GENETIC ENGINEERING AND ORGANIC AGRICULTURE:

PERCEPTIONS OF ORGANIC EXPORTERS, PRODUCERS, AND CONSUMERS

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ABSTRACT

Genetic engineering technology is becoming increasingly widespread throughout the world. Since the late 1990s there has been intense controversy regarding its use in food production. Organic agriculture could lose or gain significantly from consumer uncertainty and apprehension regarding the genetic engineering of food products. Concerns about genetic engineering spread across the world, and organic agriculture is in a strong position to exploit consumer concerns about genetically engineered food. However, organic farming is also at risk from the cross-contamination of engineered crops, pest-resistance exacerbated by the technology, and the corruption of organic seedlines. In addition, there has been debate as to whether organic standards should be altered to permit the use of genetically engineered crops.

This study attempts to gauge the attitudes of three key sectors of the organic industry in New Zealand towards genetic engineering, namely producers, exporters and consumers of organic food in New Zealand. Producers of organic food in New Zealand were questioned regarding their views on genetic engineering, and whether they would consider incorporating genetically engineered crops in their food production. Exporters of New Zealand organic produce were questioned on the international organic markets and the exporters own opinions of consumer concerns towards genetically engineered food. Consumers of organic food were surveyed on their attitudes and beliefs about genetic engineering, and the possibility of genetically engineered organic food. Results for each survey sample were analysed using the statistical package SPSS.

The results show conclusively that organic exporters, producers and consumers do not want to eat or grow genetically engineered organic food. This appears to be based on intrinsic and ethical concerns as much as environmental and health concerns. Even if reassured about the safety of genetically engineered food to the environment and to human health, most organic consumers claim they would not eat it.

It is concluded that there is no future for genetic engineering in the organic industry. The industry would be wise to take advantage of the general consumer unease towards genetic engineering. Research into alternative methods of pest control would also be advised.

Keywords: Organic agriculture, Genetic engineering, Genetically modified organism, Consumer perception

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1 INTRODUCTION

1.1 Background of the Study

Genetic engineering has been a controversial topic since the late 1990s. Until it became widely known that food containing engineered genes was being sold, and has been sold for a number of years, the public were largely unaware of the technology. It came as a shock to many people to discover that a considerable amount of food containing genetically modified organisms (GMOs) is consumed on a daily basis throughout the world. The media has played a significant role in bringing the attention of the public to this, and may have influenced people's opinions to a certain extent. The debate continues, with new issues being raised by different groups from around the world. The environmental effects of transgenic crops are largely unknown, and while few human health effects have been recorded, the long-term effects are unproven. Consumers are demanding clear labelling of food, while manufacturers claim this is too difficult. Growers are unsure whether to plant transgenic crops, risking having them ripped out by protestors, or finding that demand for the product has fallen due to consumer unease.

Organic foods do not contain any genetically engineered organisms. However, organic food production is under threat from genetic engineering technology. It is possible that in future, current organic pest control methods may become useless because of the technology, and/or organic crops may become contaminated from genetically modified crops. It has been suggested that, involuntarily or voluntarily, the organic industry may have to consider incorporating food grown with altered genes. Additionally, it has been proposed that genetically engineered crops could be included in organic standards (Kirschenmann and Kirschenmann 1998). The reaction of the increasingly important organic market to the potential introduction of GMOs into organic food is unknown but crucial to the industry. It may also be the case that this sub-group of the population can provide insights into emerging patterns in the general population.

At present there is no commercial production of genetically modified crops in New Zealand, however, it is almost inevitable that eventually there will be. Before this happens it would be wise for New Zealand to seriously consider all potential situations, including the damage that may be done to the organic industry and the international image of the country.

1.2 Hypothesis, Aims and Objectives of the Study

The aim of this thesis is to investigate the role that GMOs may play in the future of the organic industry.

The hypothesis formulated, based on the situation regarding genetic engineering in New Zealand, and background knowledge of the New Zealand organic industry, is that "organic" consumers do not expect organic produce to contain genetically altered genes - and would not buy it if it did.

The primary objectives are:

1. To explore the beliefs, perceptions and attitudes of producers, exporters and consumers of organic food in New Zealand towards genetic engineering.
2. To identify the reasons for acceptance or rejection of GMOs by the producers, exporters and consumers of organic food in New Zealand.

The secondary objectives of this study are:

1. To determine whether the organic industry would consider using and accepting GMOs in their food production and consumption
2. To identify the main export markets for organic food and what the expected demands from those consumers would be
3. To compare the results within the organic community with similar data from the general population.

In order to achieve these objectives, a survey of representative groups of the organic industry was undertaken. Producers, exporters and consumers were questioned on their beliefs about genetic engineering, their opinions about organic food and the organic industry, and if they felt there was any future for genetic engineering in organic food. The results were analysed using the Statistical Package for the Social Sciences (SPSS).

This research is important because the organic industry is growing in importance in New Zealand, both in the export and to a lesser degree, national markets. If current trends persist, demand for organically grown produce will continue to increase. The organic industry must be aware of consumer demands, and cater for them accordingly. The study is important also to give a clear indication of the beliefs and attitudes of the organic sector. By introducing the commercial growth of genetically engineered organisms, New Zealand may be putting a growing export industry at risk.

1.3 Layout of the Thesis

The thesis consists of six chapters. Chapter two contains the background and literature review of the topic. Chapter three consists of a discussion of risk perception and the theory of attitudes and beliefs. The methodology used is described in chapter four and the reasons for its use are discussed. Chapter five presents the results obtained. Chapter six presents a discussion of the findings from the study, while chapter seven provides a conclusion and recommendations. References and appendices follow.

For the purposes of this thesis, the terms genetic engineering, genetically modified organisms (GMOs), transgenic organisms, and biotechnology, will be used interchangeably. The contexts they are used in should not in any way indicate any bias or attitude.

2 ORGANIC AGRICULTURE AND GENETIC ENGINEERING

2.1 Organic Agriculture

This section provides background information about organic agriculture, its origins and the underlying principles of the organic movement. The structure of the New Zealand organic industry is described, as is the position of the organic certification agencies towards genetic engineering at present.

2.1.1 What is organic agriculture?

Organic farming is an approach to farming which relies primarily on biological processes, rather than the purchase of chemical inputs, to maintain soil fertility and plant and animal health (MAF 1994). It is based on appropriate stocking rates, consideration of animal welfare, sound rotations using diverse stock and cropping strategies with the extensive but rational use of animal manure and other vegetative residues, and the use of appropriate cultivation techniques. It avoids the use of soluble mineral salt fertilisers, nearly all chemical pesticides, and all genetically modified organisms (BIO-GRO 1998).

Organic agriculture seeks to produce food of optimum quality, and to manage productive ecosystems according to a total concept that endeavours to make them sustainable and non-polluting to the environment, while providing an appropriate level of income to the producer, families and communities. The main principles employed aim to:

1. Foster beneficial processes and interaction such as occur in natural ecosystems, thus encouraging internal stability rather than heavy reliance on external control measures;
2. Reduce external control to the absolute minimum required for maintaining the chosen state of production. Inputs used should aim to work as far as possible in conjunction with natural cycles, rather than trying to dominate such cycles;
3. Achieve cycles and flows of nutrients and minerals that have as few losses as possible. This requires the conservation and recycling of nutrients and organic material;
4. Sustain and enhance the fertility and life supporting ability of the production medium including its biological, physical and chemical components. For landbased production systems great emphasis is placed on the importance of soil organic matter, and soil flora and fauna; and

5. Minimise any deleterious environmental effects of particular management practices including any that may reduce the natural diversity to the detriment of plant and wildlife habitats (BIO-GRO 1998 p3).

Organic farming includes the terms biodynamic and biological. It is an approach to farming that seeks to create an integrated, sustainable and humane agricultural system. The degree to which organic farming achieves these goals varies between different soil, climatic and enterprise types in accordance with the managerial skills and aims of the farmers (MAF 1994).

2.1.2 The origin of the organic movement

Rudolph Steiner laid the basis for biodynamic agriculture in the 1920s, conducting a series of lectures on alternative agriculture throughout Germany. As a result many farms in Germany, Austria and Switzerland converted to the biodynamic way of farming. Steiner had felt that "during the last few decades the agricultural products on which our life depends have degenerated extremely rapidly. It is not only human moral development that is degenerating, but also what human activity has made of the Earth and of what lies just above the Earth" (Steiner 1924, p3).

Steiner's philosophies make use of a deeper spiritual insight in order to discover what our "increasingly unreliable instincts are now less and less able to supply". They look at the life of plants and animals in a broad way, and also at the life of the Earth itself. In order to arrive at spiritual-scientific methods applicable to agriculture, it is necessary to look at nature, and the spirit's activity in nature, in its entirety, in its most encompassing dimensions (*ibid*). The guidelines are based on spiritual, moral and social responsibility, from which guarantees for the quality of the end product are made.

The origins of organic agriculture occurred even before the explosion of the agrichemical revolution and before the environment had really become an issue. Balfour (1975) carried out a large experiment on organic agriculture, the Haughley Experiment, from 1939 through to 1969. The researchers were concerned with *health* and not environment alone. They paid more attention to building soil fertility and vitality through recycling nutrients within a more or less closed system than they did to the avoidance of mineral salts (Boeringa 1980).

The early practitioners and pioneers of organic agriculture broke away from the narrow confines of the preconceived ideas that dominated the scientific thinking of their day. They

looked at the living world from a new perspective and asked new questions. Instead of the contemporary obsession with disease and its causes, they set out to discover the causes of *health*. This led inevitably to an awareness of wholeness and to a gradual understanding that all life is one (Balfour 1978, cited in Woodward 1996).

'Health' was thought to be part of a continuum through soil, plant, animal and man. By recycling nutrients through this chain, productivity could be maintained over time and health could be enhanced at all stages, as long as food was consumed fresh and for the most part whole. It should be subjected to little or no processing and to no chemical intervention at any stage (Balfour 1944; Besson and Vogtmann 1978, cited in Woodward 1996).

In all those respects the Organic Movement represented a marked departure from the trend towards the increasing fragmentation of science, the piecemeal application of science through technology, and the unceasing struggle to deal with the ever-changing manifestations of individual diseases, whether in plants, animals or humans.

Balfour (1975) conducted a number of studies of exceptionally healthy cultures, and found that health was related to four factors shared by all the groups. These are:

1. Fresh food
2. Whole food (all edible parts eaten)
3. Food grown on soil to which all organic wastes are returned to complete the cycle
4. Food grown without chemicals or man-made substitutes for natural processes.

When the last two factors are put into practice in modern systems of food production, they give rise to the method referred to as 'organic farming'.

The first conference of the International Federation of Organic Agricultural Movements (IFOAM) in 1977 concluded that IFOAM was seeking to:

> provide an articulate, informed and coherent alternative to contemporary agricultural dogma...(and)...provide further impetus for both the research into, and the practice of, methods of husbandry which are based on the ethic of satisfying need and the obligation to do so by technologies that our planet can sustain (Fisher 1978, cited in Woodward et al. 1999, p21).

The major concerns of researchers and founders of the early organic movement were research approaches, soil fertility, nutrient supply, weeds, pests, disease and food quality. Later, the development of standards for organic production were added to the agenda.

The main points of "principles of organic agriculture", as adopted at the opening section of the IFOAM Basic standards of Organic Production (1981) are:

1. To work as much as possible within a closed system, and draw upon local resources;
2. To maintain the long-term fertility of the soils;
3. To avoid all forms of pollution that may result from agricultural techniques;
4. To produce foodstuffs of high nutritional quality and sufficient quantity;
5. To reduce the use of fossil energy in agricultural practice to a minimum;
6. To give livestock conditions of life that conform to their physiological needs and to humanitarian principles;
7. To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human beings;
8. To use and develop appropriate technology based on an understanding of biological systems;
9. To use decentralised systems for processing, distribution and marketing of products;
10. To create a system which is aesthetically pleasing to both those within and those outside the system; and
11. To maintain and preserve wildlife and their habitats

(Woodward et al. 1999 p 23).

These eleven points capture the essential part of the concept of health, which the pioneers of the organic movement espoused. They also provide a description of the goals of "sustainable agriculture," encompassing social, economic and environmental parameters beyond as well as behind the "farm gate" - a comprehensiveness which has only recently been seen as important (*ibid*).

2.1.3 A change in organic principles

The founding concept of health, sustainability, and the concept that, by providing farmers with the skills to grow food organically, we will be developing a crucial vehicle for bringing about a more equitable, healthy and genuinely sustainable world, appear to have been neglected in today's organic agriculture. (Woodward et al. 1999)

The organic movement today has retained the prohibition of "chemical intervention" but seems to have neglected the other principles. The revolutionary concept of human health

being one and indivisible with the health of environment, status of animal welfare, and nature of processing, packaging and distribution has been largely unheeded.

Woodward et al. (1999) note that a truth can easily be suborned, undermined, and twisted against itself by appropriating its language, distorting its logic and misapplying its conclusions. They argue that today this has happened with the term "sustainable". The term has been appropriated by government and industry, and used as a code to indicate there is no conflict between growth and environment that cannot be traded off (*ibid*). The essence of sustainability as described by Balfour (1978 cited in Woodward et al. 1999, p21) is: "the criteria for sustainable agriculture can be summed up in one word - permanence - which means adopting techniques that maintain soil fertility indefinitely; that utilise, as far as possible, only renewable resources; that do not grossly pollute the environment, and that foster life-energy (or biological activity) within the soil and throughout the cycles of all the involved food chains."

The delocalisation of the organic industry, with the proclivity towards highly packaged, homogeneous and shelf-stable food products is one of the least sustainable practices in modern agriculture (Friedmann 1994, cited in Coombes and Campbell 1998). This is occurring in the organic industry and is fundamentally antithetical to the beliefs of philosophically committed growers in the alternative agriculture movement (Tovey 1997, cited in Coombes and Campbell 1998). Whether or not this is an inevitable progression or if it is a regression and a slighting of the organic name, it is important to realise that this has happened. Reasons for this will be discussed in the section 'Structure of the industry'.

2.1.4 Organic farming in New Zealand

The organic agriculture movement in NZ arose from a wide coalition of interests: urban food consumers, lifestyle residents in peri-urban areas, European migrants to NZ in the 1950s and 60s, and direct contact with the British soil association. By 1983 this loose coalition had institutionalised itself as the New Zealand Biological Producers Council which administered the standards for production under the BIOGRO certification system (Saunders et al. 1997).

There has been a trend in consumer demand towards buying food that is perceived to be healthy, with low chemical residue levels, and produced in environmentally friendly ways with concern for animal welfare (Ministry of Agriculture and Fisheries 1994). Organic food consumption has been linked with subjective factors in consumer purchasing by clearly situating the rise of organic food trading within consumer reactions to food scares and health

concerns (Friedland, 1994; James, 1993, cited in Campbell and Coombes 1999). Alvensleben and Altinann (1987, cited in Beharrell and MacFie 1991) summarise the basic conditions behind the rising demand for organic produce as:

1. The socio-cultural background: changing values in the society ("post-materialism" scepticism against economic growth and modern technology, environmental movement, etc);
2. General discontent with the present food supply (concern about residuals, etc);
3. Positive image of organic food (health, taste, etc);
4. Health consciousness of consumers;
5. Discontent with the mass distribution system ("alienation"); and
6. Positive income elasticity, negative price elasticity of demand.

Many consumers perceive that organic products fulfil this demand. Market growth will depend largely on how much of the market for environmentally friendly, low residue products is supplied by organic products (Ministry of Agriculture and Fisheries 1994). Campbell and Coombes (1999) state that the growth in organic food exporting from New Zealand is synergistically linked to the environmental and health threats to conventional exporting, and these threats are in turn linked to the continuing contradictions of the last remnants of Fordism[1] and its breakdown.

Between 1983 and 1990, there were a number of changes within the organic agricultural movement. Within that period, NZ organic agriculture developed stronger links with international organic bodies such as the IFOAM. In addition to this, the standards for organic production were formalised, and an inspectorate to administer them was set up. The New Zealand Biological Producers and Consumers Council (Inc) was founded in 1984 to promote the interests of organic production in New Zealand. This council now trades as the BIO-GRO New Zealand (BGNZ) organisation, and is the main labelling agency in the country. The other certification agency operates under the Demeter label, and is run by the New Zealand Biodynamic Farming and Gardening Association. The Demeter label was established in 1982.

2.1.5 Structure of the New Zealand organic industry

According to Saunders et al. (1997), two developments in the 1990s have strongly influenced the current structure of the industry. These developments are: the professionalisation of BIO-GRO, and the development of organic exporting. BIO-GRO has been a professional inspectorate since 1994, when fees for inspection were significantly increased for that

purpose. New Zealand had very low levels of organic food production prior to 1990. A Ministry of Agriculture and Fisheries (MAF) report estimated that the total value of organic food traded in New Zealand in 1990 was NZ$1.1 million (MAF 1991).

Since that time, organic food production has escalated dramatically. The period from 1990 to the present has been characterised by the conversion of conventional farmers at the bequest of export agribusiness (Coombes and Campbell 1998). In 1990, Wattie Frozen Foods Ltd (later to become Heinz-Wattie NZ) and the New Zealand Kiwifruit Marketing Board (now Zespri International) began to experiment with organic products. They now form the backbone of the new organic food exporting industry. Given that the nature of large corporate firms and that of the organic agriculture movement are apparently incompatible, the relationship was unlikely to be easy. The arrival of the large corporate entities placed pressure on both the institutions behind the organic certification system and the ideological loyalty of many long term members of the organic movement (Campbell and Coombes 1999).

In 1992, a Tradenz Joint Action Group produced a report on the prospects of organic food in export markets. By 1995, the rate of growth in organic exports was such that Tradenz fostered the establishment of the Organic Products Exporting Group, and assigned a Tradenz officer to help facilitate the development of organic exporting. These actions were the most significant moves by the NZ government to actively support the development of organic food production in NZ.

The economic structure of organic farming in New Zealand is characterised by two types of farms. The first (and original) organic farm in New Zealand is the interdependent lifestyle, domestic, small-scale production type. The second type is the export-oriented, commercialised organic farm (Coombes and Campbell 1998). The traditional organic farm generally supplies the domestic market and is likely to be of the mixed farming type, particularly market gardening. The motivation for many of these producers to farm organically appears to be because of philosophical viewpoints. They may have a strong concern for the environment and/or be farming organically for lifestyle reasons, generally not because of strong financial incentives (Saunders et al. 1997).

The second type of farm is largely aiming at production for the export sector. These farms are of two kinds; those producing permanent crops and those on broadacre production systems where the export crop is rotated with other crops (*ibid*). The number of these export-based

[1] Symbol of mass production

farms has grown since early 1990 with large processing companies such as Heinz Wattie New Zealand and Zespri International marketing organic produce.

Since the early 1990s a number of conventional farmers have been attracted into organic production due to the increase in exports. Initial success in targeting overseas niche markets presented processing companies with the need to encourage a continuity of supply from growers and also to recruit conventional farmers into organic production (*ibid*). The internationalisation of the New Zealand organic industry may be viewed as being oppositional to the philosophy of the organic movement, especially in terms of a lack of producer-consumer accountability and the use of fossil fuels for global transport (Coombes and Campbell 1998).

It has been said that organic farming is conventionalising, with large firms from conventional agriculture "commandeering" the 'organic' label (Buck et al 1997 cited in Coombes and Campbell 1998). Accordingly, the influence of such firms is believed to have regulated organic certification, thereby debasing the meaning of organics to allowable inputs, rather than sustainable practices. This process of 'corporate greening' may negatively transform organic agriculture, with a possible dilution of standards for organic certification. However, Coombes and Campbell (1998) maintain that small-scale organic producers can coexist with agribusiness involvement in the organic industry. This is evident as the introduction of agribusinesses in the industry has not been at the expense of the smaller, earlier organic farmers.

The organic producer sector is therefore likely to be made up of two different groups of people who are quite likely to hold varying beliefs and ideologies, which may potentially conflict with each other.

2.1.6 Standards and regulations

BIO-GRO standards have evolved since 1984, and there are procedures in place which enable these standards to be reviewed. The standards have evolved in dialogue with international organic groups like the IFOAM and the Australian organic agriculture body NASAA. The great majority of exporters have decided to use the BIO-GRO standards rather than the alternative biodynamic Demeter label (Saunders et al. 1997). These standards are held in high regard overseas, and the overall structure of the organic industry is strongly influenced by the certification and labelling system.

In addition to the standards for organic production issued by either BIO-GRO or Demeter, all primary producers in New Zealand are obliged to meet the requirements of the New Zealand Resource Management Act 1991, which defines sustainable management as:

> *managing the use, development, and protection of natural and physical resources in a way, or at a rate, that enables people and communities to provide for their social, economic and cultural well being and for their health and safety while -*
> *a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
> *b) safeguarding the life-supporting capacity of air, water, soil and ecosystems; and*
> *c) avoiding, remedying or mitigating any adverse effects of activities on the environment.*
> (Resource Management Act 1991)

2.1.7 Present stance on GMOs

Genetically modified organisms are clearly prohibited from BIO-GRO regulations. Under section C: Materials and Practices, it states that "materials must....not be GMOs; and not be products containing or originating from GMOs." (p26).

Section E also states explicitly that genetic engineering is not to be used: Livestock, Poultry, Egg and Dairy Production and Processing states that 'Genetically Engineered Breeds are Prohibited', and that the following products shall not be included in, nor added to, the feed or in any way be given to farm animals: genetically engineered organisms or products thereof (p39). Section F (Cropping, Vegetable, Fruit, and Wine Production and Processing) also indicates that seeds from genetic engineering, and/or transgenic plant material are prohibited (p51).

In Appendix 7: Procedure to evaluate other inputs to organic agriculture, BIO-GRO has the following stance on genetic engineering:
Consumers' perception: Inputs should not meet resistance or opposition of consumers of organic products. An input might be considered by consumers to be unsafe to the environment or human health, although this has not been scientifically proven. Inputs should not interfere with a general feeling or opinion about what is natural or organic - for example, genetic engineering (p87) (BIO-GRO 1998).

The BIO-GRO position on GMOs is obviously very clear at this point. Should genetic engineering become more widespread, with the resulting cross-contamination of plants

becoming common, and possibly contaminating organic crops, they may change their stance. Or, indeed, if GMOs are shown to be beneficial to the environment if used in a certain way, the regulations may potentially be changed. BIO-GRO standards have evolved since 1983 and there are procedures in place which enable these standards to be reviewed.

2.2 The Genetic Engineering Controversy

This section describes the theory of genetic engineering, and discusses the controversial aspects of the technology. The benefits and risks of each situation are presented and reviewed in order to provide a balanced view of the genetic engineering debate.

2.2.1 The science

In order to have an understanding of the opposition to genetic engineering, it is first necessary to have some knowledge about genetic engineering.

Genes are contained in every organism, from a single bacteria cell to a human being. All the information the organism needs regarding growth, survival and reproduction are carried in the genes. Genetic engineering involves removing, turning off, or moving between one organism to another, these genes (Independent Biotechnology Advisory Council 1999). The result of this shuffling around means that the information from one organism is now transferred to another. This means the chemical normally produced by the gene in the first organism is may be produced by the second; or the chemical may not be produced if the gene has been removed.

Basic genetic engineering involves identifying the gene for a particular trait, and transferring it from the species it naturally occurs in to another species. The two methods used for this are either vectorless transmission (biolistic {particle gun} delivery), or through the use of a vector. The former can cause physical damage to the cells, and only a small proportion of cells tend to take up the foreign DNA[2].

Vectors involve the use of an organism to carry genetic material from one species to another, and involves the following three steps:

1. Obtaining the desired piece of genetic material from the donor species;

[2] DNA - Deoxyribonucleic acid

2. Inserting this piece of genetic material into the vector species; and
3. Infecting the species to be genetically engineered with the vector species so that the desired piece of genetic material passes from the vector to the genetically engineered species (Reiss and Straughan 1996).

2.2.2 Genetic engineering versus traditional selective breeding

It has been indicated that the process of genetic engineering is not significantly different to that of traditional selective breeding that has been practised for centuries (Connor 1997). 'Traditional biotechnology' includes all of biotechnology, and is based on activities such as the farming of animals and plants and the use of micro-organisms in the manufacture of beer, wine, cheese.

The distinction appears to be important to opponents and proponents alike. Reiss and Straughan (1996) assert that genetic engineering differs from traditional biotechnology in at least three important ways:

1. In traditional biotechnology the species crossed are always closely related to each other. The capacity to combine genes from dramatically different organisms has no precedent in evolution. This is where the big step beyond traditional plant breeding occurs (IBAC 1999).
2. The pace of change in traditional biotechnology is much slower (time scale of years)
3. Genetic change as a result of traditional biotechnology happened to only a relatively small number of species, namely those that provide us with food and drink, such as crop plants, farm animals and yeasts. Genetic engineering is far more ambitious, in that it seeks to change not only the species that provide us with food and drink, but also those involved in sewage disposal, pollution control and drug production.

