	1.46	
4 Sixth form certificate or UE	87	1.39	1.17	
5 Higher school qualification	22	1.5	1.43	
6 Trade certificate or equivalent	150	1.15	1.27	
7 Bachelors degree	59	1.42	1.24	
8 Postgraduate	27	1.37	1.21	
Position	621			
1 Owner	372	1.31	1.3	
2 Shared owner	224	1.32	1.37	
3 Paid farm manager	8	1.38	1.3	
4 Member of family	10	1.9	0.99	
5 Unpaid spouse	4	0.75	1.25	
6 Other	2	1.5	2.12	
Parents farmers	622			1-2
1 Yes	472	1.24	1.34	
2 No	150	1.55	1.23	
Involved in ‘green’ production	520			
1 Yes				
2 No	107	1.4	1.3	
	627	1.32	1.32	
Considered organic production	558			
1 Yes				
2 No	246	1.26	1.42	
	312	1.27	1.26	
Type	620			
1 Horticulture	88	1.38	1.33	
2 Pastoral	330	1.3	1.34	
3 Specialist livestock	28	1.64	0.95	
4 Dairy	154	1.25	1.34	
5 Arable	20	1.35	1.31	

Chi square Tests between Involvement in Organic Production and External Components

	Chi-square	Degrees of Freedom	Significance
Sex	.01	1	.9065
Qualification	11.09	7	.1349
Position	1.78	6	.9383
Parents farmers	4.33	1	.0373
Involved in 'green' production	12.74	1	.0003
Considered organic production	17.34	1	.0000
Type	22.34	4	.0001

External components by Involvement in Organic Production

		Involved in organic production	Not involved in organic production
Try to achieve GE free status	Mean Std dev	1.32 1.75	0.39 * 1.79
Try not to and achieve GE free status	Mean Std dev	-1.13 1.96	-0.31* 1.82
Gross farm income	Mean Std dev	151737 214509	281744 * 868335
Income	Mean Std dev	45147 55309	50378 61057
Influence of demand for produce with less chemicals	Mean Std dev	5.12 1.59	4.27 * 1.64
Dependency on chemicals for pest control	Mean Std dev	2.15 1.53	2.71 1.52
Dependency on chemicals for weed control	Mean Std dev	2.43 1.31	3.39 * 1.46
Dependency on manufactured fertilisers	Mean Std dev	2.73 1.71	4.34 * 1.66
Influence of demand for environmentally friendly production	Mean Std dev	4.96 1.71	3.92 * 1.59
Change in expenditure on chemicals	Mean Std dev	0.94 1.37	0.36 * 0.96
Age	Mean Std dev	51.08 11.22	50.8 11.11

Note: * = significant difference between means (t-test, $P < 0.05$)