In addition to these three basic differences between genetic engineering and traditional breeding, there are some related and more subtle variances associated with the technology. There is such an enormous pool of genes available for manipulation, scientists are no longer limited to the gene pool of the plants that can specifically interbreed with a crop. This, the opponents allege, will increase the likelihood of something going awry (Rissler and Mellon 1996).

The outcomes may be less predictable than traditional breeding due to the novelty and power of genetic engineering. Unlike the replacement of one version of a gene for another, a wholly new gene may interact with the rest of the plant genome in more unpredictable ways. New

traits may enable weeds to overcome ecological limits on population growth, especially since many of the traits established in most crops are ecologically advantageous (*ibid*).

2.2.3 The environment

Connor (1997) asserts that the three main characteristics that are engineered in most crops world-wide are improved resistance to viruses, insects and herbicides. Others traits being developed include: bacterial and fungal resistance, male sterility and fertility, chilling and freezing tolerance, altered pigmentation, delayed fruit ripening and improved postharvest storage, flavour and nutritional quality. These qualities appear advantageous and beneficial, however their effects on the environment are largely unknown, as the long-term effect of the release of transgenic organisms into the environment has not been assessed. Scientists and environmentalists alike have concerns about the effects these genetically engineered crops will have on the environment. The main considerations that have been raised regarding genetically engineered crops and the environment are discussed in this section.

2.2.3.1 Bacillus thuringiensis (Bt) resistance

Genetic engineering is a technique used to genetically modify plants for greater natural resistance against pests (Savage and Connor 1994). One technique to improve resistance to insects is to engineer the ability of plants to produce their own insecticides. By far the greatest research effort in developing pest-resistant transgenic crops has gone into expression of *Bacillus thuringiensis* (Bt) toxins in plants (Gatehouse et al. 1999). Bt is a naturally occurring soil bacterium. The gene for resistance is inserted into the new plant, (mainly corn, potato and rapeseed) which could potentially minimise or reduce the use of pesticides altogether (Kloppenburg and Burrows 1996). "In an attempt to reduce the use of man-made pesticides, pest-resistant cultivars of many vegetable and fruits are being developed" (Savage and Connor 1994).

Engineering plants to produce their own insecticides poses a real threat to organic farmers. Bt sprays have been used for the last 40 - 50 years by organic farmers as an environmentally friendly biopesticide. Bt targets specific groups of insects, such as caterpillars, so is useful in serious pest infestations. Purified Bt toxins are used as an externally applied insecticide. In the form used by organic growers, these biological toxins break down quickly. Now, constant high-dose protection is possible with transgenic plants (Snow and Palma 1997). Constant exposure to the high levels of toxins in the engineered plants is likely to increase the

resistance of pest species (Soil Association 1999). Insects are continually exposed to the toxin, and are therefore under constant pressure to develop resistance. The USEPA (Environmental Protection Agency) has estimated that most pests targeted by the new generation of transgenic crops will build up resistance within 3 - 4 years (Soil Association 1999). Gatehouse et al. (1999) state that however effective a transgene might be initially, just as with chemical pesticides it is highly likely that the pests will develop resistance to it. The resistance trait is highly stable, and also exhibits broad spectrum cross-resistance to other delta-endotoxins, which undermines many potential options for resistance management (Ho 1998). Many entomologists regard Bt as an unusually benign pesticide that warrants extremely careful management, given the lack of acceptable alternatives (Snow and Palma 1994). Its loss may promote the use of more environmentally damaging methods of pest control.

Interestingly, the transgenic crops engineered to produce Bt have not been totally successful in the field. Bt cotton failed to control pests in Australia and in widespread areas throughout the US (Hilder and Boulter 1999). The reasons for this are not yet completely known, possibilities include inadequate expression levels, naturally resistant insect populations, development of resistance, all of which may have been influenced by the environment (Kaiser 1997 cited in Hilder and Boulter 1999).

2.2.3.2 Herbicide tolerance

A large proportion of research conducted by biotechnology companies has focused on making crops resistant to the company's own broad spectrum herbicides. An argument used by the biotechnology industry to promote genetic engineering, is that the technology will reduce the use of chemical pesticides, or at least reduce the use of the more damaging ones. However, it will allow non-persistent herbicides (for example glyphosphate) to be used more widely and will permit post-emergence spraying of herbicide resistant crops. This could promote greater reliance on herbicides and allow crops to be grown in soil contaminated with hazardous herbicides (Snow and Palma 1997). This creates problems not only for the environment due to excessive herbicide use, but also in the form of pest resistance to these chemicals. Pest insects have shown a remarkable capacity to develop resistance to chemical pesticides with over 500 species of insects now resistant to chemicals (Moberg 1990 cited in Hilder and Boulter 1999). It is possible therefore, that pests will develop resistance to these chemicals as well. A further concern is that selection for resistance to one type of pesticide sometimes

confers cross-resistance to other pesticides (Gould et al. 1982, cited in Snow and Palma 1994).

"Roundup" is the world's best selling weed-killer, and is produced by Monsanto. It is a broad spectrum herbicide and is based on glyphosphate. While it is considered relatively safe for birds and animals, its toxicity for humans is still incompletely understood. Nevertheless, to permit genetically engineered Roundup sprayed crops to be used for livestock fodder, the USEPA has allowed an increase in glyphosphate residues tolerances to go from 6 to 20ppm for raw soybeans and from 100 to 200 ppm for soybean hay and 100 ppm for their hulls (Lappé and Bailey 1999). This indicates that greater amounts of the herbicide will be applied.

The safety of these products to animal life and the environment is also disputed. While Roundup is promoted as an environmentally benign herbicide, the United States Fish and Wildlife Service has identified 74 endangered plant species potentially threatened by excessive use of glyphosphate (Nottingham 1998). Glyphosphate has been shown to kill fish in concentrations of 10 ppm (UNEP 1994), reduce growth of earthworms and increases their mortality, and is toxic to many mycorrhizal fungi which enable nutrient uptake by plants from the soil (Chakravarty and Chatarpaul 1990). There is also some evidence that glyphosphate can combine with nitrates in the stomach secretions and human saliva to become carcinogenic (Weir 1997).

2.2.3.3 The spread of genetically engineered crops

Commercialisation of genetically engineered plants will allow transgenes coding for beneficial traits to be transferred to wild or weedy populations of these taxa and their close relatives (Snow and Palma 1994). This situation is a concern to organic farmers, whose produce may inadvertently become contaminated with genetically engineered plants, and would therefore no longer be considered organic. The problem of crossing with wild relatives could lead to a generation of "superweeds", with herbicide resistant traits. Rissler and Mellon (1996) state that given enough time and a broad enough selection of engineered crops, movement of transgenes into wild relatives of crop plants is a virtual certainty. They do assert that genetically engineered crops are not inherently dangerous, they only present problems where new traits, or combinations of traits, produce unwanted effects in the environment. A potential risk of escaped transgenes is that hybridisation with populations of free-living relatives will make these plants increasingly difficult to control, especially if they are already recognised as agricultural weeds and if they acquire resistance to widely used

herbicides (Snow and Palma 1994). Different crops will present different problems depending on the new genes they contain, the characteristics of the parent crop, and the locale in which they are grown. Genetically engineered crops would only pose risks when the crop itself can survive without cultivation or when the crop spontaneously hybridises with closely related wild taxa (*ibid*).

2.2.4 Human and animal health

Considerable attention has focused on the health effects of consuming food produced with genetic engineering techniques. The concerns relate both to the health of humans and that of animals, and the result of eating animals fed genetically engineered food. The major issues are discussed in the following sections.

2.2.4.1 Antibiotic resistance

Genetically modified plants often carry antibiotic resistant marker genes to indicate to scientists where the modified genes rest in the plant. The use of these marker genes in genetic engineering is an important tool, but one which may prove to be dangerous. When a genetically engineered food plant containing an antibiotic resistant marker gene is ingested by humans or animals, the resistant gene could transfer to bacteria in the gut, and be expressed by them, making them resistant to that particular antibiotic (Soil Association 1999). Geneticists have linked the emergence of pathogenic bacteria and of antibiotic resistance to horizontal gene transfer. The presence of antibiotics typically increases the frequency of horizontal gene transfer a hundred-fold or more (Ho 1998).

2.2.4.2 The creation of new toxins and new diseases

Genetic engineering is not necessarily safe, because the pest-resistant varieties of vegetables and fruit usually contain elevated levels of natural pesticide that may be harmful to human health (Savage and Connor 1984). New toxins can be created unexpectedly through genetic engineering. In 1989 a new disease called EMS (Eosinophilia myalgia syndrome) occurred in the US. This disease was linked to a batch of the food supplement Tryptophan that had been produced through genetic engineering. Thirty seven people died and 1500 people were disabled as a result of EMS (Soil Association 1999).

Ho (1998) says that as some transgenic plants are now engineered for resistance to viral diseases by incorporating the gene for the virus's coat protein, there is the concern that they may generate new diseases. Additionally, there are many other ways in which genetic engineering could go wrong and result in hazardous toxins in food. Many plants produce toxic chemicals naturally, so manipulating their genes may result in these toxins being transferred to another organism (Soil Association 1999).

2.2.4.3 Allergenic or toxic effects

By incorporating genes from other plants or species into a product, the potential for allergic reactions to the original plant still exist. Genetic engineering can transfer allergies from foods to which people know they are allergic, to foods they think are safe. Findings from Nordlee et al. (1996) demonstrate that an allergen from a food known to be allergenic can be transferred into another food by genetic engineering.

In addition to this relatively straightforward situation, the possibility exists of toxic or allergenic effects due to transgene products or products from interactions with host genes (Ho 1998). This is considerably less predictable, but could have serious consequences.

2.2.4.4 Other health effects

It has been assumed that DNA is easily broken down in the environment, a stand used to dispel fears relating to the ingestion of genetically engineered DNA. However, DNA actually survives rigorous boiling and is therefore much hardier than the public has been led to believe. It has been shown that the DNA of a virus can survive passage through the gut of mice, and readily finds its way into the blood stream, and into cells of the body. Once inside the cell, the altered DNA may insert itself into the cell's genome and create genetic disturbances there, including cancer (*ibid*).

Gene multiplication and a high proportion of gene transfers are mediated by vectors, which have been shown to be problematic. They are derived from disease causing viruses, plasmids, and mobile genetic elements, genetic parasites that have the ability to invade cells and insert themselves into the host genome, causing genetic damage and unpredictable physiological effects (Weir 1997).

2.2.5 Feeding the world

In order to feed present and future world populations we cannot rely on the techniques we use at present to produce food (Savage and Connor 1994). An alleged benefit from genetic engineering is that the technology will improve crop yield and therefore help feed the world's growing population. Genetic engineering has the two advantages of decreasing the time required to produce a new cultivar and widening the potential gene pool that can be used (*ibid*). Plants could be modified to grow in marginal areas, such as deserts, thereby better utilising the surface area of the earth. They could produce greater yields on less land and reduce the need for expansion of agricultural land. However, opponents such as Montague (1998) view this claim with sarcasm and cynicism, and call it "Greenwash with a Guilt Trip". Those opposing genetic engineering believe the primary reason for genetic engineering is for the biotechnology firms to make a profit.

Ho (1998) states that "food scarcity", like "overpopulation" are socially generated. While populations in the North are suffering from obesity, cardiovascular diseases and diabetes from over-consumption, populations in the South are dying of starvation. Simplistic 'solutions' which leave out the unequal power relations are oppressive, and ultimately "reinforce the very structures creating ecological damage and hunger" (Hildyard 1996, cited in Ho 1998). Producing more food is unlikely to feed the starving people if the distribution problem is not solved first.

Even if increased food production were to reduce the number of starving people in the world, it is unlikely at present that genetic engineering will achieve increased yields. The crops are not being developed to produce greater yields, rather, evidence from the University of Wisconsin shows genetically modified soya under-performing conventional soya in 17 out of 21 times (Simms 1999).

The trend that began in the Green Revolution, of basing production on large areas of monocultures with a high dependence on chemical inputs is being continued with genetic engineering. This is likely to persist and exacerbate the problem of starving people. According to Kimbrell (1998), the industrial system has "enclosed" peasants off the land so that the land can be used for export crops. Millions of peasants lose their land, community, traditions and most directly their food independence. Increasing agricultural output has little effect on the hungry because it fails to address the key issues of access to land and purchasing power, which are allegedly at the root of hunger.

A related claim to the issue of food security, is that larger, technology-intensive farms are more efficient for food production. While in purely economic terms this may be the case, the secondary effects of this, such as the destruction of rural communities, the exodus to the cities, the resulting increases in unemployment, crime, food-dependency and hunger offset any advantage. In addition to this claim, the biotechnology companies assert that "low tech" alternatives to high yield industrial crop production require more land to produce the same output, and in the process threaten wetlands, forests and other unique ecosystems (Kimbrell 1998). This is an almost direct attack on organic farmers, who are increasingly posing a threat to the genetic engineering business. However, studies have indicated that alternative agriculture is at least as efficient in producing output as industrial, chemical based agriculture, and that the relationship between farm size and productivity is inconclusive (Mendis 1992).

Conversely, a study undertaken by Evenson (1999) shows that while a "global food crisis" is unlikely to occur by the year 2020, in many countries "local food crisis" will occur. Simulations show that delays in the diffusion of modern technology research capabilities to developing countries will exacerbate these crises. The results would indicate that biotechnology is indeed important to feed the world. Conflicting arguments such as these are typical throughout the literature on this topic.

2.2.6 Biotechnology firms

Many arguments against biotechnology centre around the perception that the firms behind the technology are driven by profit only. The common impression is that regardless of the claims made by biotechnology firms such as Monsanto and Novartis, the beneficial claims are a cover for the underlying motives of the industry. As a result of a number of acquisitions and mergers between firms, the biotechnology firms have concentrated economic power in just a few of the biggest players. Monsanto is worth about US$96 billion dollars, more than the economic value of some countries (Kimbrell 1998). At the end of 1998, Monsanto controlled 87 percent of the United States cottonseed market, Cargill controlled 45 percent of the global grain trade, and the top five vegetable seed companies control 75 percent of the global seed market (Anderson 1999). The co-president of Monsanto's agricultural sector, Robert Fraley, has been quoted as saying:

"This is not just a consolidation of seed companies, it's really a consolidation of the entire food chain" (*ibid* p87).

There is evidence that these companies have close links with governments, particularly in the United States, and the United States government has allegedly put considerable pressure on other countries to conform to their wishes. According to Anderson (1999), the US threatened the New Zealand government if it carried on with its plans to test and label transgenic food. They warned they may pull out of a potential free trade agreement with New Zealand. Ho (1998) states that what makes genetic engineering biotechnology dangerous in the first instance is that it is an unprecedented close alliance between two great powers that can make or break the world: science and commerce. Practically all established molecular scientists have some direct of indirect connections with industry. Ho (1998) refers to it as a mixture of "bad science and big business".

These companies are very powerful and a lot of their technologies appear to bind farmers to their products year after year. The patenting laws of biotechnology firms mean they "own" the organisms they engineer, and farmers must sign contracts which require them to pay a "technology" fee, use the company's own chemicals, prevent them from saving seed, and even allowing the company to inspect the farm (Friends of the Earth 1999).

A controversial technology, the "terminator" gene, causes the plant's seeds to "switch off" after one growing season, so that seeds could not be saved from one harvest to the next year. This would have threatened the ancient farming practice of saving a part of the harvest to plant as seed for next year's crop, reducing the self reliance of farmers and forcing them to spend money each year on new seeds from the genetic engineering companies. This technology has not been released yet, possibly due to the level of opposition.

Monsanto is not popular in environmental circles. Wheeler (1999, p 15) writes: " genetic engineering is just the latest move on the part of the chemical industry to maintain its dominance and it's no coincidence that the dirtiest player by popular vote in that industry is Monsanto - who gave the planet Agent Orange, PCBs, rBGH and Nutrasweet/Aspartame". Monsanto has a bad reputation for marketing unsafe products while falsely claiming safety (Montague 1998).

The trials run by these companies have also received considerable criticism from a wide section of the public. Field trial reports often include statements such as "no characteristics associated with weediness were detected" or " no effects were seen in non-target organisms" when little attention was paid to those effects (Snow and Palma 1997). The fact that "nothing happened" in the field trials is not useful in evaluating ecological risk unless these questions are the focus of carefully designed long-term experiments (Rissler and Mellon 1996).

2.2.7 Social and ethical concerns

Social and ethical concerns underlie a lot of the apprehension the public has about genetic engineering. The public may not know scientific facts about environmental effects of GMOs, or the potential health effects of genetic engineering, however they may have a perception that genetic engineering is somehow "morally" or "ethically" not acceptable. This section covers the main social and ethical reasons people are sceptical about the technology.

It should be noted that concerns about genetic engineering can be categorised as either intrinsic or extrinsic. Most of the arguments against genetic engineering in this chapter so far, have dealt with the extrinsic concerns about genetically modified organisms, that is, they are extrinsically wrong because of their consequences. In contrast, if something is thought to be intrinsically wrong, no further considerations are morally relevant, for nothing can reverse that intrinsic wrongness; consequences do not have to be taken into account (Reiss and Straughan 1996). Many of the following ethical questions are intrinsic in nature.

Even if agreement is reached about the likely consequences of genetic engineering, this does not automatically answer the moral and ethical questions. It still must be questioned whether they are good or bad, right or wrong. The consequences then have to be weighed and compared against each other, and this cannot be a matter of purely factual assessment. Ethical judgements must still be made about the value or priority placed on different possible costs and benefits produced by different possible consequences (*ibid*).

2.2.7.1 Freedom of choice

Results from opinion polls throughout the world regarding genetic engineering appear to vary and depend on who is interpreting and reporting them. However it is clear that a large proportion of consumers globally are unhappy with the current situation on genetically engineered foods. At present there are a lot of unlabelled processed foods containing genetically modified organisms. Immediately this brings about the issue of consumer choice. If products are not labelled that they contain genetically engineered foods, consumers lose their right to choose whether or not to eat these products.

Many people have reservations about the technology, for the reasons mentioned previously, and more intrinsic considerations which will be discussed later on. By having these products

forced on them, the sovereignty of choice is overruled. In Anderson (1999, p 103), the chair of the United Kingdom advisory Committee on Novel Foods and Processes, Janet Bainbridge, is quoted as saying people should not have the choice whether to eat genetically engineered food or not. "Most people don't even know what a gene is.....sometimes you just have to tell people what's best for them". It is this type of attitude that is creating the negative feeling in the public. The fact that a particular product or process of genetic engineering is declared 'safe' by a panel of experts does not remove other possible legitimate reasons why people might feel concern about that product or process and believe that it ought not to be offered or developed (Reiss and Straughan 1996).

2.2.7.2 The role of the government

After discovering that genetically engineered foods have been on our shelves for some time, the public in many countries, particularly Europe and the United Kingdom, began to wonder about the role of governments and regulators. In the United Kingdom, 61percent of the British Public said they did not want to consume genetically engineered ingredients (Soil Association 1999). There is widespread feeling that the government (in some countries, notably the United Kingdom and the European Union, to some extent also in New Zealand) is not listening to public opinion and is out of step with what the people want. It is thought by opponents that governments are doing this to keep on side with the large multinational firms.

The British public have lost faith in assurances from the government following the outbreak of BSE in the late 1990s. The government is giving similar assurances about something that no one can be sure about. John Gummer, who was Minister of Agriculture, Fisheries and Food in 1990 is quoted as saying " there is no reason to believe BSE will be any different from scrapie". As Secretary of State for the Environment in 1996, he was quoted as saying: " there is no reason to believe that the genetic modification of maize will give rise to any adverse effects on human health from its use in human food" (Ferrara 1998 p 284).

2.2.7.3 Sanctity of life and patenting life

People object to genetic engineering on the grounds that dictating the forms and properties of other living creatures is a very anthropocentric and arrogant activity. Animals and plants have intrinsic values, and we should not have the right to tamper with them.

Another vaguely connected argument is that of patenting life. In a landmark case in the USA in 1980, it was ruled that life forms could indeed by patented. The judge at the time declared that the "relevant distinction is not between animate and inanimate things but whether living products could be seen as human made inventions" (Anderson 1999). But really all genetic engineers do is manipulate genes that already exist, they do not actually create genes themselves.

Anderson (1999) makes the statement that it is extraordinary that a company can make a single genetic alteration to a plant, and claim private ownership to it as their invention, when the very plants that are being engineered result from thousands of years of careful selection and breeding by farmers around the world.

The patenting of life forms does not stop at plants. There are patents on a large number of animals such as sheep, cows, fish, pigs, mice, rabbits (*ibid*). Patents on human genes also exist. A US based company called Biocyte holds a patent on all umbilical cord cells from foetuses and new born babies (GRAIN 1998). This was awarded because they were able to isolate the blood cells and freeze them. Other patents exist on bone marrow stem cells (Kimbrell 1997).

The term 'biopiracy' is used by authors such as Shiva (1997) to describe the process of patenting knowledge that has been collected by indigenous populations for many years. Knowledge about valuable plants and organisms is taken back to laboratories and samples analysed and researched in order to find active ingredients, and then patented as the company's own inventions. For example, the Neem tree has been used in India for thousands of years, and is valued as a biopesticide and for its medicinal qualities. In the last fifteen years, a number of companies from Japan and the US have taken patents out on formulas for neem-based solutions and emulsions (*ibid*). As useful characteristics of plants are identified by indigenous communities, the communities themselves, along with their lifestyles and knowledge systems, become dispensable. An estimation made by Christian Aid in 1996 states that the Third World could have earned US$4.5 billion a year in the absence of biopiracy (Madeley 1996).

2.2.7.4 Cultural, spiritual and religious concerns

In a 1992 report to the UN conference on Environment and Development, the Maori congress wrote that economic utilisation of the environment must not compromise traditional values, the needs of future generations, or the earth's spiritual integrity (Te Pareake Mead 1997).

According to Te Pareake Mead (1997), the main concerns of Maori about genetic engineering are that biotechnology is transforming a natural food resource into a privately owned commercial product. Biotechnology itself will not serve the needs of many if the driving force is the profits of the few. Te Pareake Mead notes also that science is neither neutral, objective, nor is a universal value that all cultures place at a level superior to or different from social and cultural values and traditions.

It is very important for Maori that the balance of nature is not disturbed. Maori also have strong spiritual values that may be affected by genetic engineering. Everything in nature has a life force, which may be affected by the changing of the genes (*ibid).*

Genetic engineering is sometimes considered to be unacceptable on the grounds that it involves scientists trying to improve on 'God's creation'. Basing one's objections on religious grounds is rather more complex than the initial statement would suggest, as there are a variety of views held across the religions on this issue (Reiss and Straughan 1996). Some religions encourage humans to "subdue the earth, rule over .....every living thing that moves upon the earth" (Genesis). In other religions, such as Hinduism, all life is sacred. Some persons interpret biotechnology as playing God and others as serving God, so it is difficult to draw religious boundaries (Macer 1998). Therefore religion does not provide a straightforward answer to this problem, but does highlight the complexities of the issue.

According to Reiss and Straughan (1996) there are three typical religious approaches to genetic engineering. They are *rejection* (too exploitative, clashes with understanding of God's action in the world); *caution* (hesitation about movement of genes between humans and other species, this may diminish the distinctiveness of being human); and *acquaintance with caveats* (may have a theological responsibility to use genetic engineering to root out imperfections in the world. Can be used as a tool to restore creation to its full glory).

2.2.7.5 Differing world views

Ho (1998) maintains that the world view that science has legitimised and promoted is reductionist, manipulative and exploitative. Reductionism, she explains, is the view that sees the world as bits and pieces and denies there are organic wholes such as organisms, ecosystems, societies and communities of nations. This world view is also manipulative because it regards nature and fellow human beings as objects to be manipulated and exploited for gain.

Boeringa (1980) also states in regard to organic farming, that "alternative methods of agriculture are based on a different concept of the reality in which we live. The subject matter is seen as a part of a greater total reality, which comprises more than that which can be weighed, measured and counted".

Ho (1998) claims that the mindset that leads to and validates genetic engineering is *genetic determinism:* the idea that organisms are determined by their genetic makeup, or the totality of their genes. This view is in conflict with the holistic world view and holistic ways of life that many of the opponents of genetic engineering support.

2.2.8 The threat to organic farming from genetic engineering

Organic farming faces a potential threat from the introduction of genetically modified plants in the environment. This is in the form of three main factors:

1. The corruption of organic seedlines;
2. The loss of *Bacillus thuriengensis*; and
3. Further reduction in seed varieties

(Wheeler, C. 1999).

Campbell (1999) has stated that New Zealand may be attempting to develop products which both threaten some of our most promising 'green' export products and yet may have no future in some of our key markets.

The corruption of organic seedlines is possibly the greatest threat to organic farming. This would occur due to cross-contamination from genetically engineered crops in the vicinity with organic crops. Pollen from a genetically engineered plant could blow into non-genetically engineered plants. The danger with "biological pollution" is that unlike chemical pollution, which eventually disperses, biological pollution will continue to survive and persist in the

environment. Once a modified organism is released, its dispersal will be difficult to monitor effectively and to control (Pimental et al. 1989).

The loss of *Bacillus thuriengensis* (Bt) as an organic pest control would be a major setback for the organic industry. It has even been viewed as a deliberate strategy on the part of Monsanto to destroy or at least severely hinder organic agriculture and increase reliance on chemical industry products (Wheeler 1999). The kiwifruit industry is now 100 percent either organic or IPM (integrated pest management), both of which rely heavily on Bt for natural pest control (Campbell 1999).

There may be a potential further reduction in seed varieties available for organic farmers as genetically engineered seeds dominate the market place (Wheeler 1999). The seeds acceptable for use in organic agriculture are already limited and genetic engineering is likely to further this limitation, because more and more seeds will have been produced using the technology. This will eliminate their acceptability in organic production.

2.2.8.1 The proposed USDA rule on organic agriculture

In December 1997 the United States Department of Agriculture (USDA) issued the National Organic Program (NOP), which establishes standards for organic agricultural products. Although the USDA had been advised by the National Organic Standards Board (NOSB) to exclude GMOs from organic food production standards, the draft included their use (Kirschenmann and Kirschenmann 1998). According to IFOAM principles, organic systems have demonstrated that production and processing has been possible without the use of GMOs. Therefore, there can be no demonstrated need for GMOs in organic agriculture.

However, the USDA justified its decision on the basis that *"GMOs and their products should be regulated based on risk, not on how they are produced"* (*ibid*). Needless to say, certifiers, growers and manufacturers were virtually unanimous in their opposition to the proposal. The revised standards also allowed the irradiation of organic food, the application of sewage sludge as a field fertiliser, more lenient animal husbandry standards and landless animal husbandry, all of which are prohibited in other certification systems. In addition to this, the proposal prohibited private certification programmes from exceeding the federal organic standard (Kirschenmann and Kirschenmann 1998; Cummins and Lilliston 1998). The proposal has since been withdrawn (Cummins and Lilliston 1998), but gives another example of the potential threat to the organic industry from GMOs.

3 RISK PERCEPTION AND BEHAVIOUR

3.1 Beliefs and Attitudes

Fishbein and Ajzen (1975) describe 'attitude' as a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object. It is viewed as a general predisposition that leads to a set of intentions that indicate a certain amount of affect toward the object in question.

A conceptual framework has been developed to represent the way in which people relate beliefs, attitudes, intentions and behaviours. It suggests that the performance or non-performance of a specific behaviour with respect to some object usually cannot be predicted from knowledge of the person's attitude toward that object. Instead, a specific behaviour is viewed as determined by that person's intention to perform that behaviour (*ibid*).

It is noted that a person's beliefs represent the information they have about themselves, and their social and physical environment, and as they form beliefs, they automatically and simultaneously acquire an attitude toward that object (*ibid*). We automatically acquire an attitude toward some new object when we learn its associations with other objects, attributes, or qualities toward which we already have attitudes. A person's attitude may change as a function of variations in their belief system.

3.2 Risk Perception

Slovic (1987) describes DNA technologies as seeming to evoke several of the perceptions that made nuclear power so hard to manage. These views are that the risks are unacceptably great, because they are unknown, dread, uncontrollable, inequitable, catastrophic, and likely to affect future generations. Even small accidents will be highly publicised and may produce large ripple effects.

The genetic engineering debate also has similarities to other food safety controversies in the past. Invisible hazards, imperfect knowledge and information about foodborne risks make food safety an explosive issue that can disrupt markets and cause substantial economic losses

for everyone from farm input suppliers to consumers (Smallwood and Blaylock 1991). Food choice is a facet of everyday existence where judgements of risk often appear to be a major concern. In many cases there is a trade-off between safety characteristics, price, appearance, and other product attributes. Willingness to pay for additional food safety and/or particular types of food safety is an important aspect of both public and private strategies to control risks.

In general, perceptions of risk have been found to be related to characteristics of the hazards such as: the incidence; severity; reversibility; and lag-time in the onset of outcomes; perception of consumer control; spatial and temporal dispersion of cases; and past experience with similar risks (*ibid*).

There is often apparent exasperation with public attitudes towards "scares" and new technologies (as has been throughout the genetic engineering issue). These attitudes are likely to be interpreted either as indicative of the 'irrational' nature of a highly emotive public, or as testimony to their paucity of understanding of technical issues (Sparks and Shepherd 1994). For example: "A good deal of the criticism of the agrochemical industry has an emotive rather than a scientific basis" Taylor (1994, cited in Hilder and Boulter 1999). This attitude arises from an insufficient appreciation of the multidimensional nature of the public perceptions of risk. Irwin (1997), claims that one cannot ignore the rhetorical role played by appeals to 'scientific rationality', often accompanied by accusations of 'irrationality' and 'hysteria' aimed at those who disagree on a particular stance on an issue. Scientific arguments accordingly appear as a means through which particular perspectives are defended rather than serving to resolve issues in an 'objective' manner.

Perception and acceptance of risk have their roots in social and cultural factors, and Slovic (1987) states that the basic conceptualisation of risk by the public is much richer than that of the experts, and reflects legitimate concerns that are typically omitted from expert risk assessments. Douglas and Wildavsky (1982, cited in Slovic 1987) assert that people, acting within social groups, downplay certain risks and emphasise others, as a means of maintaining and controlling the group. Conflicts over "risk" may result from experts and lay people having different definitions of the concept.

There is some evidence that optimism is apparent for those hazards where control is generally perceived to be greater, such as fat, sugar etc, in contrast to genetic engineering, which is a hazard the public has little control over. Another study by Starr (1969 cited in Slovic 1987) concludes that people, given the same level of benefits, will accept voluntary risks that are

roughly 1000 times as great as they would tolerate from involuntary hazards. Ott et al. (1991) show similar results from a study of perception of pesticide residues. Panellists in that study may have been so concerned about pesticide residues because they felt they had no control over them. The study also found that consumers appear to be sceptical of the government's ability to ensure the safety of the food supply. Experts' judgements appear to be prone to the same biases as those of the general public, particularly when experts are forced to go beyond the limits of available data and rely on intuition (Slovic 1987).

Disagreements about risk should not be expected to evaporate in the presence of evidence. Strong initial views are resistant to change because they influence the way subsequent information is interpreted. New evidence appears reliable and informative if it is consistent with one's initial beliefs; contrary evidence tends to be dismissed as unreliable, erroneous or unrepresentative (*ibid*). Irwin (1997) states that the modern loss of faith in 'science, truth and progress' leads to our current sense of insecurity and external threat. Richardson-Harman et al. (1998) illustrate that high consumer knowledge of a food production method does not necessarily mean that the method will be acceptable, or that the level of perceived knowledge can predict awareness of current practices.

3.3 The Difference Between Scientific and Public Perceptions of Risk.

Issues of risk and environment unavoidably engage with the conventionally separate realms of the 'social' and the 'scientific', despite attempts to keep them apart (Irwin 1997). Scientific arguments are inevitably loaded in social terms, and these social pressures in turn heighten the sense of uncertainty. In one sense, all environmental discussion is socially constructed. Ecological principles themselves are part of science, and science in turn is part of human culture. The idea of environmental sustainability is part of the social construction of modern science (Woodgate and Redclift 1997).

The contrast between scientific research results and consumer perceptions is particularly marked in the case of organic foods. According to Beharrell and MacFie (1991), this can be summarised as follows:

1. The difficulty science has in giving clear, simple answers to complex questions;
2. The need by government agencies to give clear and safe advice on food safety;
3. The demand by consumers for simplicity in choice, and food quality and safety (given time and information);

4. The low risk factors placed by scientists on the unknown and improbable compared with a high risk factor assigned by consumers and the consequent tendency to moral panics and food scares; and
5. Value systems and beliefs which place a growing emphasis on preserving the natural environment.

Experts use numerical estimates obtained from previous incidence or extrapolated from animal experiments. Consumers use a more complex function (*ibid*). Slovic (1987) states that the majority of citizens rely on intuitive risk judgements, typically called 'risk perceptions'. Experience with hazards tends to come from the news media, which rather thoroughly document mishaps and threats.

Within most discussions of risk and the environment, scientific argumentation plays a central role. The call for 'the facts' and the consequent battle to establish the 'real facts' has become a standard rhetorical feature of environmental discussions (Irwin 1997). The characteristic official response has often been to dismiss oppositional versions of the facts as emotive and ignorant, thus setting in motion a spiralling process of claim and counterclaim.

The example of BSE in the United Kingdom illustrates the difficulty of risk assessment in a social environment, and has distinct parallels with the genetic engineering issue. Each fresh 'revelation' was seized on by the press and government bodies as support for their own assessments of the level of risk. Thus science has in no sense stood apart from social conflict but has played a crucial role in providing support for the contradictory social and political stance (*ibid*).

4 RESEARCH METHODOLOGY

This chapter describes the methods used in the collection of data for the study, as well as a justification for their selection, and a description of their limitations. The analysis of the data is briefly described.

In order to obtain the information required for the study, it was decided that a quantitative survey would be the most appropriate instrument. These in general use explicit, standardised and objective methods of sampling, data collection and data analysis. Comparability and reproducibility are critical goals to which flexibility and depth may have to be sacrificed to some extent (Thomas 1996). The data would be collected in the form of a questionnaire, for the following reasons:

1. To make comparisons with other studies.

   There have been a number of studies carried out both in New Zealand and the rest of the world investigating the views people hold on genetic engineering, and the use of GMOs in food (Macer 1998; Eurobarometer 1997; Couchman and Fink-Jensen 1990). It would be desirable to be able to make comparisons between the organic industry and the general public. These surveys consisted mainly of questionnaire questions, so it was thought in order to allow for more convenient comparison, this study would also be in a questionnaire form;
2. To obtain the required type of information.

   The information required (beliefs and attitudes about GMOs) is relatively easily measured through agreement with statements in a Likert scale format.
3. To be able to analyse the data with statistical software.

   Analysis of quantitative data can be carried out in a relatively straightforward manner with a number of software packages, and more definite statements about the results can be made
4. To obtain the required number of respondents.

   A cross section of the industry was desired and this would require a considerable sample size - more than would be feasible for conducting personal interviews.

Survey research has been described as the method of collecting information by asking a set of pre-formulated questions in a predetermined sequence. These questions are presented in a structured questionnaire to a sample of individuals drawn so as to be representative of a defined population (Hutton, 1990, cited in Blaxter et al. 1997). Survey research seeks an

understanding of what causes some phenomenon by looking at variation in a variable across cases, and looking for other characteristics which are systematically linked with it (De Vaus 1995).

4.1 Defining the Populations

As the aim of the study is to investigate the future of GMOs within the organic industry, what actually constituted the "industry" had to be identified. Consumers drive the market, growers supply the products, and exporters are responsible for sending the produce overseas. It was therefore decided that to get an overall perspective of the whole industry, three different but related populations would be questioned, namely: organic producers, exporters and consumers in New Zealand. The questionnaires for each group were slightly different due to the differences in required information. The intention was to discover information and knowledge from the exporters, who would know the international market. Producers were questioned more about potential effects of GMOs on a practical basis, while opinions and beliefs were the major part of the consumer survey.

4.1.1 The organic producer sample

Organic growers in New Zealand are certified by two organisations; BIO-GRO, which is the major certifier, and Demeter, which certifies bio-dynamic farmers, and is run by the Bio Dynamic Farming and Gardening Association in New Zealand. There were 252 producers on the BIO GRO list for 1998/99 and 37 producers on the Demeter list for 1999. It was decided to include all the certified producers in the sample, so in effect the survey was a questionnaire of the whole population. The re-evaluation of the fee for certification has led some small-scale growers to abandon certification because their turnover did not warrant the increased fees (Coombes and Campbell 1998). Although there are a significant number of uncertified organic farmers in New Zealand, this study only includes those growers that are certified with either BIO-GRO or Demeter in 1999, as there was no way to obtain the contact details of all organic producers in New Zealand.

4.1.2 The organic exporter sample

The names and organisations of exporters were obtained from the Organic Products Exporters Group (OPEG), an organisation set up by the Trade New Zealand Development Board (Tradenz). There were 27 food exporters on the list provided by OPEG, so again, they were

all included in the sample. It should be noted that in both the producer and exporter groups, only those producing or exporting food products of any kind were included, those producing other products such as fertiliser or clothing were not incorporated.

4.1.3 The organic consumer sample

There is no registry of organic consumers in New Zealand, so it was decided to use shoppers in organic stores as the sample. Other methods were considered, such as enclosing the questionnaire inside a magazine that organic consumers are likely to read, for example Soil and Health; or sending questionnaires out to a sample of the general population of New Zealand, and discarding those that did not consume organic food. This last option in particular had many disadvantages, notably the cost and the likelihood of a very low response rate. The former option also had disadvantages that included not obtaining a large enough proportion of organic consumers and a significant response bias in that only those people who felt strongly about the topic would reply.

4.1.4 Sample size

The consumer group was the only one for which an appropriate sample size had to be decided upon, as the other two groups would consist of the entire respective populations. The required sample size depends on two key factors: the degree of accuracy required for the sample and the extent to which there is variation in the population in regard to the key characteristics of the study (De Vaus 1996). De Vaus also notes that for a population in which most people will answer a question in a particular way, a smaller sample will suffice. Because the population is a subset of the entire population, and by nature of the fact they consume organic food, the respondents are likely to have similar views on this issue. It was decided to select a sample of 600 respondents. This would lead to a sampling error of four percent at the 95 percent confidence level, which was considered ideal.

4.2 Questionnaire Design

Designing the questionnaire is of key importance as the questionnaire is what the respondents will see, and they will decide whether or not to respond, based on their opinion of the questionnaire. Therefore it is vital that the layout is appealing, the questions easy to follow, and that the respondent becomes interested enough to complete the questionnaire.

The complete survey instruments for exporters, producers and consumers can be seen in Appendix One.

4.2.1 Introduction

According to Sheatsley (1983), the introduction to a questionnaire is crucial. If the survey task sounds overly demanding or if its purpose seems trivial or threatening, respondents may refuse to participate. In general, the introduction should not include any additional information beyond the survey's general purpose and content. All questionnaires to the three different groups contained some type of introduction. The consumer introduction consisted only of a small paragraph on the first page, as it was assumed that the purpose of the survey could be explained verbally to respondents. The producer and exporter questionnaires had more lengthy introductory sections, explaining the purpose of the survey and who was undertaking it.

4.2.2 Question design

A well-designed questionnaire should (a) meet the objectives of the research; (b) obtain the most complete and accurate information possible; and (c) do this within the limits of available time and resources (*ibid*).

Sheatsley (*ibid*) advises that researchers firstly include some measure of *knowledge* of the respondents, so that it is possible to distinguish among the well informed, the poorly informed, and the unaware. Knowledge is often highly correlated with education, but not always. In the consumer questionnaire, respondents were asked to indicate how much they themselves felt they knew about the topic: "I have a good understanding of the main issues in the GMO debate", "I have followed the GMO debate closely" and "I would be able to explain the concept of GMOs to a friend". Secondly, Sheatsley advises discovering the respondents' *interest* in the problem or concern about it. This was addressed with the question "I frequently discuss this issue with other people".

Thirdly, one should determine the *attitudes* of the respondent on the topic, and the direction of their opinions. This section of the questionnaire forms the body of this survey. The fourth dimension necessary according to Sheatsley (1983) is to find out *why* respondents feel the way they do, and fifthly, to find out how *strongly* the opinion is held. In the questionnaires for this study, strength of opinion is measured in Likert scales, with "strongly agree" through to "strongly disagree" categories.

Questions were designed based initially on other studies researching similar topics (Wilson-Salt, 1996; Macer, D. 1998; Eurobarometer 1997). However these were used as a guide only, and were modified or changed considerably to suit the topic and the type of respondent.

Sheatsley (1983) states that the opening question for all surveys should be an easy, non-threatening one. It is crucial because it is the respondent's first exposure to the interview and sets the tone for the nature of the task to be performed. If they find the opening question easy and pleasant to answer, they are encouraged to continue.

4.2.3 Demographic questions

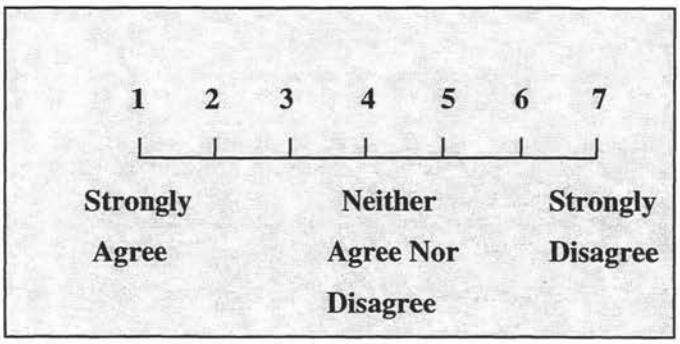
Demographic questions were included only in the producer and consumer questionnaires as it was not thought necessary to know about the exporters themselves, only their opinions. Questions were asked regarding age, gender, level of education, ethnic group and income. Statistics New Zealand (1993) state that it has been observed that members of a dominant ethnic majority often find it difficult to see themselves as having a culture or belonging to an ethnic group. In the New Zealand context, some of the difficulties encountered when attempts are made to describe and categorise the culture of the dominant majority group, arise from the lack of suitable terms. 'European' has traditionally been used for this purpose, but in recent surveys people have ignored all categories and written in 'New Zealander'. An alternative has been the use of 'New Zealand European/Perked. Consumers were given the term 'European', and producers 'New Zealand European'.

4.2.4 Likert scales

Likert scales involve providing people with statements and asking them to indicate how strongly they agree or disagree (De Vaus 1995). Likert scales were used extensively in this study. This was to simplify the analysis, and to provide a more appealing visual layout for the respondent. It is possible to combine the agree and disagree positions on a Likert scale when wanting to look at subgroups of smaller size (Sheatsley 1983). An example of a Likert scale and question are shown in Figure 4.1.

Figure 4-1: Example of a Likert scale and question

Using the following scale, please indicate the extent to which you agree with the following statements (circle the appropriate number)



11.I have followed the GMO debate closely 1 2 3 4 5 6 7

An option of "don't know" was omitted from the range of options. Sheatsley (1983) asserts that when there is not a "don't know" option, uninformed or uninterested respondents are forced into stating an opinion that they never thought of before and may never think of again. However, it was felt that if a respondent really did not know how they felt about a statement, they would indicate the level four: "neither agree nor disagree".

A Likert scale can reduce the amount of space required per question significantly, and allows for *strength* of opinion as well as simply opinion. The intention was to make the questions as simple as possible for the respondent to fill out, thereby encouraging them to complete and return the questionnaire.

4.2.5 Open versus closed questions

The majority of questions throughout all three surveys were closed questions. A major problem of closed or forced-choice questions is that on some issues they can create false opinions either by giving an insufficient range of alternatives from which to choose or by prompting people with 'acceptable' answers. Further, the forced-choice approach is not very good at taking into account people's qualifiers to the answers they tick (De Vaus 1996). However, there are a number of advantages to a well-developed forced-choice questionnaire. Where the questionnaire is long or people's motivation to answer is not high, forced choice questionnaires are useful since they can be completed quickly. Additionally, coding is made much easier.

Open-ended questions can elicit a great deal of repetitious, irrelevant material. Respondents will sometimes miss the point of the question, and more time is taken up in coding. Open-ended questions were therefore avoided wherever possible in order to make the analysis simpler. However, this may have predisposed respondents to answer in particular ways (Couchman and Fink-Jensen 1990)

The main advantage of open-ended questions according to Sheatsley (1983) is that they allow respondents to answer in their own frames of reference, entirely uninfluenced by any specific alternatives suggested by the interviewer. They reveal what is most salient to respondents, what issues are foremost in their minds. Some respondents might give one answer on an open question but a different one on the closed, because the list of options reminded them of something they had not thought of when they answered the open question. Conversely, the list of options may not include what a respondent really thinks, and they are therefore forced into making a false answer, or leaving it blank.

The danger with closed questions is that it is very easy to invent a set of categories on an a priori basis which appear to be self-evidently adequate (Foddy 1995). However, on further reflection, perhaps after the questionnaire has been administered, it may become apparent that the categories had not been appropriate and respondents were forced into answering differently than if the categories had been better designed.

4.2.6 Filter questions

The producer and exporter questionnaires included a number of filter questions. These involve directing respondents to a question not directly after the one being asked. This is useful if the initial question then leads on to further questions which are only applicable if the respondent answered in a certain way to the initial question. Filter questions are useful in order to avoid wasting respondents' time reading questions which are not relevant to them. They do however, tend to make the survey appear longer than it actually is.

4.2.7 Producer questionnaire

The principle aim of the producer questionnaire is to explore the attitudes of growers of organic produce towards genetic engineering. Their personal views on possible environmental effects relevant to the organic industry are also requested. Producers are important as the direct link between the engineered seed and the consumable product. Also,

they are directly affected by potential outcomes of genetic engineering, such as pest resistance and cross contamination. Additionally, producers are keenly aware of consumer demands, and strongly influenced by demand/supply fluctuations. Therefore, they presumably have a good indication of consumer opinion on genetic engineering.

The questionnaire began with asking general questions on the size of the farm, the certification agency, how long the farm had been certified organic, and if all of the farm was organic. This follows the advice of De Vaus (1996) who indicates a survey should begin with easily answered factual questions, but not with demographic ones such as age or income. This information was considered to have value for exploring the relationship between demographic situations and beliefs held.

The second section consisted of a series of questions relating to what was produced on the farm. This was important for discerning whether the production of a certain type of crop would correlate with having a particular opinion. This relationship is supported by Saunders et al. (1997) who describes the organic industry as characterised by two types of farmers; those who supply a mixed type of crop and mainly for the local market; and those who supply primarily for the export market. This section also included questions on whether conventional produce was grown, and if so, what percentage of the total crop was organic.

A general demographic section including questions on age, education, income, and ethnic group followed this.

The last section in the producer survey was the section on genetic engineering. This consisted entirely of the Likert scale statements, the scale ranging from one to seven. The statements were grouped loosely in sections relating to GMOs in organic food; why the producers think consumers buy organic food; New Zealand and GMOs; the reasons the producers have for farming organically; their concerns about GMOs; their perceptions of how consumers feel about GMOs; and some general questions about more philosophical areas, such as how the producers feel ethically about genetic engineering.

4.2.8 Exporter questionnaire

The exporter questionnaire began with a section on what products are exported. This was divided into fresh fruit; fresh vegetables; processed vegetables; meat, wool and dairy products; and "other" products. It included questions on which specific type of product; which countries the products are exported to, and what percentage goes to each country. It then

asked whether the exporter also exported conventionally grown products, and if so, what percentage of products exported were organic.

The demographic questions were omitted from this survey as it was not considered important to know about the individual exporters, as presumably they would be representing a larger company.

Following the exported product questions was the section on opinions about genetic engineering and organic food. Again, the questions were grouped loosely in the following (undivided) sections: the image of New Zealand's organic food internationally; GMOs and the organic industry; international demands in organic food; GMOs and organic farmers; consumers and GMOs; and the New Zealand organic industry as a whole. Finally, there was an open-ended question regarding the opinion of the exporter as to what would happen if GMOs were found in New Zealand organic export produce.

4.2.9 Consumer questionnaire

The consumer questionnaire began with the demographic information such as age, gender, and education Although this is commonly advised against (De Vaus 1996; Sheatsley 1983), in this situation it was considered appropriate to lead the respondent into the questionnaire by asking questions that were easy for them to answer. There were no completely easy to answer questions, and beginning with a difficult question may have discouraged the respondent from continuing.

This section was followed by a description of household consumption of organic food, which was included to determine whether the amount of organic food consumed was in any way correlated with the opinions given later in the survey.

The next section consisted of reasons for purchasing organic food. This consisted of two sets of questions. The first one required the respondents to select, from a list of possible benefits of organic food, the three that were the most important to them. The list consisted of the following options:

1. Fewer pesticide residues in food
2. Less harmful to the environment
3. Less harmful to farmers
4. Support local growers
5. Does not support chemical industries

6. Does not contain GMOs
7. Nutritionally superior
8. Tastes better
9. Longer lasting
10. Fresher
11. Support the organic industry

The purpose of this question was to force the respondents to choose only three benefits, and to see how many answers included GMOs in their top three. If the respondents had the option of simply indicating which choices were important to them, some would no doubt indicate all of them, which would not help in seeing whether GMOs were included or not.

The second question for this section again required respondents to choose three options from a list, but this time they had to rank the selection in order 1, 2, 3. The list consisted of possible risks to human health, and "1" would indicate they felt this option was the greatest risk to health, followed by "2" and then "3". The list consisted of the following categories:

1. Organic food
2. Foods high in saturated fats
3. Foods high in sugar
4. Foods high in cholesterol
5. Genetically modified food
6. Food poisoning
7. Chemical food additives
8. Pesticide residues
9. Other (state).

The aim of the question was, to determine how importantly people ranked genetically modified food as a health concern. It was particularly interesting to see how this compared in rank to pesticide residues, because the genetic engineering of plants could potentially reduce the need for pesticides.

The next group of questions were the Likert-scale statements regarding attitudes and feelings related to genetic engineering and organic food. The questions were again loosely grouped in sections of : knowledge and familiarity with the issue; organic food and genetic engineering; concerns about GMOs; genetic engineering and New Zealand; the New Zealand organic industry; and some questions relating to different applications of genetic engineering and how morally acceptable the respondents felt they were, and how great a risk to society that they

posed. This last group of questions was based on both the Eurobarometer (1997) survey and Macer (1998), and attempt to find out if the public is concerned about certain aspects of genetic engineering, and comfortable with others; or if they are opposed or supportive of the technology however it is applied.

The last section of questions investigates *why* people are opposed to the technology. They were filter questions, with the first statement asking whether they would be prepared to eat GMOs if they had been reassured about the safety of GMOs to human health and the environment. If respondents answered yes, they could proceed to the next question, and if no, they were asked for reasons for their answer. This attempted to find out whether opposition was based on extrinsic or intrinsic concerns about genetic engineering. If consumers still refused to accept GMOs after being reassured that there would be no health or environmental effects, it would suggest their concerns are based more on an intrinsic feeling of "wrongness" about GMOs.

The last question was essentially the same format, but asked whether respondents would be prepared to accept GMOs in organic food, if they had been reassured about the safety to human health and the environment. This was included to gauge whether consumers felt GMOs could ever be included as part of organic food. If respondents had answered "yes" to the first question and "no" to the second question, it would indicate that the perception was that GMOs could never be a part of organic food.

4.2.10 The pilot study

On completion of the design of the survey instruments, the questionnaires were pilot tested to ensure the questions made sense and were simple to understand. The pilot test respondents were told they were participating in a pilot study, and were queried about their opinions and understanding of the survey. De Vaus (1995) indicates four factors that should be checked in a pilot study:

1. *Flow* - do the questions fit together, are the transitions between sections smooth? Is the format easy to follow?
2. *Question skips* - where filter questions are used, it is important to ensure that the respondent will not skip more than is intended
3. *Timing* - it is helpful to time each section in order to gain some idea of how long is required to complete the questionnaire

4. *Respondent interest and attention* - respondents may become bored if the questionnaire is too long or the questions all of a similar type. Bored respondents will provide unconsidered and unreliable answers and produce high non-response to questions.

Following the feedback from the pilot tested questionnaires, appropriate changes were made to the surveys to ensure they were simple to follow, made sense and were not boring to the respondents.

4.3 Administering the Questionnaires

Following the design of the questionnaires, the completed instruments were sent or taken to the sample populations. This section describes the distribution of the survey instruments for the producers, exporters and consumers of organic food.

4.3.1 Distributing producer questionnaires

The producer questionnaire included a general covering letter explaining what the survey was about and who was implementing it. It also contained a return self addressed, freepost envelope. The questionnaire itself and the covering letter were printed on coloured A5 paper, printed on both sides, and folded in the form of a booklet. The addresses were printed by computer onto white labels. Each questionnaire contained an identification number on the inside back cover.

Producers were not mailed a follow up letter, mainly because of time and financial constraints. The response rate (which is discussed in the Results chapter) was considered to be acceptable and a follow up letter not essential.

4.3.2 Distributing exporter questionnaires

Due to the small number of organic exporters, each received a personalised letter on Massey University letterhead paper with a standard cover sheet attached to the questionnaire. The questionnaire was also printed on coloured A5 size paper, printed on both sides and folded in the form of a booklet. In addition to this, the exporters were telephoned in the week the surveys were sent out, warning them to expect the questionnaires, and that it would be very much appreciated if they would complete them. This was hoped to increase the response rate, as it was assumed these people may not have the time nor inclination to complete them.

The envelopes also included a return, self-addressed freepost envelope, and the address was printed on white labels.

4.3.3 Distributing consumer questionnaires

The consumer questionnaire was printed on plain white A4 size paper. It was not considered necessary to make the appearance especially eye-catching, as it was not a mail survey, and the response rate would have to be increased through other methods. It was only printed on one side of the paper, in order to make it easier to fill out while standing in a shop.

The sampling method used is a non-probability sampling technique, because there was no sampling frame made up, and no random sampling carried out. In this situation, where no sampling frame exists, non-probability sampling techniques are considered acceptable (De Vaus 1996).

It was necessary to identify the shops from which to obtain the consumer sample. It was decided to select organic shops from the three main centres in New Zealand: Auckland, Wellington and Christchurch, in order to get a cross-section of the country. Palmerston North was also included, simply for convenience. There were to be 200 from both Auckland and Christchurch, and 100 from Wellington and Palmerston North. The greater numbers in Auckland were to account for the larger population, and in Christchurch because it was the only South Island representative.

A list of organic retailers in New Zealand was obtained from the Soil and Health Organisation. Where there was a selection, the retailers were selected on size and location characteristics. The shops visited were:

In Christchurch: Pico Wholefoods, Opawa Bio Shop
In Auckland: Harvest Wholefoods, Ceres Wholefoods, East West Organics
In Wellington: Commonsense Organics
In Palmerston North: Organic Living

The managers or co-operative members were then approached by telephone to ask permission to question people in their shop. Some retailers requested a copy of the questionnaire be faxed to them first, however there were no instances of the request being denied.

It was initially thought that consumers could be approached in the shop and verbally asked the questions, with the interviewer writing the responses. However, after some deliberation, it was decided that this would take too long and may discourage the respondent, and would also restrict the interviewer from gaining the responses of as many people as possible. Therefore, it was decided that the consumers would be given the questionnaire attached to a clipboard, and would complete it themselves. This method would have the disadvantage of the respondent being unable to ask questions regarding the survey, however the interviewer would still be present in the shop to provide any assistance. There would also be some self addressed stamped envelopes available in case the consumers wanted to take them home to complete. As it turned out, a majority of those approached preferred to take them home, and either bring them back into the shop or send them off themselves. While this increased the rate of dispensing of the questionnaires, it reduced the response rate significantly, as many people did not return them.

4.4 Self Administered Questionnaires

An advantage of self administered questionnaires as were used to sample the organic consumer population, in comparison with verbal interviews, is that they can overcome the problem of respondents not answering honestly. 'Dishonesty' may occur in a face-to-face interview as the interviewee may not to give their opinion if they think it is not what the interviewer wants to hear. (Dillman 1983). Or the interviewee may simply not want other people in the vicinity to hear their answers. A self-administered questionnaire that the respondent is asked to complete even while the interviewer sits and waits can overcome both problems.

Another advantage mentioned by Dillman (1983) to self-administered questionnaires is that they can be used to survey large groups of people simultaneously. The appeal in this case is that a survey requiring weeks for results to be returned by either mail questionnaires or face-to-face interviews can be done in a matter of hours. The presence of the interviewer can ensure a high completion rate and be used to reassure respondents, and to answer their questions (Sheatsley 1983).

The various types of self administered questionnaires can be viewed as occupying a middle ground between mail questionnaires and face-to-face interviews, retaining some of the advantages but overcoming most of the disadvantages of each.

4.5 Mail Surveys

The advantages of mail surveys include lower survey costs, as it is not necessary to travel any distance to contact the respondent, and data from populations that would otherwise be difficult to survey. In addition to this, the accuracy of answers is generally greater, as the responses to sensitive or controversial questions can be affected by *social desirability* considerations: giving acceptable rather than true opinions (De Vaus 1995). This has been discussed in the section under Self-Administered Questionnaires. In a similar vein, distortion caused by interviewer characteristics and opinions is avoided in mail surveys.

A further advantage of mail surveys is that they are not demanding in terms of staffing requirements. A large mail survey can be conducted readily by one or two people. They have the ability to cover a large geographical area without incurring significantly greater costs than a smaller area. A mail survey was thought to be the most appropriate instrument for gathering information from the producers and exporters.

4.5.1 Limitations

There are some limitations associated with mail surveys. Mostly these are related to the fact that there is no interviewer present to stimulate interest in the survey or to compensate for any of its inadequacies. The absence of an interviewer leaves questions open to be misread and misinterpreted by respondents. Complex questions are not advisable for mail surveys, as respondents may simply give up if they find the questionnaire too difficult. De Vaus (1995) mentions that respondents of mail questionnaires may also have difficulty coping with *boring* questions.

Respondents may be forced into what to them seems an unnatural reply as they have no opportunity to qualify their answers or to explain their opinions more precisely. The respondent may desire the personal contact with the interviewer that is lacking in a mail survey.

Mail questionnaires provide no control over the order in which people answer questions, thus obscuring the extent to which answers may be affected by later questions (*ibid*). Therefore, although the survey may be designed to ensure questions flow in a logical order and the most sensitive ones are left till the end, there is no way to stop the respondent from seeing all questions in the beginning.

4.5.2 Response rates

One of the most common criteria by which a method is judged is the response rate it achieves. The response rate obtained in a particular study will be due to the combined effect of the topic, the nature of the sample, the length of the questionnaire, the care taken in implementing the particular survey and other related factors (*ibid*). Response rates are likely to be greater when the topic under investigation is of particular relevance to the group.

Statistics New Zealand (1995, p 37) gives the following possible reasons for non-response:

1. Sensitivity of the questions
2. Fear of the misuse of information requested
3. Length of questionnaire
4. Difficulty of the questions
5. Wrong person approached to provide the information
6. Respondent does not understand the language of the questionnaire
7. Illness
8. Inability of the respondent to provide the information requested
9. Inability to contact the respondent
10. Inaccuracy in the sample frame

Non-response can introduce bias into the survey results where the non-respondents differ in characteristic from respondents. In the case of this study, non-respondents may not have felt as strongly about the issues as those that did respond.

4.6 Limitations of survey methodology

Sheatsley (1983) notes that questionnaires are usually written by educated persons who have a special interest in and understanding of the topic of their inquiry. In addition, these people usually consult with other educated and concerned persons, therefore it is common for questionnaires to be overwritten, overcomplicated, and too demanding of the respondent. While every effort was made to keep the questionnaires for this study simple, easy to follow and within the knowledge range of most people, it may have proven to be too academic for some respondents.

People are generally poor predictors of their own behaviour because of changing circumstances and because so many situational variables intervene (*ibid*). Therefore some of

the responses, particularly the hypothetical ones about future actions, may not be accurate. Respondents may also often answer questions that appear to be marginally relative to them or about which they have thought very little (Foddy 1995).

A key assumption underlying the use of questions in survey research is that the answers respondents give can be meaningfully compared with one another (*ibid*). Unless respondents have a clear understanding of what the question is about and are told what perspective to adopt when framing an answer, different respondents will answer the same question in quite different ways.

4.7 Analysis of the Data

The results were entered into the computer statistical programme, Statistical Package for Social Scientists (SPSS). They were entered as three separate files, and analysed separately. Frequency distributions of all the variables were initially created in order to give an overall picture of the data.

4.7.1 Exploring the relationships

Key relationships between variables were analysed to determine their significance. The methods used are described in the following sections

4.7.1.1 Crosstabulations

Crosstabulations were carried out on some variables in order to determine whether there were any significant relationships between them. Crosstabulations are a way of displaying data so that it is possible to detect association between two variables. The information is displayed in the form of a table with rows and columns. One variable is placed across the top column, and the other variable is placed on the side of the table. The intersection of the rows and columns is called a cell, and is used to represent cases which have the characteristic of both the column and the row. If there are large differences between sub-groups there is a strong relationship, which can be identified as either positive or negative. A positive relationship indicates that respondents who score high on one variable are more likely than others to score high on the other variable.

4.7.1.2 Correlations and Regression

Measures of correlation indicate both the strength and the direction between a pair of variables (Bryman and Cramer 1997). To provide such estimates, correlation coefficients are calculated. These provide succinct assessments of the closeness of a relationship between pairs of variables. The most common measure of correlation is *Pearson's r. Pearson's r* is the correlation coefficient used for two interval level variables to describe their relationship. It also indicates the direction (either positive or negative) of the relationship (De Vaus 1995). It allows the strength and direction of linear relationships between variables to be gauged. The values vary between -1 and +1. The closer r is to the absolute value of one, the stronger the relationship between the two variables is.

Correlation analyses were carried out on a number of variables in order to determine the inter-relationships within the data.

Regression analysis is closely connected with Pearson's *r,* however unlike correlation, regression can express the character of a relationship. The regression coefficient explains how much impact one variable has on the other, how much the dependent variable changes for each unit of change of the independent variable. In this study, regression analysis was used to explore relationships between variables, in order to determine how much impact variables of interest had on each other.

5 RESULTS

This chapter outlines the demographic profiles for the producer and consumer samples, and compares this with the national profile, and summarises the responses to the survey questions. Bivariate and multivariate analyses are carried out to determine underlying relationships in the data.

5.1 Response Rate

The response rates for each group surveyed for this study are shown in Table 5.1.

Table 5-1: Response rate for each group of surveys

	Number sent out	Number returned	Percentage
Producers	289	163	56.4
Exporters	28	19	67.8
Consumers	550	285	51.8

The percentage shown was calculated from the useable returns. A small proportion of people sent a questionnaire no longer lived at that address and the questionnaire was therefore returned. These were classified as non-responses.

Because of the low return rate of the consumer questionnaires, the final number of useable questionnaires was only 285. This is considerably lower than the 600 issued. However, according to De Vaus (1995), because a high proportion of the population is expected to give a particular answer, this sample size gives a five percent sampling error at the 95 percent level of confidence. This level of sampling error makes it possible to say with 95 percent confidence that the population of consumers will have the same views, plus or minus five percent, as the sample.

Exporters were telephoned in the week before the questionnaire was sent out to them, which may explain the higher response rate for that particular group. Exporters also received personalised letters while producers received a standard letter addressed to "Dear Sir/Madam". Reminder letters were not sent to any groups. This was primarily because it was

felt that the response rates were sufficiently high to provide accurate information, and also due to financial and time constraints.

The response rates increase with the level of personalisation given to each one. Exporters, who received both a personal telephone call and a personal letter, had the highest rate. Producers, who received a standard letter but a personal label on the envelope, were next. Consumers had the lowest response rate and had simply been given the questionnaire in a shop. This is consistent with studies by Dillman and Frey (1974); Carpenter (1975), (both cited in Dillman 1983). They show that personalised procedures increased response rates from 85 to 92 percent (Dillman and Frey 1974) and from 64 to 72 percent (Carpenter 1975). It was not possible to send reminder letters to consumers to increase the response rate, as their names were not known.

5.2 Missing Variables

Frequently, non-randomness of missing data is imposed by some systematic causal factors that depend on the structure of the sample, (for example when high income groups refuse to report their incomes more frequently than do people with low incomes) (Anderson et al. 1983). This may have been the case with income from questions in this data. For the purpose of this thesis, cases were excluded from analyses if they had a variable missing for that particular analysis.

5.3 Demographic Results (Consumer and Producer Only)

The order in which the questions are described and analysed in this report does not necessarily correspond to the order in which they were asked of the respondents.

The summaries of each of the demographic questions asked in the producer and consumer questionnaires are presented in Table 5.2. The statistics for the New Zealand population as a whole are included in the table for comparison. These are obtained from the last census of the New Zealand population, carried out in 1996. All percentages shown are rounded to the nearest whole number.

Table 5-2: Demographic results

Demographic Characteristic	Category	Producers (%)	Consumers (%)	General NZ population
Age (years)	less than 20	1.2	2.5	7.2
	20 - 30	0.6	29.1	15.2
	31 - 40	0.2	30.4	16
	41 - 50	39.9	22.3	13.7
	51 - 60	27.6	10.6	9.6
	greater than 60	9.8	4.9	15.6
Gender*	Male	63.8	31.2	49.24
	Female	22.1	68.1	50.74
Level of Education	Secondary School for up to 3 years	13.5	7	33.9
	Secondary School for 5 years	12.9	6	32.2
	Some tertiary education	38	41.4	25.4
	University degree	25.2	31.9	5.7
	Postgraduate degree	9.2	13	2.8
Ethnic Group	Maori	3.1	6	14.5
	European	92.7	87.4	71.71
	Asian	0	1.4	3.16
	Other	1.2	2.1	1.59
Income(NZ$)**	less than 20 000	15.3	34	30
	20 - 35 000	24.5	26.7	19
	36 - 50 000	21.5	18.9	21
	51 - 65 000	6.7	6	10
	66 - 80 000	6.1	4.2	10
	Greater than 80 000	20.2	4.6	10

* 11% of producers answered the questionnaire as a couple

** the values for the general population are given as an indication only, from similar data presented in slightly different category groupings.

The occupations of consumers are shown in Figure 5.1. The largest group of respondents classify themselves as professionals, and the category for "other" occupations is the second largest.

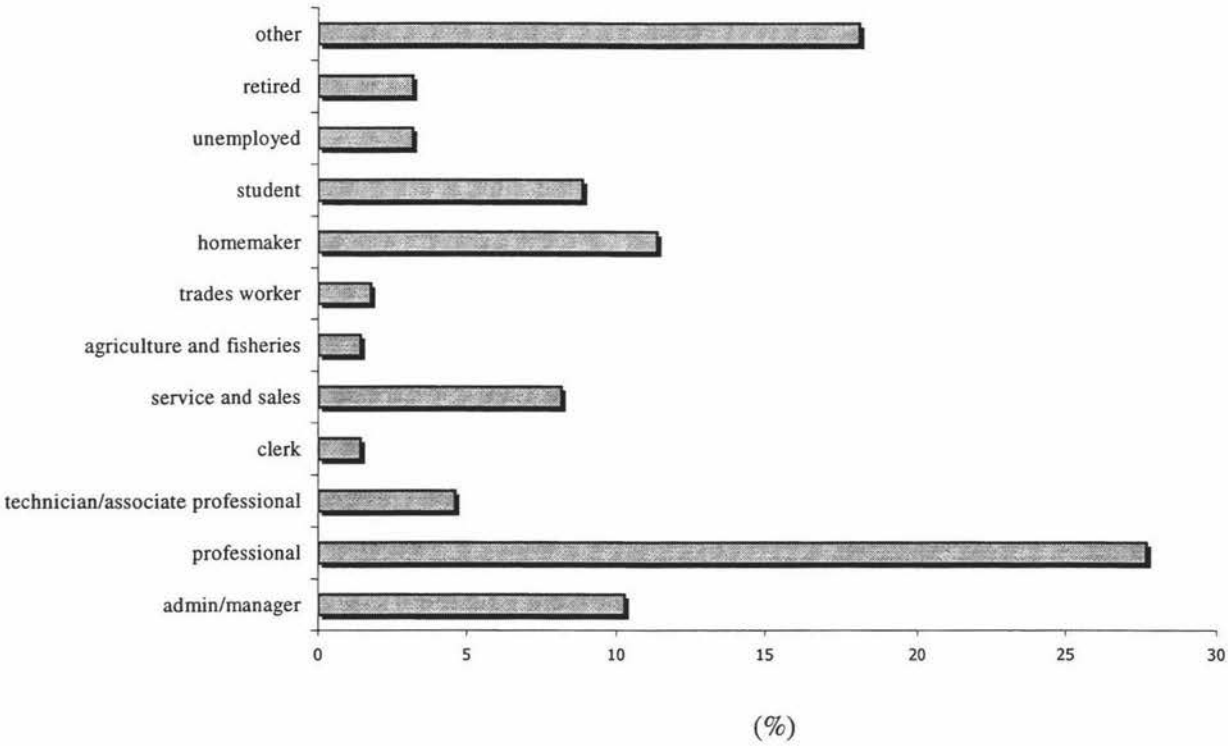


Figure 5-1: Occupations of consumers surveyed

Most (39.6 percent) of consumer respondents lived in households with two people; 16.1 percent lived on their own, and only 2.1 percent of respondents had greater than five people in their household.

5.4 Production and Export Information

This section shows the results from the introductory producer and exporter questions, inquiring about the size and nature of their business. The percentage totals shown may exceed 100 percent when respondents have the option of providing more than one answer to the same question. They may also vary slightly from 100 percent (for example 99 percent or 101 percent) as figures have been rounded.

The mean farm size was 75.3ha, with the smallest being 1ha, and the largest being 1400ha. The mean area certified organic was 56.1ha; the smallest 1ha, and the largest 1400ha. There

are thirty-eight missing cases, many of which produce bees and therefore do not need to own land.

BIO-GRO is the most common certification agency, with 82.8 percent of producers certified with them; 12.3 percent are certified with Demeter; and 3.1 percent are certified with both.

The mean length of certification is 6.1 years; the minimum time was one year, and the maximum was 21 years.

5.4.1 Food types produced

Figure 5.2 displays the percentages of each category of food produced by respondents. They are not mutually exclusive; some farmers produce a number of categories. The most commonly produced category is fruit (65.6 percent).

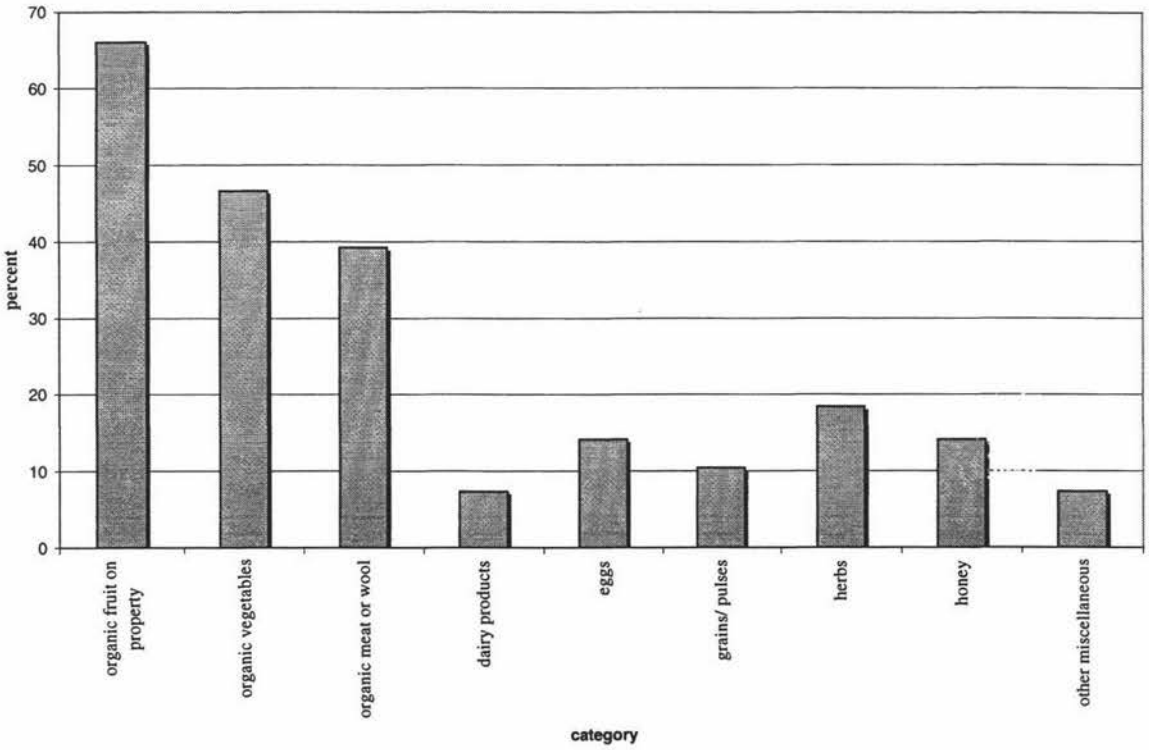


Figure 5-2: Organic food types produced from producers surveyed

Within each category, producers were asked questions on which type of the product they produced. Within the fruit category, kiwifruit was the most commonly grown, with 37.4 percent of respondents growing this. Root vegetables and peas/beans were produced most in the vegetable section (30 percent) with "other" vegetables making up 31.3 percent of the total.

Cattle (29.4 percent) and sheep (24.5 percent) were the most numerous of the meat and wool section. The other categories do not have sub-categories within them.

5.4.2 Reasons for producers farming organically

Producers were asked a number of questions relating to their motivations for farming organically. These questions are related to the environment; health reasons; economic advantages, or lifestyle reasons. Table 5.3 portrays the summarised results:

Table 5-3: Reasons why organic producers farm organically

	Valid	missing	mean	median	Std deviation
Economic advantages	158	5	4.4	4	2.0
Environmental reasons	159	4	2.0	2	1.3
Lifestyle	157	6	2.9	3	1.7
better for health	159	4	2.0	2	1.3

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

Perhaps unsurprisingly, the mean for farming organically because of the economic advantages is in the neutral category of responses. The standard deviation is also considerably higher than that for the other variables. The statements generating the most agreeance are that producers farm organically because it is better for their health, and farming for environmental reasons.

When asked whether they would use genetically engineered seeds or crops on their farms, 74.2 percent of producers strongly disagreed that they would and only 6.2 percent agreed to any extent. When presented with the statement: Organic farmers do not want to use genetically modified crops; 78.5 percent strongly agreed, with 9.1 percent disagreeing.

5.4.3 Food types exported

Exporters were questioned on the types of organic food they exported. Figure 5.3 shows the percentages of each category exported.

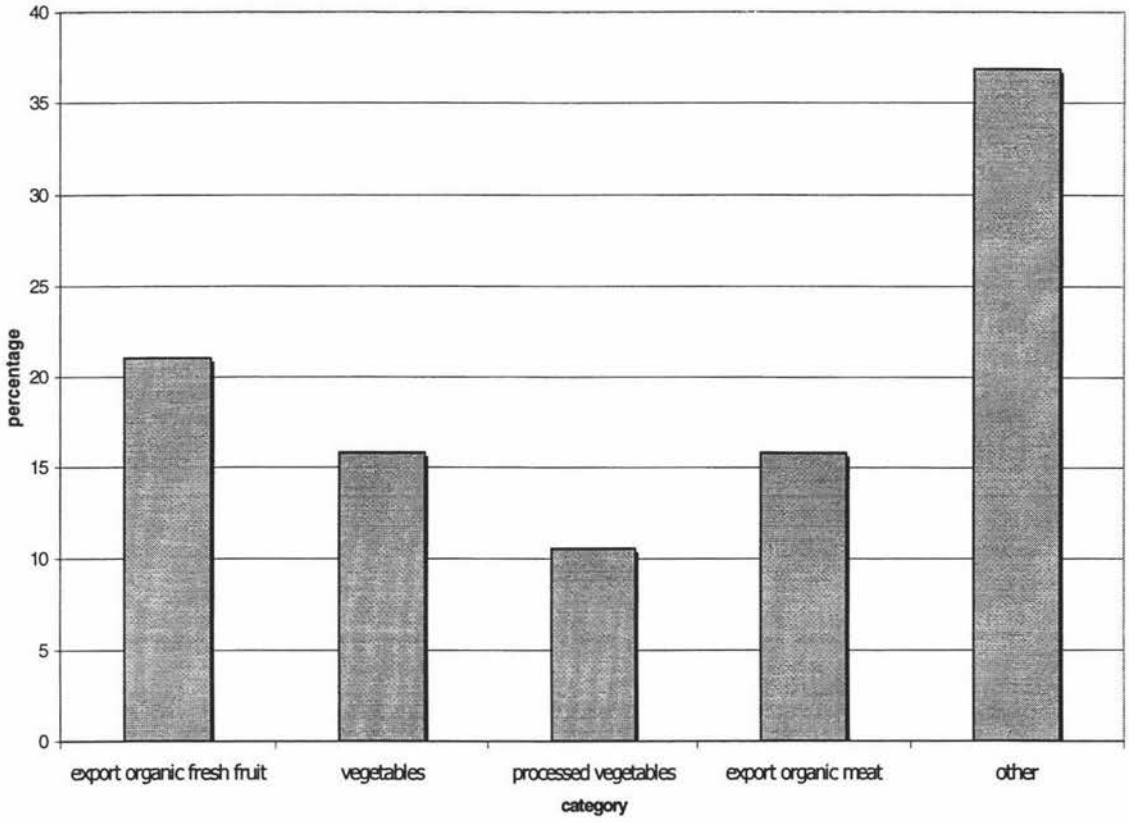


Figure 5-3: Categories of organic food exported

Of the fresh fruit exported, 10.5 percent of organic exporters export kiwifruit; 10.5 percent export pipfruit; 5.3 percent export stone fruit; and 10.5 percent export other fruit. Squash and vegetables other than root vegetables, peas/beans, and corn, are the only fresh vegetables exported. In the processed vegetables section root vegetables, corn and peas are all exported by 10.5 percent of respondents. In the meat, wool and dairy section, dairy and "other" are the only products exported. In the "other" category, baby-food, eggs, honey, juice, wine, and "other" are exported.

Exporters were also asked about which countries are their major markets, and what percentage of their products go to each country. The export destination indicated most often was Japan, followed by the European Union , the USA and Australia.

5.5 Organic Consumers' Reasons for Purchasing Organic Food

Respondents were asked to select the *three* most important benefits of organic food for them. Lower pesticide residues were indicated by 79.1 percent of respondents; 54.6 percent said no genetically modified organisms was a benefit of organic food; 52.5 percent considered the environmental benefits were of the three most important reasons they bought organic food, and 50.7 percent indicated organic food being nutritionally superior in their selection. The lowest category was that organic food is longer lasting, with only 0.7 percent indicating this. The results are presented in Figure 5.4.

A number of respondents mentioned that they found it very difficult to narrow it down to three benefits, and would consider all of the benefits very important to them.

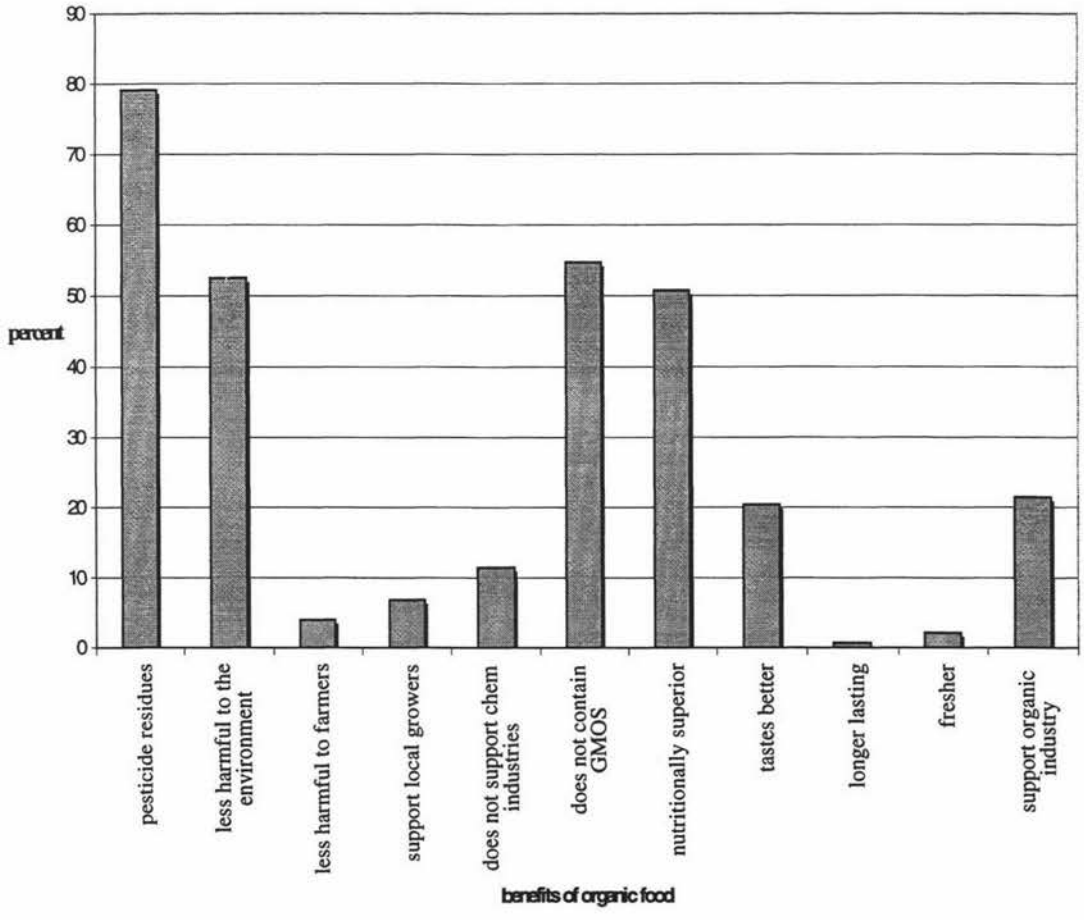


Figure 5-4: Most important benefits of organic food to consumers

Respondents were also required to rank which categories they considered to be the three greatest risks to human health. The results are presented in Figure 5.5. Some consumers did not rank them at all, but indicated three options, hence the category "equally important".

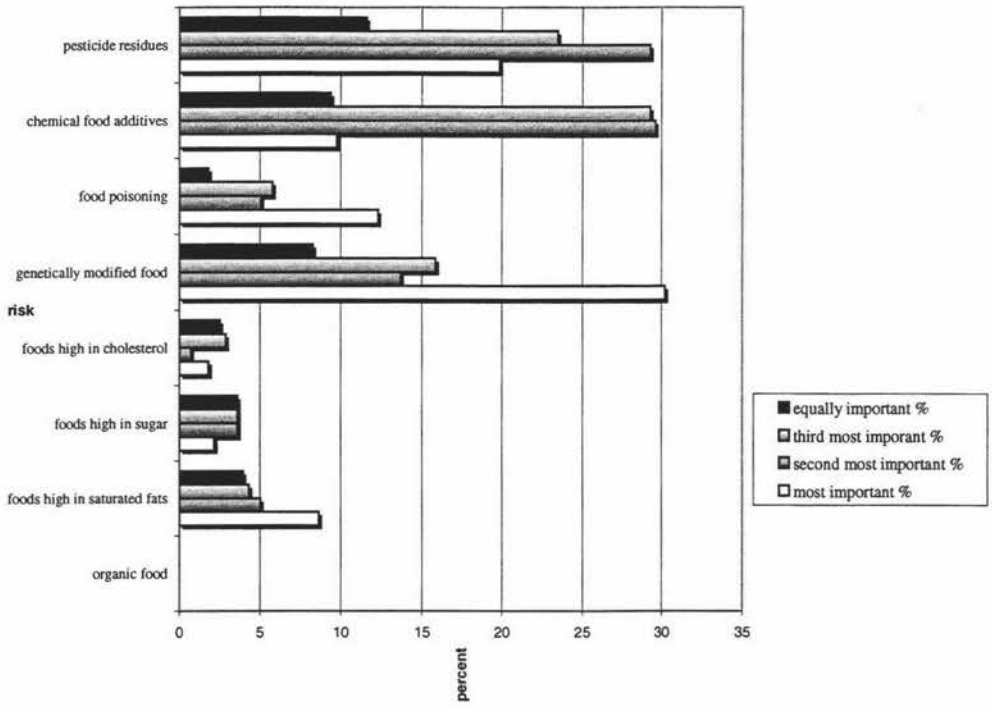


Figure 5-5: Organic consumers' perceptions of the greatest risks to human health

Genetically modified food was indicated as the greatest concern by 30 percent of respondents; 20 percent indicated pesticide residues were their greatest concern. Ten percent of respondents indicated chemical food additives were their greatest concern, 29.6 percent indicated these as their second greatest concern, and 22 percent indicated pesticide residues as being their third greatest concern. None of the respondents mentioned organic food as being of any concern at all.

There was an option for writing "other" concerns. 1.4 percent indicated processed foods; others stated factors such as unhealthy lifestyles, cigarettes, alcohol; two percent indicated factors such as greed, anger, and lack of unity - which are not related to food consumption.

5.6 GMOs in the New Zealand organic industry

Respondents from all three groups were required to react to the statement that GMOs would make the New Zealand organic industry more competitive. The results are presented in Table 5.4.

Table 5-4: Perceptions of the competitiveness of the NZ organic industry

Statement: GMOs would make the organic industry more competitive

	valid	missing	mean	Median	Std.deviation
Producers	155	8	6.1	7	1.7
Consumers	278	7	6.1	7	1.6
Exporters	19	0	5.4	7	1.7

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

These results indicate that the organic industry as a whole does not agree that GMOs would make the organic industry more competitive. All groups of respondents indicate this to varying degrees, exporters show the least strength of feeling in comparison with the other two groups (mean = 5.4).

There was some confusion regarding this question in the exporter and producer groups. Some exporters made a note that they agreed with the statement because they thought it meant it would make the NZ organic industry more competitive because it did *not* use GMOs. However, the intended meaning, and that taken by the majority of people, was if the organic industry *did* use GMOs.

Exporters, producers and consumers were all asked if they thought New Zealand organic farmers would be forced to accept GMOs. Producers were additionally asked whether they thought New Zealand farmers would have to use genetically modified seeds. The results are shown in Table 5.5. Strong disagreement is shown by all groups of respondents, consumers have the lowest mean of all the groups. This may be accounted for by a larger number of neutral responses, as consumers may not have sufficient knowledge on the topic to give a strong response.

Table 5-5: Perceptions of whether organic growers will be forced to accept GMOs

	valid	missing	mean	median	Std deviation
Consumers	276	9	5.75	7	1.65
Producers	159	4	6.16	7	1.66
Exporters	19	0	6	7	1.86
NZ farmers will have to use GM seeds					
Producers	159	4	6.43	7	1.23

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

Of the producers surveyed, 77 percent strongly disagreed with the statement that GMOs would have a positive effect on the local organic industry, while 58 percent of exporters strongly disagreed with that statement. A similar number of producers (70.6 percent) strongly disagreed and 12.3 percent disagree that GMOs were an important technological development for them. Regarding the same question, just over half (52 percent) of exporters strongly disagreed, while 10.5 percent agreed that GMOs were an important technological development. Just under half of the exporters strongly disagreed that GMOs would lower the production costs for New Zealand organic farmers, with 57.7 percent of producers strongly disagreeing, and 15.3 percent of producers neither agreeing nor disagreeing with the same statement.

5.6.1 Threats to the organic industry

Producers were presented with statements regarding threats to the organic industry from genetically engineered organisms. The questions referred to cross contamination, pest resistance, and the killing of beneficial insects. The results are illustrated in Figure 5.6. The results indicate that organic farmers are most concerned about cross contamination of genetically engineered crops, followed by beneficial insects being harmed. Producers appear more uncertain about whether insect resistance will increase due to the technology.

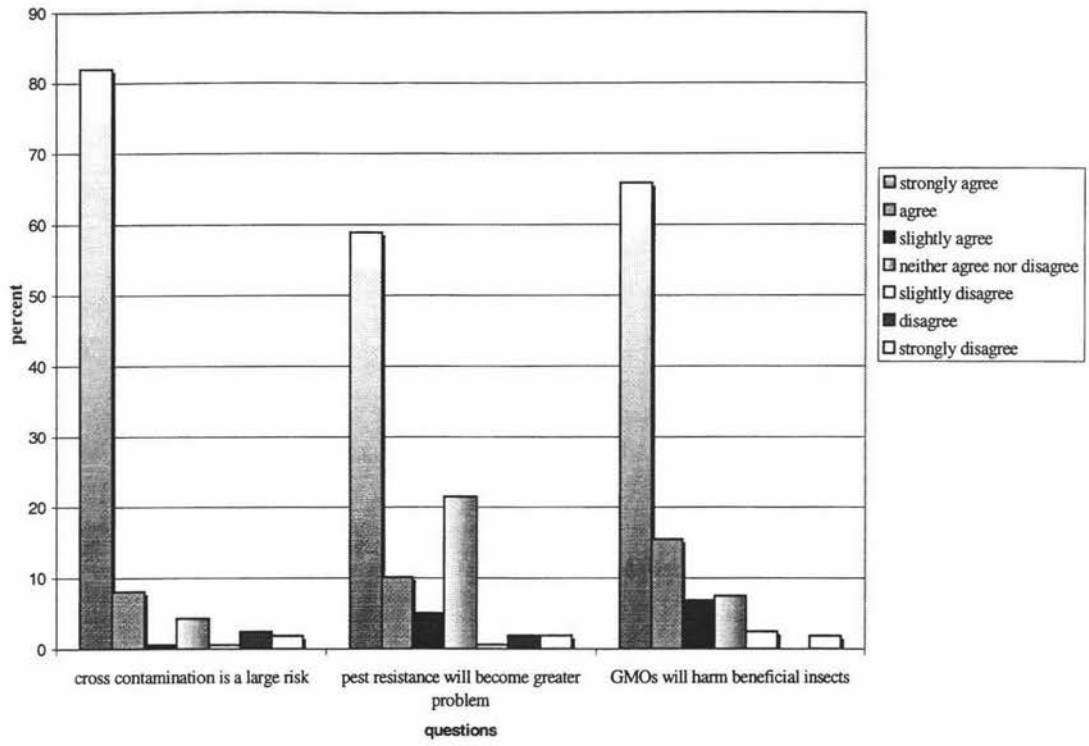


Figure 5-6: Threats to organic farming

5.7 International Organic Consumers

Organic exporting forms a major part of the New Zealand organic industry and therefore it is important to know the demands of international consumers. Exporters, in particular, were questioned on their opinions regarding international organic consumers.

5.7.1 New Zealand's international image

Of the organic exporters questioned, 42 percent strongly agreed that New Zealand is perceived as being clean and green. None of them disagreed with this statement. 52.6 percent of exporters strongly agreed that New Zealand would lose it's clean green image if its organic food contained GMOs, and 83 percent of producers strongly agreed with that statement. Ten percent of exporters disagreed that New Zealand would lose it's clean green image. Consumers were asked whether they believed GMOs would affect New Zealand's clean green image internationally, and 68.3 percent strongly agreed that it would.

Table 5.6 presents the summaries of questions asked of organic exporters regarding New Zealand's image. These results show that organic exporters believe New Zealand does have a good reputation internationally, and that the image of New Zealand is important to consumers and their demand for organic food.

Table 5-6: Exporters' perceptions of New Zealand's international image

Statement	valid	missing	mean	median	Std deviation
NZ organic food has good international Reputation	19	0	2.2	2	1.3
NZs image has a positive impact on organic buyers	19	0	1.7	2	0.7
Demand for NZ organic food depends on its image	19	0	2.1	2	1.1

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

5.7.2 The international organic industry

Exporters and producers were presented with a set of statements regarding international buyers and the international organic market. Their questions and the responses are presented in Table 5.7.

Table 5-7: Exporters' and producers' perceptions of the international organic market

Statement	respondent group	valid	missing	mean	median	Std deviation
International buyers want gm free produce	Exporters	19	0	1.2	1	0.5
	Producers	160	3	1.4	1	1.2
Intl. Organic buyers care more about pesticide	Exporters	19	0	4.3	4	1.7
Residues than GMOs	Producers	151	12	4.6	4	1.8
International organic associations will accept GMOs	Exporters	19	0	6.4	7	1.4
	Producers	160	3	6.6	7	1.2

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

It is interesting to note how similar the results between producers and exporters are for these statements. Exporters obviously feel more strongly or are more certain about these statements than many of the other statements, as the results for these tend more towards the extremes.

Of the exporters surveyed, 42 percent strongly agreed that demand for organic produce has increased because of GMOs, and none of them disagreed with the statement. 31.6 percent of

the exporters slightly disagreed that demand for New Zealand organic food depends on its price, however the total of the agrees and slightly agrees for that statement was 47.4 percent, higher than the total that disagree.

5.8 Beliefs About GMOs

This section describes the beliefs New Zealand producers, exporters and consumers have regarding GMOs, based on the results from the questionnaires.

5.8.1 Potential advantages of GMOs.

The exporters, producers and consumers of organic food were presented with statements about GMOs and organic production, the environment and New Zealand. The responses from all groups of respondents are shown in Table 5.8. These categories were obtained by adding the three agree positions on the Likert scale together to give one "agree" position. The same addition was performed on the disagree positions. These results show that the majority of all the producers, exporters and consumers surveyed do not believe GMOs could be compatible with organic agriculture, and disagree that New Zealand would benefit if GMOs were introduced.

Table 5-8: Perceptions of possible benefits of GMOs (percent)

Statement		Agree	Neutral	Disagree
GMOs could be	Producer	3.7	6.1	89
Compatible with	Exporter	5.3	10.5	84.3
organic agriculture	Consumer	5.0	7.9	84.8
NZ would benefit	Producer	3.6	3.1	91.4
if GMOs were	Exporter	5.3	15.8	79
Introduced	Consumer	6.9	8.6	84.6

5.8.2 GMOs and the environment

Of the organic consumers surveyed, 84 percent of them, 82.7 percent of producers, and 52.6 percent of exporters disagree to varying extents that GMOs could be beneficial to the environment. In addition, 76.7 percent of producers strongly agree that they are concerned about the environmental effects of GMOs in New Zealand.

5.8.3 Consumers and organic food

Producers and exporters were asked a number of questions on their opinions of consumer demands and behaviour. The summarised results for each group are shown in Table 5.9.

Table 5-9: Producer and exporter perceptions of consumer demands and behaviour

Producers

	N Valid	Missing	Mean	Median	Std. Deviation
International consumers want GMO free produce	160	3	1.4	1	1.2
Intl. Consumers care more about pesticide residues	151	12	4.6	4	1.8
Consumers buy organic food for health reasons	160	3	1.9	2	1.0
Consumers buy for environmental reasons	160	3	2.9	3	1.4
Price is the most important factor for organic consumers	158	5	5.2	6	1.7
Environment is main concern for consumers	157	6	3.3	3	2.8
Consumers never accept environmental damage	155	8	2.6	2	1.7
If consumers were reassured they would accept GMOs	154	9	5.4	6	1.8

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

Exporters

	N Valid	Missing	Mean	Median	Std Deviation.
Consumers purchase organic food mainly for health reasons	19	0	2.0	2	1.0
Price is the most important factor for organic buyers	19	0	5.4	5	1.6
Environment is main concern for consumers of organic food	19	0	3.6	4	1.3
Consumers would never accept any environmental damage	19	0	3.0	3	1.8

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

These results show that both producers and exporters have the perception that consumers of organic food purchase it mainly for health reasons, more than environmental, and markedly more than price reasons. The results between the two groups of respondents, producers and exporters, are very similar for the same questions, with no obvious discrepancies between them. Although both groups of respondents agree in some form that consumers would never accept any environmental damage from the use of GMOs, both means are closest on the scale to "slightly agree", rather than "strongly agree" or "agree".

Consumers were also asked questions relating to their personal views on genetically engineered foods and their apprehensions. The results from this are shown in Table 5.10:

Table 5-10: Consumer views of GMOs

	N Valid	Missing	Mean	Median	Std. Deviation
Organic food should not contain GMOs	281	4	1.2	1	1.0
Would not buy organic food if it contained GMOs	280	5	1.6	1	1.3
If organic food contained GMOs I would grow more of my own food	278	7	2.2	1	1.8
Even if GMOs lowered the price of organic food I would not buy it	280	5	1.8	1	1.8
Concerned about the health effects of GMOs	282	3	1.5	1	1.1
Concerned about the environmental effects of GMOs	282	3	1.4	1	1.2
More concerned about agrichem use than impacts of GMOs	274	11	3.6	4	1.8
Pesticide residues are a greater health concern	271	14	3.7	4	1.7

Note scale: 1= strongly agree, 4= neutral, 7=strongly disagree

Consumers agree (only slightly above neutral however), to both statements indicating they are more concerned about agrichemicals and pesticide residues than GMOs. However, answers to other variables tend to contradict this, such as the statement "even if GMOs lowered the price of organic food I would not buy it", where the mean to this variable is 1.8, and "I would not buy organic food if it contained GMOs", the mean of which is 1.6.

5.8.4 Effect on demand for organic food

Exporters were presented with a statement that demand for organic food has increased because of publicity about GMOs. 87 percent of exporters agreed with this statement, of those, 44.8 percent strongly agreed. The consumers were presented with a statement saying "I buy more organic food since hearing about GMOs." 61.3 percent of respondents agreed with this, with 33.9 percent in the strongly agree category. 17 percent neither agreed nor disagreed. Consumers were asked if they believed organic food was GMO free at present. 46.9 percent strongly agreed that it was, 12.6 percent neither agreed nor disagreed, and 10.8 percent disagreed in some way. It is interesting that under half of the consumers thought organic food was free of GMOs at present, yet still said they would not buy organic food if it did contain GMOs.

5.8.5 Political aspects of the debate

Producer and consumer questionnaires included a statement claiming that multinational seed companies are too influential. 74.2 percent of producers strongly agreed with this, with under 5 percent disagreeing in any form. 80 percent of consumers agreed to varying degrees, with only 3.7 percent showing any disagreement.

Consumers were asked whether they felt the government would listen to their concerns about genetic engineering. Of the responses obtained, 31percent of consumers agreed that it would, while 23.9 percent neither agreed nor disagreed. Some qualified this by saying it would depend on which government was in power. Producers were asked whether the New Zealand government should allow the introduction of GMOs. Most (84 percent) of producers strongly disagreed that it should, only 3.6 per cent showed any agreement with that statement. Producers were also given the statement that organic farmers should be allowed to use GMOs. Of the producers surveyed, 81 per cent strongly disagreed with this statement, and only 2.4 per cent showed any agreement.

5.8.6 Specific producer beliefs

Of the producers surveyed, 71.2 percent strongly agreed with the statement that they were concerned about the effects of GMOs on human health and 73 percent strongly agreed that GMOs are not vital to feed the world, 28.2 percent agreed in some way that it was important for New Zealand to keep up with developments in genetic engineering. Over one third (38 percent) of producers strongly disagreed with this. Some respondents noted on their questionnaires that it is possible to keep up to date with developments made in other countries, without actually practising the technology in New Zealand.

Approximately one quarter (25.7 percent) of producers indicated that genetic engineering was against their religious beliefs, with 35 percent neither agreeing nor disagreeing, and 22.7 percent strongly disagreeing with that idea. 43.6 percent of producers strongly agreed that genetic engineering is not ethically acceptable, 16.6 percent neither agreed nor disagreed, and 13.5 percent disagreed in some way with that statement.

5.8.7 Specific consumer beliefs

Consumers were presented with a set of statements determining their familiarity with the topic of genetic engineering. The questions and their results are shown in Table 5.11.

Table 5-11: Consumer's familiarity with the GMO topic (%).

Statement	Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly disagree
I have followed the GMO debate closely	30.4	27.9	20.7	13.6	3.9	2.1	1.4
I have a good understanding of the issues	29.4	28	21.9	10.4	7.2	2.1	1.4
I would be able to explain the concept of GMOs to a friend	30.8	26.2	21.1	12.2	5.4	3.6	0.7
I frequently discuss this issue with other people	23.5	22.4	21.7	15.5	9	4.3	3.6

As illustrated in table 5.11, most of the consumers surveyed felt they had some understanding of the genetic engineering topic and many discussed the issue with other people. This was expected as consumers of organic produce were thought to be more informed on issues of health and environment than the general population.

Consumers were also presented a set of statements discussing different aspects of biotechnology. Respondents had to indicate for each, whether they felt it was morally acceptable, and whether it posed risks for society. These data are presented in Figures 5.7 and 5.8, one showing moral acceptability, and the other risks to society.

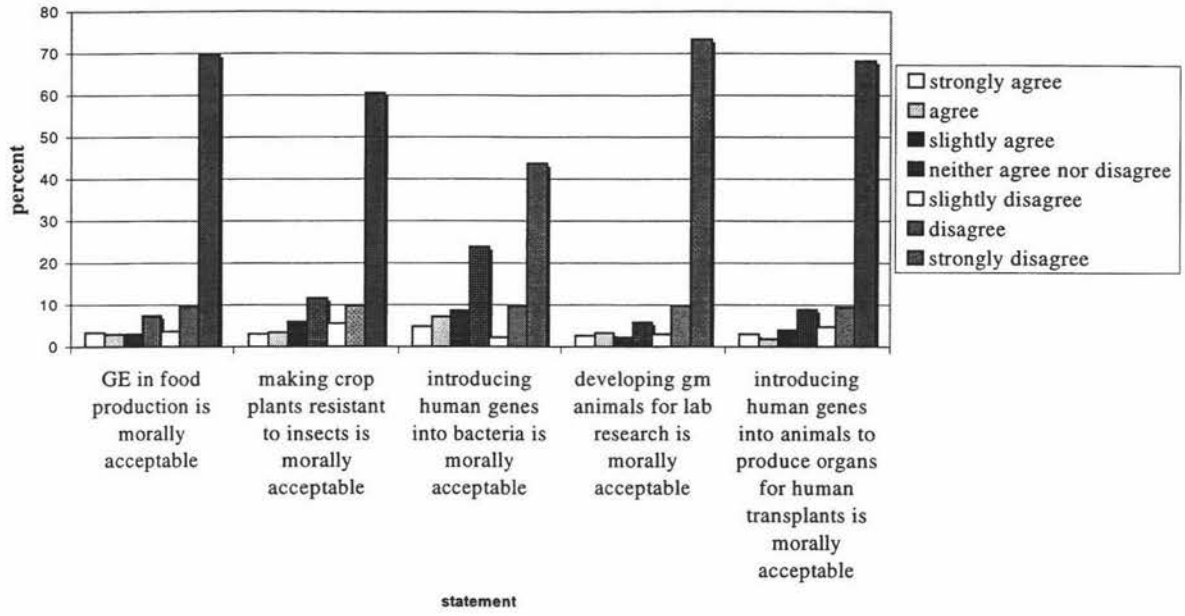


Figure 5-7: Perceived moral acceptability of different genetic engineering applications by organic consumers.

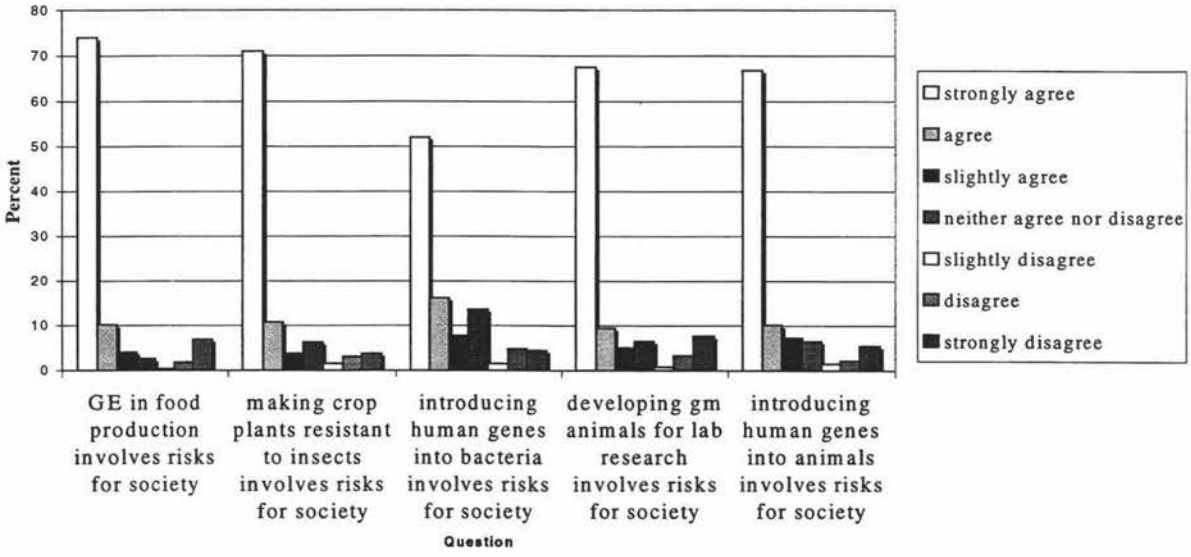


Figure 5-8: Perceived risks to society of different genetic engineering applications by organic consumers.

5.9 Relationships Between Variables

This section explores some of the relationships between variables and tests to determine whether or not the relationship is significant. This is achieved primarily through the use of correlation analysis, with some regression analysis and crosstabulation.

5.9.1 Differences between producers

A correlation analysis was carried out to determine whether the type of food produced was related to the attitudes held by producers. The results indicate that production of kiwifruit is significantly correlated with the length of time the producer has been certified (r=.232), and whether or not they farm organically for lifestyle reasons(r=.307). These correlations are both significant at the 0.01 level. Production of meat also appears to be correlated with the length of time the producer has been certified organic(r=.228). The closer the coefficient is to one, the stronger the relationship, which indicates that these relationships are not particularly strong.

5.9.2 Perceptions of pesticide residues and GMOs

Consumers indicated they are more concerned about pesticide residues in their food than they are about GMOs (79.1 percent). However, some people would have indicated they are concerned about both pesticides *and* GMOs, as the question required giving the three most important reasons for buying organic food. Pesticide-residue-free was indicated more often than GMO-free, which had 54.6 percent. Conversely, the question which asks respondents to indicate the three greatest risks to human health to them, and rank them from 1- 3, 30.2 percent indicated GMOs as their number one concern, and only 19.9 percent indicated pesticide residues. Pesticide residues and chemical food additives ranked highly as people's second and third concerns, while GMOs dropped considerably.

5.9.2.1 Bivariate analysis

The other two questions in the consumer survey regarding pesticide use versus GMO use both indicate that consumers are more concerned about pesticide use. One question states specifically: "I am more concerned about agrichemical use than the impacts of GMOs on the environment." While 41.6 percent agreed in some way to this, 34.7 percent neither agreed nor disagreed. The other statement was: "pesticide residues are a greater health concern

than GMOs to me." Here 42.8 percent agreed in some way, and 34.3 percent neither agreed nor disagreed. When correlated with each other on SPSS they gave a Pearson's *r* coefficient of 0.463, and the relationship is significant at the 0.01 level.

When a correlation analysis was carried out on all four variables which measure pesticide use versus GMO use, none of them have such a strong Pearsons *r* coefficient as the above two. The question relating to reasons for purchasing organic food and Question 23; "pesticides are a greater health concern than GMOs to me" have a Pearson coefficient of 0.163 and the relationship is significant at the 0.01 level. The question on health concerns and Question 23 have a Pearson coefficient of 0.137 and are significant at the 0.05 level. All the questions relating to GMO use versus pesticide use are therefore correlated to some degree.

The attitudes towards pesticides and GMOs are not significantly correlated with education, income, gender, occupation or age. The question stating that pesticides are a greater health concern than GMOs has a statistically significant correlation (r = 0.191) with the question asking whether they would eat food with GMOs if they were reassured about the environmental and health effects. Health concerns are significantly correlated with whether consumers would accept GMOs in organic food (r = .168). This is interesting because although the respondents have indicated they are more concerned about pesticide residues than GMOs, they still would not eat GMOs in any circumstances.

After crosstabulating another set of questions, it is shown that 33.6 percent of respondents agree in some way to *both* of the following statements: that they would not buy organic food with GMOs even if the price was lowered, and that pesticide residues are a greater health concern to them. Eight percent of consumers agree strongly with both statements. This apparent inconsistency is shown similarly in that 37 percent of consumers agree to varying degrees that they would not buy organic food if it contained GMOs, *and* that pesticide residues are a greater health concern than GMOs to them.

There was no statistically significant relationship between the two variables measuring preference between GMO and pesticide use, and education.

When asked whether international buyers care more about pesticide residues than GMOs, 42.1 percent of exporters agreed in some form (although there were no "strongly agrees" and most were "slightly agree"). 36.8 percent disagreed with that statement, 15.8 percent of whom strongly disagreed. This result is so close as to really be undecided, particularly in light of the small sample size.

Producers were also asked whether they thought international consumers cared more about pesticide residues than GMOs in their food. 22.1 percent agreed in some form, 29.4 percent neither agreed nor disagreed, and 41.1 percent disagreed in some way.

5.9.3 Religion and ethics

Producers and consumers were both presented with statements relating to their religious and ethical views of GMOs. Producers were asked whether GMOs were against their religious beliefs and whether GMOs were considered ethically acceptable. Consumers were asked in a slightly different way: following a question on whether they would eat food containing GMOs, if they had indicated that they would not, they were given the options of "because of my religious beliefs" and "because of ethical concerns". They were then presented with a similar question of whether they would eat organic food containing GMOs, and the same justification options. Table 5.12 presents the summarised results. The consumer values are the means for the two questions.

Table 5-12: Percentages of consumers and producers with religious and ethical concerns about GMOs.

		Agree	Neither Agree nor disagree	Disagree
Religion	Producers	27.5	35	33.7
	Consumers	8.3		79.5
Ethics	Producers	67.6	16.6	13.5
	Consumers	39.7		47.9

(Note that consumers did not have the option of neither agreeing nor disagreeing)

The results in this table show that most respondents, consumers particularly (79.5 percent), do not attribute their attitudes about GMOs to their religious beliefs. Just under half of the consumers (47.9 percent) disagreed that GMOs were against their ethical beliefs. It is difficult to define what an ethical belief is, and some respondents may have different interpretations than others.

5.9.3.1 Bivariate analysis

The variables measuring religious and ethical beliefs were analysed using bivariate correlation analysis. Religious beliefs were significant at either the 0. 01 or 0.05 level for 28

out of the 39 variables on the producer Likert scales. However, they were only significant for two of the 34 variables on the consumer Likert scale. The greatest level of correlation in the producer data was with the question on ethics (r = .588, significant at the .01 level). Other variables correlating highly with religious concerns were whether it is important for New Zealand to keep up with technological developments (-.363); producers who farm organically for environmental reasons (.333); and whether GMOs could be beneficial to the environment (-.301);and whether GMOs could be compatible with organic agriculture (-.257). These relationships are all significant at the 0.05 level.

In the consumer data, the only significant correlation with religious beliefs were the questions on ethical concerns (Pearsons coefficient .349 and .275 respectively), and with the question on whether the introduction of human genes into bacteria is morally acceptable (-.130).

Ethical concerns were more highly correlated in both the producer and consumer data. These concerns are significant at the 0.01 and 0.05 levels in 31 out of the 39 variables in the producer data, and in nine out of the 34 variables in the consumer data. The greatest correlation for producers (apart from religious beliefs) was whether GMOs could be beneficial to the environment (Pearsons coefficient = .498). Other variables rating highly were whether GMOs could be compatible with organic agriculture (-.485); whether New Zealand could lose it's clean green image (.444); whether the producer is concerned about the effect of GMOs on human health (.435); whether the producer would use GMOs on their farm (-.408); and whether organic farmers should be allowed to use GMOs (-.429).

For consumers, the highest Pearsons coefficient for ethical concerns with another variable was 0.198: "Genetic engineering in food production is morally acceptable". None of the other significant variables have particularly high Pearson's coefficients.

5.9.4 Knowledge and beliefs

Consumers were asked a number of questions relating to their knowledge about GMOs, and the importance of the issue to them. These questions consisted of "I have a good understanding of the issues; I would be able to explain the concept of GMOs to a friend; I have followed the debate closely". The reason for the inclusion of this type of question was to see whether it affected the beliefs or attitudes of the respondents. A regression analysis with "I have a good understanding of the issues" as the dependent variable, and the other Likert scale statements as the independent variables show that five variables explain 73 percent of the variance in that statement. The variables are the ability to explain the issue to a

friend; following the debate closely; discussing the issue with other people; concern about the environmental effects of GMOs; and whether the introduction of human genes into animals to produce organs for human transplants is morally acceptable.

A correlation analysis was carried out the four statements measuring knowledge and interest, and all the other variables. Those with a Pearson coefficient of greater than .200 are shown in Table 5.13.

Table 5-13: Correlation analysis of knowledge about genetic engineering with all other variables for consumers.

	Followed the debate closely	Good understanding of issue	Able to explain to a friend	Frequently discuss the issue
I buy more organic food since hearing about GMOs	.217**	.288**	.229**	.391**
Food		.200**		.367**
Seed companies are too Influential		.419**	.373**	.488**
GMOs will affect NZs clean green image		.200**		.300**
NZ would benefit from the introduction of GMOs				-.282**
I am concerned about the health effects of GMOs		.247**	.200**	.352**
I am concerned about the environmental effects of GMOs		.251**	.221**	.247**
GMOs are compatible with organic agriculture				-.282**
G.E in food production involves risks to society				.224**
G.E in food production is morally acceptable				-.295**
making crop plants resistant to insects is morally acceptable		.201**	.223**	
organic food should not contain GMOs				.208**
I would not buy organic food if it contained GMOs				.252**
Even if GMOs lowered the price of organic food I would not buy it				.222**
NZ organic industry would become more competitive by allowing the use of GMOs				-.272**

**= *significant at the 0.01 level*

The largest amount of correlation shown in this table indicates that knowledge and interest in the topic are related to whether respondents thought seed companies are too influential.

5.9.5 Consumption of organic food

The mean amount of organic food consumed was correlated with the other variables in the consumer sample. The original data (see Appendix Two) was first transformed using SPSS to create a new variable consisting of the means for all categories of food consumed. The results are shown in Table 5.14. Note that the variables shown are only those greater than .300, as a large proportion were significant at the .05 level.

Table 5-14: Correlation analysis of amount of organic food consumed.

Question	Pearson's coefficient
Followed the debate closely	-0.349
good understanding of issues	-0.334
able to explain to friend	-0.314
Frequently discuss issue with other people	-0.397
If organic food contained GMOs I would grow more of my own food	-0.325
seed companies are too influential	-0.423

The values shown are all significant at the 0.01 level.

The amount of organic food consumed is therefore correlated with the knowledge and understanding of the genetic engineering debate. The consumption of organic food is also correlated with the opinion of whether seed companies are too influential or not, and whether the consumer would grow more of their own food if organic food contained GMOs.

6 DISCUSSION

6.1 Introduction

The aim of the study is to investigate the future of GMOs within the organic industry. This chapter discusses this aim with reference to the results obtained, and in comparison with other studies. The reasons for the outcomes are investigated, and the main points summarised. The objectives are discussed individually, how they were achieved and what the results indicate.

The limitations of the study are discussed as well as scope for further research.

The main points made in the discussion are summarised below.

1. The beliefs and attitudes of the organic industry are strongly against genetic engineering. Consumers hold particularly strong beliefs.
2. The reasons for the rejection of genetic engineering are based more on the intrinsic "wrongness" rather than purely factual justifications.
3. The industry would not consider using GMOs in food production or incorporating them into organic standards.
4. The consumers are undecided over whether they consider GMOs to be a greater health risk than pesticide residues.
5. Demand for New Zealand organic produce is quite dependent on the image of the country, and international consumers do not want genetically engineered organic food.
6. The organic sample shows more extreme views than the general population but the trends are similar to those of the general public.

6.2 The Sample Profile

The demographic information collected from the producers and consumers shows that both groups are more educated than the general population. This may be explained by research carried out by Dillman (1983) which shows that those who do not respond to questionnaires tend to have a lower educational level than those who do. It may be that those who buy organic food or are involved in the organic industry have a higher education level than the general public.

Female consumers outnumber males by over two to one. This is likely to be due to females tending to shop more than males. There were a considerable number of mothers with young children. Conversely, producers are predominantly male.

The sample of consumers is very concentrated in the middle age groups and under-represented in the under 20 and over 60 age groups (based on data from the 1996 New Zealand census). The 20 - 50 age groups are particularly over-represented. This may be because those age groups do most of the shopping (for example, for their families). Based on the statistics from the New Zealand Census in 1996, the producers are under-represented in the under 30 and over 60 age groups, with most (39.9 percent) aged between 41 - 50 years.

Maori and Pacific Islanders are under-represented in both samples, in comparison with the general public.

6.3 Beliefs, Perceptions and Attitudes of Producers, Exporters and Consumers of Organic Food towards Genetic Engineering.

The primary objective of the study is to explore the beliefs, perceptions and attitudes of producers, exporters and consumers of organic food, towards genetic engineering.

The most striking result gained from the analysis of the questionnaires is the strength of feeling against genetic engineering, particularly evident in the consumer population. The hypothesis indicates that the organic industry was expected to be against genetic engineering, however, the strength of the responses was not expected. Consumers were especially passionate about the subject, many writing additional notes on the questionnaire form, expressing their total aversion to the technology.

Fishbein and Ajzen (1975) state that predispositions to respond in consistently favourable or unfavourable ways are assumed to be the result of past experience. Attitude can therefore be described as a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object.

The results obtained from the surveys indicate that respondents appear to be consistently opposed to genetic engineering. This is not totally surprising as it was assumed that those involved in the organic industry would have strong opinions regarding food and food production.

6.3.1 Producers' attitudes and perceptions towards GMOs

The results from the producer survey indicate producers do not want genetic engineering to be part of the organic industry. 87 percent would not use them on their farm, and 88 percent of the producers surveyed stated that organic farmers do not want to use genetically modified crops. 82 percent did not think organic growers would be forced to accept genetic engineering, and 94 percent did not think international organic associations would accept GMOs as part of organic practices.

These results may reflect a confidence in knowledge and facts, or they may reflect the *hopes* and *ideals* of the producers. If cross-contamination or Bt-resistance became widespread, organic farmers would potentially have to accept modified organisms, no matter how conflicting with their principles it is. The farmers either may not be completely informed on the issue; may be stating what they hope happens rather than thinking realistically about it; or they may indeed feel that organic growers will not be forced to accept genetic engineering. A shortfall of the closed question format is evident in this situation, where it would have been helpful to have some clarification and qualification.

6.3.2 Exporters' attitudes and perceptions towards GMOs

Organic exporters are also opposed to GMOs although their strength of feeling (measured in Likert scales) is not as strong as the producers, and certainly not as strong as that of the consumers. However, the questionnaire intended to gain the knowledge and opinions of the exporters about the industry, and particularly about consumers, rather than the exporters' own personal views. This would probably explain the less extreme answers. In addition, they are

exporters of organic food, which in many cases may simply be a 'job' for them, rather than a lifestyle based on more philosophical and idealistic foundations.

Notwithstanding this, 94 percent (16 cases) of exporters disagreed that international organic associations would accept GMOs as part of organic agriculture. 84 percent disagreed that the organic industry world-wide would be forced to accept GMOs. These results support those of the producers. As exporters are likely to have a more objective viewpoint than the consumers, this may mean the producers are indeed making their decisions on realistic expectations rather than ideals.

Exporters disagree that GMOs could be compatible with organic agriculture (84 percent). They also disagree that GMOs could be beneficial to the environment, however not by a large proportion (52.6 percent).

6.3.3 Consumers' attitudes and perceptions towards GMOs

Consumers were the most extreme in their views on GMOs. Observing some people filling out the questionnaires, many began with the view that they were absolutely against genetic engineering, and therefore answered the questions by indicating the most extreme view consistently (that is,. one and seven on the Likert scales). If the individual questions had been given more thought, many respondents perhaps may not have felt equally strongly about every question. In addition to this, some respondents did not read the questions correctly, or ignored the instructions even if they apparently understood them. This was notably the case where they had to select *some* benefits of organic food, or *some* health concerns. The extreme type of respondent indicated all the options, even when told by the interviewer that this would make their response unusable.

The strength of opinion was apparent while observing and speaking with the people in the organic shops. Although this study is impartial, and attempts to simply describe the situation rather than take sides, some consumers were convinced it was produced by Monsanto in an attempt to infiltrate the organic market. They thought it was "obvious" that it had been produced by the biotechnology industry, even when it was explained to them that it was a neutral study for a Masters degree. This is interesting as considerable effort was made to ensure it did not take any "sides" in the debate.

There were also a number of comments (interestingly they were almost solely from the Auckland sample) about the use of the term "genetic modification" as opposed to "genetic

engineering". Respondents in some cases were extremely adamant to the point of abusive in some cases, that genetic modification was a term used by the biotechnology industry to play down the unnatural aspect of the technology. At the time of writing the questionnaire, the author was under the assumption that the terms were interchangeable. BIO-GRO, the organic certification agency, uses the term "GMO" in their production standards publication (1998), and it has been widely used across both proponent and opposition literature. Following the printing of the questionnaires, a notice appeared in the Soil and Health magazine (58(6) 1999), stating that the definition of genetic modification is "using genes from the same species; an example is selective breeding for disease-resistant apples or sheep", and genetic engineering means "transgenic i.e. using genes from different species; an example is the toad gene in a potato". There is no reference given for these definitions and this was the first (and only time) the author had heard of such a distinction. The use of the term "GMO" throughout the questionnaires appeared to add to the "evidence" that the survey was conducted on the part of Monsanto.

The consumer results consistently show strong feelings against genetic engineering, and certainly against the inclusion of GMOs within organic food. In some cases decisions appear to have been made without any form of risk-benefit analysis. This would indicate that the respondents are against genetic engineering intrinsically, and any arguments for the technology are disregarded because nothing can reverse that intrinsic wrongness. Reiss and Straughan (1996) argue that intrinsic arguments cut deeper than extrinsic ones. They focus attention on the precise nature of the issue and its distinguishing characteristics.

This is shown for example in the statement "GMOs could be beneficial to the environment". Here 84 percent of the consumers disagree with this statement. However, literature indicates that GMOs do have the *potential* to be beneficial to the environment. They could reduce the use of pesticides, or reduce the land area required for food production, to name two examples. Whether or not the engineered organisms will be beneficial to the environment, because of who they are controlled by and how they are used is a different matter. Consumers are either not aware of the potential benefits or choose to answer in this way because they are fundamentally against genetic engineering.

The familiarity and knowledge of the topic seemed to be related to the concerns about GMOs (that is, environmental and health concerns); how GMOs would affect New Zealand (our image and whether GMOs would have an effect or not), and how to avoid GMOs (grow more of their own food, and buy more organic food). It was also correlated with agreeing that seed companies are too influential, which respondents who did not have a good understanding of

the issue were undecided about. It was not significantly related to any of the other variables, which indicates that opinions on many aspects of genetic engineering can be formed without significant background knowledge.

6.3.4 Misleading claims by the biotechnology firms

Biotechnology firms such as Monsanto have been accused of turning the genetic engineering issue into an environmental one, and "greenwashing" the technology. The aim is for it to be seen as an environmentally friendly technology that will help feed the starving people, reduce pollution and generally an indispensable tool in the continuation of successful life on earth. Opponents such as Montague (1998) are very cynical of this claim, while supporters contend that genetic engineering is indeed necessary (Evenson 1999).

Organic farmers would respond by saying that conventional agriculture is indeed not "sustainable", but organic methods would ensure the sustainability of the land indefinitely. The essence of sustainability as described by Balfour (1978 cited in Woodward 1999, p23) is:" the criteria for sustainable agriculture can be summed up in one word - permanence - which means adopting techniques that maintain soil fertility indefinitely; that utilise, as far as possible, only renewable resources; that do not grossly pollute the environment, and that foster life-energy (or biological activity) within the soil and throughout the cycles of all the involved food chains".

The situation that may arise with rendering of the vital organic tool (Bt) useless, and the contamination of the organic crops with transgenic ones may leave organic producers with fewer pest control methods, and organic consumers with fewer options. By doing this, even if it does potentially have beneficial effects itself, the technology would be unfairly undermining a practice that has sincerely attempted to produce off the land with minimal detrimental impact.

The attitude of the organic industry therefore, would be that they are clearly opposed to the technology, and certainly do not want it to become part of organic agriculture.

6.4 Reasons for the Rejection of GMOs

A number of questions in both the consumer and producer questionnaires attempt to understand the reasons behind the belief structures of respondents. These questions are the ones such as "I am concerned about the environmental effects of GMOs" and "I would not eat genetically modified food because of ethical concerns". These concerns are significantly correlated with attitudes about GMOs such as "I would not use them on my farm".

Interestingly, producers' religious beliefs are correlated with many of the other variables, whereas the consumers' religious beliefs only correlate with two variables. Only a small percentage of consumers attributed their refusal to eat food containing GMOs to their religious beliefs (eight percent), while 27.5 percent of producers felt GMOs were against their religious beliefs. Some consumers mentioned "spiritual beliefs" rather than religious ones, on the questionnaire. The popular literature on this topic indicates that religion plays a significant aspect in forming people's views on genetic engineering. The results from this study would not support this.

"Ethical" concerns rated more highly among both consumers and producers in explaining their attitudes about GMOs. However, even in this category, only 40 percent of consumers indicated ethical concerns were part of their reason for not accepting organic food. This result may be somewhat misleading as the question included an "other" category, in which some consumers added their own reasons, many of which would strictly come under "ethical concerns". Questions such as this are difficult both to answer and interpret in this format as definitions of 'ethics' undoubtedly vary between respondents.

After reading through the comments written on many of the surveys, it becomes apparent that the feelings against GMOs are many and varied and not easily determined by a questionnaire. Although respondents will generally agree that they are concerned about the environmental and health effects, these are unlikely to be the underlying reasons for respondents absolute refusal to accept GMOs. Many people feel genetic engineering is a disruption of the natural cycle and that human beings are incredibly arrogant to assume the right to do this. There are many references to the "holistic" aspect of nature and the world, and that one cannot isolate aspects without considering the whole system. This is not surprising if one refers back to the principles of the organic movement. Attitudes such as this are difficult to pin down with closed questions, and if it had not been for the opportunity to make comments at the end they would never have become apparent.

Many of the respondents concerns about GMOs appear to be *intrinsic*, which is in accordance with Reiss and Straughan (1996) and their discussion of the intrinsic and extrinsic nature of concerns. This intrinsic belief is likely to be the matter which causes the controversy between proponents and opponents of genetic engineering. Proponents of genetic engineering can see that there are benefits to the technology, and become frustrated with those opposing the technology on grounds other than scientific. However, as discussed previously, if a concern is intrinsic, then any further information really is irrelevant, as nothing can reverse that intrinsic wrongness.

Regarding the question in the consumer questionnaire: "If you were reassured about the safety of GMOs to human health and the environment, would you eat them?", the overwhelming majority (82 percent) said no. Many respondents made the remark that they could never be reassured about this. Some would not trust those who were making the reassurances to tell the truth, while others felt the safety of GMOs could never be known or proven. This indicates a lack of faith in those in authority, and a feeling that humans do not have uncontested knowledge about everything. Some respondents mentioned instances where the public had been reassured by "experts" (such as in the case of BSE) and the experts had been wrong. The responses also indicate that human and environmental health are not the only issues involved in their opposition to genetic engineering.

6.5 Would the Organic Industry Consider Using and Accepting GMOs in their Food Production and Consumption?

Regarding consumption of organic food, consumers would find it difficult accepting genetic engineering in organic food. In fact, nearly ninety percent of consumers said they would not buy organic food if it contained GMOs. However, if they were faced with the hypothetical situation where *all* food contained GMOs, not only organic food (which is more likely - organic food is likely to be the last to include GMOs), they may change their opinion. Interestingly, ten percent of consumers questioned disagreed that organic food was GMO free at *present,* and of them, most also indicated they would not buy organic food if it did contain GMOs. This would lead one to believe that these respondents would continue to buy organic food even if contained GMOs, as according to their beliefs about organic food, they may already be doing this. What respondents on questionnaires say they will do and what they

actually do is often different (Macpherson 2000 pers comm.). Nonetheless, organic consumers *are* strongly opposed to GMOs in organic food.

The majority of respondents throughout the questionnaires disagreed in some form (predominantly strongly) with the statement that organic growers will be forced to accept GMOs. This question was included to determine how inevitable the organic industry felt the spread of GMOs would be. The respondents may have taken this question to mean organic farmers will be forced by law or by the government to accept GMOs. The intention of the question was would they be forced to accept GMOs due to either such wide-spread contamination of all crops that it would be impossible to keep non-genetically engineered crops separate, or because of the loss of natural pesticides such as Bt, and insect resistance being too widespread to control. The wording of the question may have been too ambiguous.

Producers would also be resistant to the idea of using GMOs in their food production practices. As mentioned above, 87 percent of producers would not use them on their farm. It is suggested that the only way GMOs would enter the organic industry would be through the unintentional cross-contamination with genetically engineered crops. The strength of feeling is such that even if pests did become resistant to Bt, it is unlikely that farmers would resort to using GMOs.

Most (74 percent) of exporters disagreed that GMOs would be an important technological development for the organic industry, and that their use would make the organic industry more competitive. Some noted that if organic food remained *GMO-free*, it would increase the competitiveness of organic food.

6.5.1 Pesticides versus GMOs?

An important aspect of the study, particularly for the consumer section, was investigating which was considered to be a greater risk: pesticide residues or GMOs in food. Proponents of genetic engineering have claimed that as some genetically modified crops reduce the need for pesticide application, genetic engineering should be allowed in organic food production. The results from this study are somewhat contradictory: the results from one question indicate that consumers are more concerned about pesticide residues than they are about GMOs. However, results from another question show that the greatest health concern to consumers are GMOs.

It is interesting that GMOs ranked highly on health effects, as these are the effects that are less known and probably not of as great concern as the other possible disadvantages such as the environmental ones. This may be similar to perception of pesticides and is another example of the difference between scientific and public perception of a health risk. Although there is some evidence that pesticides can cause some adverse health effects in workers and in animals, the effects of pesticide residues in food are uncertain (Maskill and Harre 1994).

A question later in the survey specifically states: "I am more concerned about agrichemical use than the impacts of GMOs on the environment." More respondents agreed than disagreed, although a large proportion neither agreed nor disagreed (35 percent). Another question reads: "pesticide residues are a greater health concern than GMOs to me." The proportions in this question were similar.

Approximately one third of respondents who indicated they are more concerned about pesticide residues than GMOs, claim they still would not eat GMOs in any circumstances. This appears inconsistent: if consumers are *more* concerned about pesticide residues than GMOs then surely they would continue to buy food without pesticide residues, even if they did contain GMOs? The alternative is to buy conventionally grown food which presumably would contain pesticide residues as well as GMOs, although this can not be assumed.

Some respondents mentioned that it was difficult to answer the question at present as the health effects of GMOs are largely unknown or inconclusive. They may answer differently in future when the effects are better known.

Fishbein and Ajzen (1975) discuss inconsistency with various models. The comment is made that intelligent and more educated individuals are likely to be logically consistent and are less likely to exhibit "wishful thinking". In order to see if this was true in this sample, education was crosstabulated with "Pesticide residues are a greater health concern than GMOs to me", and "I would not buy organic food if it contained GMOs". However there was no statistically significant relationship between those variables.

The results of exporters to a similar question are not conclusive, particularly in light of the small sample size: less than half the exporters (42 percent) agreed that international buyers care more about pesticide residues than GMOs, and 37 percent disagreed.

6.5.2 The international organic market

The international market is important for producers of organic food here in New Zealand. Their demands and reactions should be anticipated in order to avoid negative repercussions to the industry. Exporters (and to some extent producers) are presumed to have a good knowledge of their markets. All of the exporters said that international buyers of organic produce want GMO free produce. The exporters also all said that New Zealand's image has a positive impact on organic buyers, and 84 percent said that demand for organic food depends on our image.

From this information, it could be said that if New Zealand's markets for organic food do not want genetically modified food, and these markets form the financial backbone of the organic industry, it would not be wise to allow GMOs into organic food. In addition to this, if New Zealand is perceived to be clean and green and GMO free, it will enhance the image of the country and therefore of the food produced there. If demand for the organic food produced in New Zealand is dependent on our image, it would seem wise not to jeopardise that image. Therefore, unless there is a radical change in the views of international consumers of organic food, there is no future for genetically engineered organic foods. It would be important, if not crucial, to protect organically grown produce from potential cross-contamination. If New Zealand was successful in this while other countries were not, it could prove to be very valuable for our export success.

6.6 Comparisons with Other Studies

One of the objectives of the study was to compare the results obtained from this study with those from similar studies of the general populations. The main questions compared are those relating to consumer support for various applications of the technology.

6.6.1 Consumer support for different applications of the technology.

Questions regarding different applications of biotechnology were included in the Eurobarometer 46.1 survey, and in Macer (1998a), and in the consumer questionnaire of this study. Direct comparison of this sample with that of the general New Zealand population and of the European one on this issue is therefore possible. The other two surveys use slightly different scales (1 - 5), as opposed to this one which uses 1-7, so in order to compare them, all the agree and disagree categories are added together. These questions attempt to gauge

whether public feeling towards the technology is consistent over all applications, or whether some applications have more support than others.

Table 6-1: Risks to society of different applications comparisons

To what extent do you agree or disagree that the following application involves risks for society?			
		%	
Application	**Sample**	**Agree**	**Don't Know**
Using modern biotechnology in the production of foods	European Union	54	9
	NZ general	53	8
	NZ organic	88.1	2.5
Taking genes from plant species and transferring them into crop plants to make them more resistant to insect Pests	European Union	48	14
	NZ general	46	8
	NZ organic	85.7	6.3
Introducing human genes into bacteria to produce Medicines or vaccines	European Union	47	15
	NZ general	46	10
	NZ organic	75.8	13.6
Developing genetically modified animals for Laboratory research studies	European Union	54	12
	NZ general	43	5
	NZ organic	82	6.5
Introducing human genes into animals to produce organs for human transplants	European Union	61	13
	NZ general	71	7
	NZ organic	84.5	6.5

It is clear that the organic sample consistently rates the risk of each application higher than either the general New Zealand sample or the European Union one. While this is consistent with expectations, it should also be borne in mind that both the other surveys were carried out in 1997. Since then there has been significantly more attention paid to the issue by the media, and in Europe particularly, the results would be likely to be considerably different since then. More recent surveys have shown that the European public is highly sceptical of the technology and is very concerned about the risks perceived to be involved.

The results for the organic sample follow a similar trend of the other two samples; they all view the introduction of human genes into bacteria to produce medicines or vaccines as posing the least risk to society. Both the New Zealand and the European Union results indicate that introducing human genes into animals to produce organs for human transplants involve the greatest risk to society, while the organic sample indicates that using modern biotechnology in the production of foods would involve the greatest risk to society. This may have been influenced by the fact that this series of questions is towards the end of the questionnaire, most of which has been dealing with the issue of genetic engineering in food.

The same set of applications were combined with the question "to what extent do you agree or disagree that this application is morally acceptable?". The results from all three surveys are shown in Table 6.2.

Table 6-2: Moral acceptability comparisons.

To what extent do you agree or disagree that this application is morally acceptable?			
		%	
Application	**Sample**	**Agree**	**Don't Know**
Using modern biotechnology in the production of foods	European Union	50	12
	NZ general	64	9
	NZ organic	9.3	7.8
Taking genes from plant species and transferring them into crop plants to make them more resistant to insect Pests	European Union	62	12
	NZ general	68	7
	NZ organic	12.4	11.7
Introducing human genes into bacteria to produce Medicines or vaccines	European Union	70	11
	NZ general	72	7
	NZ organic	20.5	23.9
Developing genetically modified animals for Laboratory research studies	European Union	40	10
	NZ general	45	5
	NZ organic	8.1	5.9
Introducing human genes into animals to produce organs for human transplants	European Union	36	12
	NZ general	31	10
	NZ organic	8.8	8.8

These results show a significant variation between the organic sample and the other samples. While the difference shown between the organic sample and the others is greater than for the risk to society questions, they still display a similar trend: all of the samples indicate that the introduction of human genes into bacteria to produce medicines or viruses, is the most morally acceptable of all the applications. The organic sample indicated developing genetically modified animals for laboratory research studies was the least morally acceptable application, while the other two samples both indicated organs for human transplants was the least morally acceptable. All three samples indicate taking genes from plant species and transferring them into crop plants to make them more resistant to insect pests as the second most morally acceptable technique, with food production as the third.

6.6.2 Reasons for buying organic food

A study was carried out by Wilkins and Hillers (1994) on the influences of pesticide residue and environmental concerns on organic food preference. They conclude that preference for

organic foods is likely to be prompted by a desire to reduce personal risks related to pesticide residue exposure as well as by a desire to support a food production method that is seen as better for the environment. This would be supported by the data from this sample, with the addition of avoidance of GMOs. The majority of respondents in this survey (61percent) agreed in some way that they bought more organic food since hearing about GMOs. However it is suggested that most of them bought organic food anyway.

6.7 Limitations of the Study

There are some limitations associated with the study, particularly in the methodology. These are discussed below.

6.7.1 Bias

Often non-responders are different in crucial respects to responders (e.g. older, lower education) and increasing the sample size does nothing to produce the correct proportions of various groups if some types systematically do not respond (De Vaus 1996). It is difficult with this type of sample (consumers, producers and exporters) to make assumptions about non-responders as there is no larger known population to compare their characteristics with. It is assumed that those who feel more strongly about the topic than others will answer the questionnaire and send it back, and those who are indifferent or less interested are less likely to.

As consumers took the surveys home and did not return them or send them off were simply selected on the basis that they were in the shop at that time, there was no identifying factor to enable a follow-up letter to be sent to them. In one shop (Pico wholefoods in Christchurch) a reminder was put on a blackboard outside the shop, however apart from this there was no method of reminding people to return their surveys.

Finally, the occurrence of potential response bias may account for the significant level of feeling against the use of GMOs in the organic industry.

6.7.1.1 Sampling bias

The consumer surveys were conducted mainly on week days, with only one Saturday. This may potentially have an effect on the results, as the types of people who come in on a

Saturday may be a different part of the population than those who shop during the week. They probably work during the week so Saturday is the only day they can shop, which may mean they have a greater income, perhaps a better job, and possibly different attitudes from those who shop during the week.

6.7.2 Other limitations

Qualitative interviews would have provided more in-depth information on the topic. The results from the questionnaires give a good general picture of the target populations, but do not provide the underlying reasons and feelings. Interviews were not conducted due to time constraints. The results from this study would provide a good background on which to formulate topics for interviews.

6.8 Scope for Further Research

As discussed under limitations, in-depth qualitative interviews would be useful to gain a deeper understanding of the beliefs and attitudes of the organic population. Additionally, it would be useful to interview representatives of the two organic certification agencies in New Zealand, BIO-GRO and Demeter. These people would probably provide a valuable insight into the issue, which was not covered in this survey.

It would be interesting to compare the results from this study with similar results from the general population obtained in the same time period. Comparisons made in this study are with results from surveys that are becoming dated, particularly in light of the dynamic situation.

7 CONCLUSIONS AND RECOMMENDATIONS

The aim of this study was to investigate the future of genetic engineering within the organic industry. The research was based on quantitative surveys of key sectors involved in organic agriculture: producers, exporters and consumers of organic produce. The results clearly show that opposition to genetic engineering is widespread throughout the organic industry. There is unlikely to be any voluntary inclusion of genetic engineering within organic food production, and the consumers indicate they would stop purchasing organic food if it was to contain GMOs. Producers acknowledge threats to organic agriculture from cross-contamination of engineered crops and increased pest-resistance. However, they are not considered significant enough to alter the standards to allow for the potential inclusion of modified genes.

It is recommended that the organic industry takes full advantage of the present situation of consumer unease about food production. Consumers of conventional food may be encouraged to purchase organic food if they are convinced of its GMO-free status.

As the organic industry in New Zealand is a growing export earner, and international consumers do not want GMOs in organic food, it would be very important to ensure that no contamination of organic food occurs. If the New Zealand government does decide to allow the commercial production of genetically engineered crops in New Zealand, strict legislation must be put in place to protect organic agriculture from cross-contamination. Guidelines on aspects such as minimum distances between organic crops and transgenic ones should be ensured. It would not be worthwhile jeopardising the security of this valuable market.

Research into alternative methods of organic pest control would be advisable for the organic industry. In addition, discouragement of genetic engineering that may cause resistance to Bt would is advised. If pests become resistant to the traditional control methods such as Bt, farmers do not want to be left defenceless and with the only options being to use chemicals or genetically engineered crops. Alternatives provide growers with more options and therefore more power.

The Organic Movement has a long history of producing quality food while at the same time ensuring sustainability of the environment and the well being of the entire system. It would be disappointing to see the corruption of the standards against the will of the people involved.

If those concerned with organic agriculture do not want genetic engineering included in the allowable practices, its infiltration through contamination would be devastating for the industry and disrespectful to the underlying philosophy of organic agriculture.

But answer came there none-
And this was scarcely odd because
They'd eaten every one

Through the looking Glass
Lewis Carroll

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APPENDIX ONE: SURVEY INSTRUMENTS

PERCEPTIONS AND ATTITUDES TOWARDS GENETICALLY MODIFIED ORGANISMS (GMOs) WITHIN THE NEW ZEALAND ORGANIC INDUSTRY

CONSUMER SURVEY

This survey is part of a larger study of the organic industry and it's position regarding Genetically Modified Organisms, conducted by a student at Massey University as part of a Masters thesis. Your contribution is a vital source of information to this study, and your assistance is gratefully received. Thank you for taking the time to fill out this questionnaire.

General information (*circle appropriate number*)

1. What age group are you in?

1. less than 20 2. 20 - 30 3. 31 - 40 4. 41 - 50 5. 51 – 60 6. above 60

2. What gender are you? 1. male 2. female

3. What is your income? (*K = $ NZ '000*)

1. less than 20K 2. 20-35K 3. 36-50K 4. 51-65K 5. 66-80K 6. 80K+

4. What is your highest level of education?

1. Secondary school up to 3 years
2. Secondary school for 5 years
3. Some tertiary education
4. University degree
5. Postgraduate degree

5. What is your main occupation?

1. Administration / manager
2. Professional
3. Technician or Associate Professional
4. Clerk
5. Service and Sales
6. Agriculture and Fisheries
7. Trades worker
8. Plant or machine operator or Assembler
9. Homemaker
10. Student
11. Unemployed
12. Retired
13. Other

6. What is your ethnic group?

1. Maori 2. European 3. Pacific Island 4. Asian 5. Other (*please state*) _____

Organic food purchasing habits

7. How many people does your household consist of ? ***(circle the number of your answer)***

1. One 2. Two 3. Three 4. Four 5. Five 6. More than Five

8. Roughly, what percentage of your household's consumption of the following products is organic? ***(tick ✔ appropriate square)***

	Less than 10%	11 – 25%	26 – 50%	51 – 75%	76 – 100%
Fruit (fresh)					
Vegetables (fresh)					
Fruit / vegetables (processed)					
Cereals					
Grains / Pulses					
Rice / Pasta					
Bread					
Prepared foods eg. biscuits, muesli bars etc					
Meat					
Eggs					
Dairy products					
Soy products					
Juices					
Wine					
Other eg. herbs, oils					

Reasons for purchasing organic food

9. From the following list of possible benefits of organic food, indicate the **three that are most important to you:** (***circle three numbers***)

1. Fewer pesticide residues in food
2. Less harmful to the environment
3. Less harmful to farmers
4. Support local growers
5. Does not support chemical industries
6. Does not contain GMOs
7. Nutritionally superior
8. Tastes better
9. Longer lasting
10. Fresher
11. Support the organic industry

10. Rank the following in order of what ***you*** consider to be the three greatest risks to human health (***place number in box; 1 = the greatest risk***)

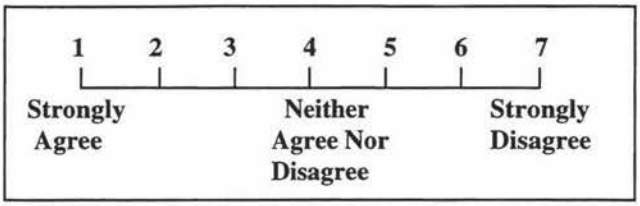
1. Organic food ☐
2. Foods high in saturated fats ☐
3. Foods high in sugar ☐
4. Foods high in cholesterol ☐
5. Genetically modified food ☐
6. Food poisoning ☐
7. Chemical food additives ☐
8. Pesticide residues ☐
9. Other ☐ (*please state*_____)

Using the scale below, please indicate the extent to which you agree with the following statements (***circle the appropriate number***

1	2	3	4	5	6	7
Strongly Agree			**Neither Agree Nor Disagree**			**Strongly Disagree**

11. I have followed the GMO debate closely	1	2	3	4	5	6	7
12. I have a good understanding of the main issues in the GMO debate	1	2	3	4	5	6	7
13. I would be able to explain the concept of GMOs to a friend	1	2	3	4	5	6	7
14. I frequently discuss this issue with other people	1	2	3	4	5	6	7
15. I buy more organic food since I have heard about GMOs	1	2	3	4	5	6	7
16. I believe that organic food is GMO free	1	2	3	4	5	6	7
17. I believe that organic food should not contain GMOs	1	2	3	4	5	6	7
18. I would not buy organic food if it contained GMOs	1	2	3	4	5	6	7
19. If organic food contained GMOs I would grow more of my own food	1	2	3	4	5	6	7
20. Even if GMOs lowered the price of organic food I would not buy it	1	2	3	4	5	6	7
21. I am concerned about the health effects of GMOs	1	2	3	4	5	6	7
22. I am concerned about the environmental effects of GMOs	1	2	3	4	5	6	7
23. I am more concerned about agrichemical use than the impacts of GMOs on the environment	1	2	3	4	5	6	7

Using the following scale, please indicate the extent to which you agree with the following statements (***circle the appropriate number***)



24.	Pesticide residues in food are a greater health concern than GMOs to me	1	2	3	4	5	6	7
25.	Seed companies are too influential	1	2	3	4	5	6	7
26.	The government will listen to my concerns about GMOs in organic food	1	2	3	4	5	6	7
27.	GMOs will affect NZ's 'clean green' image internationally	1	2	3	4	5	6	7
28.	NZ would benefit overall if GMOs were commercially introduced	1	2	3	4	5	6	7
29.	The NZ organic industry could become more competitive by allowing the use of GMOs	1	2	3	4	5	6	7
30.	The New Zealand organic industry is technologically advanced	1	2	3	4	5	6	7
31.	GMOs are compatible with organic agriculture	1	2	3	4	5	6	7
32.	GMOs could be beneficial to the environment	1	2	3	4	5	6	7
33.	The organic industry worldwide will be forced to accept GMOs	1	2	3	4	5	6	7
34.	Using genetic engineering in the production of foods is							
	a. morally acceptable	1	2	3	4	5	6	7
	b. involves risks for society	1	2	3	4	5	6	7
35.	Taking genes from plant species and transferring them into crop plants to make them more resistant to insects is							
	a. morally acceptable	1	2	3	4	5	6	7
	b. involves risks for society	1	2	3	4	5	6	7
36.	Introducing human genes into bacteria to produce medicines or vaccines for example to produce insulin for diabetics is							
	a. morally acceptable	1	2	3	4	5	6	7
	b. involves risks for society	1	2	3	4	5	6	7
37.	Developing genetically modified animals for laboratory research studies is							
	a. morally acceptable	1	2	3	4	5	6	7
	b. involves risks for society	1	2	3	4	5	6	7
38.	Introducing human genes into animals to produce organs for human transplants is							
	a morally acceptable	1	2	3	4	5	6	7
	b. involves risks for society	1	2	3	4	5	6	7

39. If you could be reassured about the safety of GMOs to the environment and to human health, would you be prepared to eat them? (***circle the number of your answer***)

1. yes 2. no

If not, please circle the reason(s) you have for this:

1. Religious beliefs
2. Ethical concerns
3. GMOs are unnecessary
4. Other *Please specify*:_____

40. If you could be reassured about the safety of GMOs to the environment and to human health, would you be prepared to accept them in "*organic*" food?

1. yes 2. no

If not, please circle the number of the reason(s) you have for this:

1. Religious beliefs
2. Ethical concerns
3. Power of multinationals
4. Unnecessary
5. It is against the principles of organics
6. Other *Please specify*: _____

41. Do you have any further comments on this topic?

Anita Wreford
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Palmerston North

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Email: anitawreford@hotmail.com

8 November 1999

Dear Sir/Madam,

As a producer of organic food in New Zealand, you are a source of important information for this survey. I am sending questionnaires to all certified growers and exporters of organic food in New Zealand, in order to determine their feelings towards genetically modified organisms in organic food. Consumers are also being questioned in organic food outlets.

Your assistance is a significant part of my research and I greatly appreciate your taking the time to fill out the questionnaire. If you have any questions or further comments, please do not hesitate to contact me at the above number.

Thank you very much.

Yours faithfully,

Anita Wreford

PERCEPTIONS AND ATTITUDES TOWARDS GENETICALLY MODIFIED ORGANISMS WITHIN THE NEW ZEALAND ORGANIC INDUSTRY

PRODUCER SURVEY

Thank you for taking the time to answer this questionnaire. Your reply will provide valuable information for this study

What is the study about?
The aim is to gain a better understanding of the organic industry and it's position on genetically modified organisms (GMOs). The study aims to determine the views of consumers, producers and exporters of organic products.

Your reply to the study
Enclosed is a **free post** envelope. No stamp is required, simply drop the envelope and completed questionnaire into the mail box.

Confidentiality
The information you provide will be treated confidentially and anonymously, and will only be used for the purposes of this study. A number, not your name, will be used to identify the completed questionnaire.

Who is the researcher?
I am a fifth year Applied Science student at Massey University, studying Natural Resource Management. As part of my degree I am researching a topic for my thesis, of which this survey forms a part.
I would appreciate receiving the completed questionnaire by ***December 1, 1999.***

If you have any questions or further comments please contact either myself or my supervisors at Massey University:

Anita Wreford	phone (06) 356 9099 extn 7040
	email: anitawreford@hotmail.com
Dr. John Holland	phone (06) 350 5565
Dr. Terry Kelly	phone (06) 350 5517

Who are the participants of this study?
The participants are consumers, producers and exporters of organic food in New Zealand.

With thanks,

Anita Wreford
Institute of Natural Resources
Natural Resource Management Group
Massey University

PERCEPTIONS AND ATTITUDES TOWARDS GENETICALLY MODIFIED ORGANISMS (GMOs) WITHIN THE NEW ZEALAND ORGANIC INDUSTRY

PRODUCER SURVEY

Information about the farm

1. What size is your farm?
total _____ ha
effective _____ ha

2. What area is certified organic?
_____ha

3. Which certification agency are you certified with? ***(circle number)***
1 Biogro
2 Demeter

4. How long have you been certified organic? _____years

(Circle the number of your answer)

5. ***Fruit***

i. Do you grow organic fruit on your property? 1. Yes 2. No ***(go to question 6)***

ii. Please specify which organic fruits you grow:
1. Kiwifruit 2. Pipfruit 3. Stonefruit 4. Citrusfruit 5. Other (state)_____

iii. What percentage of the total fruit that you grow is grown organically?

1. less than 10% 2. 11 - 25% 3. 26 - 50% 4. 51 - 75% 5. 76 – 100%

6. ***Vegetables***

i. Do you grow organic vegetables on your property? 1. Yes 2. No ***(go to question 7)***

ii. Please circle the types of vegetables you grow
1. Root Vegetables 2. Corn 3. Peas/ Beans 4. Squash 5. Other (state) _____

iii. What percentage of the total vegetables that you grow are grown organically?

1. less than 10% 2. 11 - 25% 3. 26 - 50% 4. 51 - 75% 5. 76 – 100%

7. ***Meat and Wool***

i. Do you grow meat or wool organically on your property? 1. Yes 2. No ***(go to question 8)***

ii. Please circle the types of animals you farm:
1. Sheep 2. Cattle 3. Deer 4. Pigs 5. Poultry
6. Other_____

iii. What percentage of your total stock are farmed organically?

1. less than 10% 2. 11 - 25% 3. 26 - 50% 4. 51 - 75% 5. 76 – 100%

8. ***Other***

i. Please circle the following products that you produce:

1. Dairy 2. Eggs 3. Grains/Pulses 4. Herbs 5. Honey
6. Flowers 7. Other (state) _____

ii. What percentage of these products are produced organically?

1. less than 10% 2. 11 - 25% 3. 26 - 50% 4. 51 - 75% 5. 76 – 100%

General information ***(circle the number of your answer)***

9. What age group are you in?

1. less than 20 2. 20 - 30 3. 31 – 40 4. 41 – 50 5. 51 – 60 6. above 60

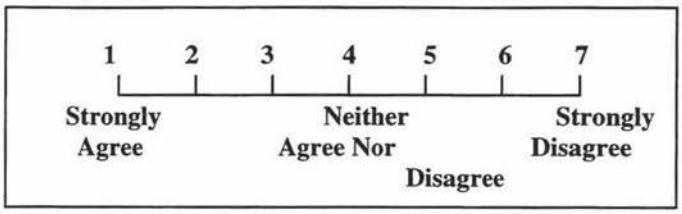
10. What gender are you? 1. male 2. female

11. What is your highest level of education?
1. Secondary school up to 3 years
2. Secondary school for 5 years
3. Some tertiary education
4. University degree
5. Postgraduate degree

12. What is your ethnic group?
1. Maori
2. NZ European
3. European
4. Pacific Island
5. Other (please state)_____

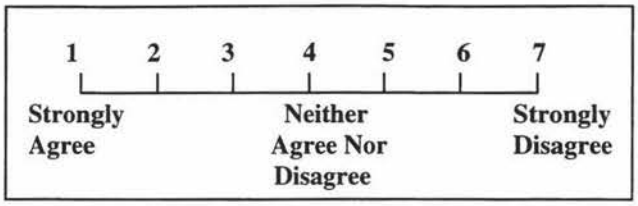
13. What is your income? (K = $NZ '000)
1. less than 20K 2. 20-35K 3. 36-50K 4. 51-65K 5. 66-80K 6. more than 80K

Using the scale below, please indicate the extent to which you agree with the following statements ***(circle the appropriate number)***



14. NZ would lose its 'clean green' image internationally if our organic food contained GMOs	1	2	3	4	5	6	7
15. GMOs would have a positive overall effect on the local organic industry	1	2	3	4	5	6	7
16. International organic associations will accept GMOs	1	2	3	4	5	6	7
17. Organic growers will be forced to accept GMOs	1	2	3	4	5	6	7
18. Demand for organic produce has increased because of publicity about GMOs	1	2	3	4	5	6	7
19. International organic consumers want completely GMO free produce	1	2	3	4	5	6	7
20. International organic consumers care more about pesticide residues than about GMOs	1	2	3	4	5	6	7
21. Consumers buy organic food mainly for health reasons	1	2	3	4	5	6	7
22. Consumers buy organic food mainly for environmental reasons	1	2	3	4	5	6	7
23. GMOs would make the NZ organic industry more competitive	1	2	3	4	5	6	7
24. NZ would benefit overall if GMOs were commercially introduced	1	2	3	4	5	6	7
25. GMOs would lower the production costs for NZ organic farmers	1	2	3	4	5	6	7
26. The NZ organic industry is technologically advanced	1	2	3	4	5	6	7
27. Genetic engineering is an important technological development for the organic industry	1	2	3	4	5	6	7
28. Price is the most important factor for organic consumers	1	2	3	4	5	6	7
29. The environment is the main concern for organic consumers	1	2	3	4	5	6	7
30. Consumers would never accept any environmental damage from the use of GMOs	1	2	3	4	5	6	7
31. GMOs could be compatible with organic agriculture	1	2	3	4	5	6	7
32. GMOs could be beneficial to the environment	1	2	3	4	5	6	7

Using the following scale, please indicate the extent to which you agree with the following statements ***(circle the appropriate number)***



33. The main reason I farm organically is for the economic advantages	1	2	3	4	5	6	7
34. I farm organically mainly for environmental reasons	1	2	3	4	5	6	7
35. The lifestyle is the most important aspect of organic farming for me	1	2	3	4	5	6	7
36. I farm organically because it is better for my health	1	2	3	4	5	6	7
37. The environmental effects of GMOs in NZ concern me	1	2	3	4	5	6	7
38. Cross contamination from GMOs is a large risk for organic farming	1	2	3	4	5	6	7
39. Pest resistance will become more of a problem because of GMOs	1	2	3	4	5	6	7
40. I am concerned that GMOs will harm beneficial insects	1	2	3	4	5	6	7
41. The effects of GMOs on human health concern me	1	2	3	4	5	6	7
42. Genetically modified crops are not vital to feed the world	1	2	3	4	5	6	7
43. Organic farmers should be allowed to use GMOs	1	2	3	4	5	6	7
44. The NZ government should allow the introduction of GMOs	1	2	3	4	5	6	7
45. Consumers expect organic food to be free from GMOs	1	2	3	4	5	6	7
46. If consumers were reassured about the environmental and health safety of GMOs, they would accept them	1	2	3	4	5	6	7
47. NZ organic farmers will have to use genetically modified seeds in future	1	2	3	4	5	6	7
48. Organic farmers do not want to use genetically modified crops	1	2	3	4	5	6	7
49. If I was reassured about the safety of GMOs, I would use them on my farm	1	2	3	4	5	6	7
50. Multinational seed companies are too influential	1	2	3	4	5	6	7
51. It is important for NZ to keep up with developments in genetic engineering	1	2	3	4	5	6	7
52. Altering the genetic structure of organisms is against my religious beliefs	1	2	3	4	5	6	7
53. Genetically modifying crops is not ethically acceptable	1	2	3	4	5	6	7

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4 November 1999

Dear

As an exporter of organic food from New Zealand, you are a source of important information for this survey. I am sending questionnaires to all certified growers and exporters of organic food in New Zealand, in order to determine their feelings towards genetically modified organisms in organic food. Consumers are also being questioned in organic food outlets.

Your assistance is a significant part of my research and I greatly appreciate your taking the time to fill out the questionnaire. If you have any questions or further comments, please do not hesitate to contact me at the above number.

Thank you very much.

Yours faithfully,

Anita Wreford

PERCEPTIONS AND ATTITUDES TOWARDS GENETICALLY MODIFIED ORGANISMS WITHIN THE NEW ZEALAND ORGANIC INDUSTRY

EXPORTER SURVEY

Thank you for taking the time to answer this questionnaire. Your reply will provide valuable information for this study.

What is the study about?

The aim is to gain a better understanding of the organic industry and it's position on genetically modified organisms (GMOs). The study aims to determine the views of consumers, producers and exporters of organic products.

Your reply to the study

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Who is the researcher?

I am a fifth year Applied Science student at Massey University, studying Natural Resource Management. As part of my degree I am researching a topic for my thesis, of which this survey forms a part.
I would appreciate receiving the completed questionnaire by **December 1, 1999**.

If you have any questions or further comments please contact either myself or my supervisors at Massey University:

Anita Wreford	phone (06) 356 9099 extn 7040
	email: anitawreford@hotmail.com
Dr. John Holland	phone (06) 350 5565
Dr. Terry Kelly	phone (06) 350 5517

Who are the participants of this study?

The participants are consumers, producers and exporters of organic food in New Zealand.

With thanks,

Anita Wreford
Institute of Natural Resources
Natural Resource Management Group
Massey University

PERCEPTIONS AND ATTITUDES TOWARDS GENETICALLY MODIFIED ORGANISMS (GMOs) WITHIN THE NEW ZEALAND ORGANIC INDUSTRY.

EXPORTER SURVEY

Export Industry and Markets

(Please circle the number of your answer)

1. ***Fresh Fruit***

i. Do you export organic fresh fruit? 1. Yes 2. No ***(go to question 2)***

ii. Please specify which organic fruits you export:
1. Kiwifruit 2. Pipfruit 3. Stonefruit 4. Citrus fruit 5. Other (state)_____

iii. Roughly, what percentage of your total organic fresh fruit exports go to the following markets? ***(tick ✔ appropriate squares)***

	less than 20%	21-40%	41-60%	61-80%	81-100%
Japan					
Australia					
USA					
EU					
Other					

iv. Do you also export conventionally grown fruit? 1. Yes 2. No ***(go to question 2)***

v. What percentage of your total exports of fresh fruit are *organic*? ***(tick ✔ appropriate squares)***

less than 20%	21-40%	41-60%	61-80%	81-100%

2. *Fresh Vegetables*

i. Do you export organic fresh vegetables? 1. Yes 2. No ***(go to question 3)***

ii. Please specify which organic vegetables you export:
1. Root vegetables 2. Corn 3. Peas / Beans 4. Squash 5. Other (state)_____

iii. Roughly, what percentage of your total organic fresh vegetable exports go to the following markets? ***(tick ✔ appropriate squares)***

	less than 20%	21-40%	41-60%	61-80%	81-100%
Japan					
Australia					
USA					
EU					
Other					

iv. Do you also export conventionally grown fresh vegetables? 1. Yes 2. No ***(go to question 3)***

v. What percentage of your total fresh vegetable exports are *organic*? ***(tick ✔ appropriate squares)***

less than 20%	21-40%	41-60%	61-80%	81-100%

3. *Processed Vegetables*

i. Do you export organic processed vegetables? 1. Yes 2. No ***(go to question 4)***

ii. Please specify which organic processed vegetables you export:
1. Root vegetables 2. Corn 3. Peas/Beans 4. Other (state)_____

iii. Roughly, what percentage of your total organic processed vegetable exports go to the following markets? ***(tick ✔ appropriate squares)***

	less than 20%	21-40%	41-60%	61-80%	81-100%
Japan					
Australia					
USA					
EU					
Other					

iv. Do you also export conventional processed vegetables? 1. Yes 2. No ***(go to question 4)***

v. What percentage of your total processed vegetable exports are *organic*? ***(tick✔appropriate squares)***

less than 20%	21-40%	41-60%	61-80%	81-100%

4. *Meat, Wool and Dairy Products*

i. Do you export organic meat, wool, or dairy products? 1. Yes 2. No ***(go to question 5)***

ii. Please specify which of the following organic animal products you export:
1. Sheepmeat 2. Beef 3. Poultry 4. Pigmeat 5. Venison
6. Dairy products 7. Wool 8. Other (state) _____

iii. Roughly, what percentage of your total organic meat, wool or dairy exports go to the following markets? ***(tick ✔ appropriate squares)***

	less than 20%	21-40%	41-60%	61-80%	81-100%
Japan					
Australia					
USA					
EU					
Other					

iv. Do you also export conventionally grown meat, wool or dairy products?
1. Yes 2. No ***(go to question 5)***

v. What percentage of your total exports of meat, wool or dairy products are *organic*?
(tick ✔ appropriate squares)

less than 20%	21-40%	41-60%	61-80%	81-100%

5. *Other*

i. Do you export any other organic products? 1. Yes 2. No ***(go to question 6)***

ii. Please specify which organic products you export:
1. Babyfood 2. Eggs 3. Grains, pulses and flour 4. Herbs 5. Honey
6. Juice 7. Wine 8. Flowers 9. Other (state)_____

iii. Roughly, what percentage of your total organic exports go to the following markets?
(tick ✔ appropriate squares)

	less than 20%	21-40%	41-60%	61-80%	81-100%
Japan					
Australia					
USA					
EU					
Other					

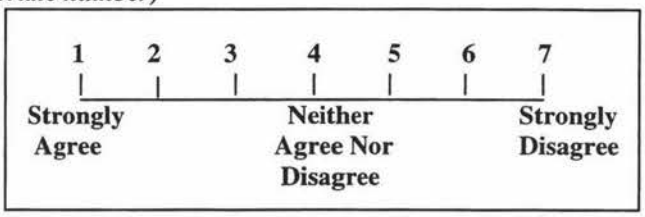
iv. Do you also export these conventionally grown products? 1 Yes 2 No ***(go to question 6)***

v. What percentage of your total exports of these products are *organic*? ***(tick✔appropriate squares)***

less than 20%	21-40%	41-60%	61-80%	81-100%

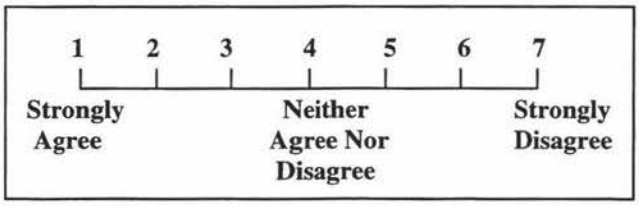
GMOs and the Organics Industry

Using the scale below, please indicate the extent to which you agree with the following statements ***(circle the appropriate number)***



6. NZ organic food has a good international reputation	1	2	3	4	5	6	7
7. NZ is perceived as being 'clean and green'	1	2	3	4	5	6	7
8. NZ would lose its 'clean green' image internationally if it's organic food contained GMOs	1	2	3	4	5	6	7
9. GMOs would have a positive overall effect on the local organic industry	1	2	3	4	5	6	7
10. International organic associations will accept GMOs	1	2	3	4	5	6	7
11. The organic industry will be forced to accept GMOs	1	2	3	4	5	6	7
12. Demand for organic produce has increased because of publicity about GMOs	1	2	3	4	5	6	7
13. International organic buyers want completely GMO free produce	1	2	3	4	5	6	7
14. International organic buyers care more about pesticide residues than about GMOs	1	2	3	4	5	6	7
15. Consumers purchase organic food mainly for health reasons	1	2	3	4	5	6	7
16. GMOs would make the NZ organic industry more competitive	1	2	3	4	5	6	7
17. NZ would benefit if GMOs were commercially introduced	1	2	3	4	5	6	7
18. GMOs would lower the production costs for NZ organic farmers	1	2	3	4	5	6	7
19. Price is the most important factor for organic buyers	1	2	3	4	5	6	7

Using the following scale, please indicate the extent to which you agree with the following statements ***(circle the appropriate number)***

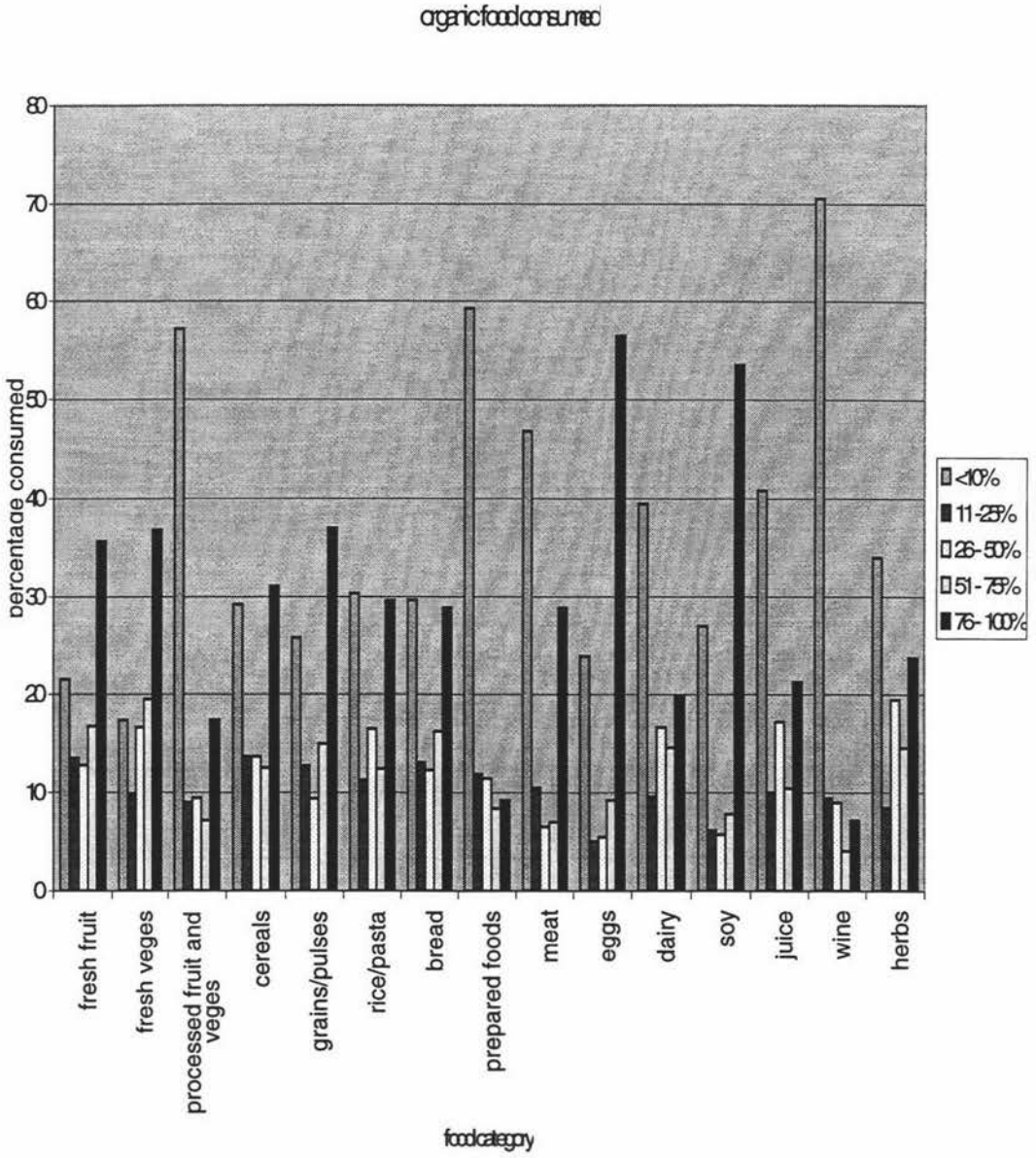


20. The NZ organic industry is technologically advanced	1	2	3	4	5	6	7
21. Genetic engineering is an important technological development for the organic industry	1	2	3	4	5	6	7
22. The environment is the main concern for consumers of organic food	1	2	3	4	5	6	7
23. Consumers would never accept any environmental damage from the use of GMOs	1	2	3	4	5	6	7
24. GMOs could be compatible with organic agriculture	1	2	3	4	5	6	7
25. GMOs could be beneficial to the environment	1	2	3	4	5	6	7
26. NZ's image has a positive impact on organic buyers	1	2	3	4	5	6	7
27. Demand for NZ organic food depends on its image	1	2	3	4	5	6	7
28. Demand for NZ organic food depends on its price	1	2	3	4	5	6	7
29. The NZ organic industry is successful because of good marketing	1	2	3	4	5	6	7
30. The NZ organic industry is robust	1	2	3	4	5	6	7
31. NZ's organic industry is successful due to low production costs	1	2	3	4	5	6	7

32. What do you think would happen if GMOs were found in New Zealand organic export produce?

APPENDIX TWO

Percent organic food consumed for each food type by organic consumers.



APPENDIX THREE

Consumer Likert Scale Responses

	Valid	Missing	Mean	Mode	Std. Deviation
Followed the debate closely	281	4	2.56	1	2.29
Good understanding of issues	280	5	2.49	1	1.41
Able to explain to friend	280	5	2.49	1	1.42
Frequently discuss issue with other people	278	7	2.92	1	1.62
Buy more organic food since hearing about GMOs	278	7	3.10	1	2.13
I believe organic food is GE free	278	7	2.74	1	6.74
Organic food should not contain gmos	281	4	1.24	1	1.00
Would not buy organic food if it contained GMOs	280	5	1.60	1	1.29
If organic food contained GMOs I would grow more of my own food	278	7	2.21	1	1.78
Even if GMOs lowered the price of organic food I would not buy it	280	5	1.82	1	1.75
Concerned about the health effects of GMOs	282	3	1.46	1	1.13
Concerned about the environmental effects of GMOs	282	3	1.38	1	1.19
More concerned about agrichem use than impacts of gmos	274	11	3.56	4	1.84
Pesticide residues are a greater health concern	271	14	3.69	4	1.66
Seed companies are too influential	276	9	2.05	1	1.39
Government will listen to my concerns	272	13	4.46	4	1.80
GMOs will affect NZ's clean green image internationally	279	6	1.73	1	1.42
NZ would benefit overall if GMOs were commercially introduced	279	6	6.22	7	1.49
NZ organic industry would become more competitive by allowing the use of GMOs	278	7	6.14	7	1.56
NZ organic industry is technologically advanced	265	20	3.80	4	1.32
GMOs are compatible with organic agriculture	279	6	6.32	7	1.42

GMOs could be beneficial to the environment	277	8	6.22	7	1.48
the organic industry will be forced to accept GMOs	276	9	5.75	7	1.65
GE in food production is morally acceptable	270	15	6.13	7	1.62
GE in food production involves risks for society	277	8	1.81	1	1.78
making crop plants resistant to insects is morally acceptable	266	19	5.85	7	1.72
making crop plants resistant to insects involves risks for society	272	13	1.79	1	1.58
introducing human genes into bacteria is morally acceptable	268	17	5.15	7	1.96
introducing human genes into bacteria involves risks for society	273	12	2.28	1	1.75
developing gm animals for lab research is morally acceptable	273	12	6.26	7	1.52
developing gm animals for lab research involves risks for society	277	8	2.04	1	1.86
introducing human genes into animals to produce organs for human transplants is morally acceptable	273	12	6.12	7	1.57
introducing human genes into animals involves risks for society	277	8	1.93	1	1.69

Producer Likert Scale Responses

	N Valid	Missing	Mean	Mode	Std. Deviation
lose clean green image	160	3	1.43	1	1.22
positive effect on local organic industry	161	2	6.14	7	1.90
intl associations will accept GMOs	160	3	6.59	7	1.20
growers will be forced to accept	159	4	6.16	7	1.66
organic demand increased	162	1	2.06	1	1.39
international consumers want GMO free produce	160	3	1.43	1	1.17
intl consumers care more about pesticide residues	151	12	4.57	4	1.77
consumers buy organic food for health reasons	160	3	1.88	1	0.99
consumers buy for environmental reasons	160	3	2.89	3	1.37
GMOs would make NZ org industry more competitive	155	8	6.12	7	1.67
NZ would benefit if GMOs were introduced	160	3	6.49	7	1.16
lower production costs	153	10	5.9	7	1.63
NZ industry technologically advanced	160	3	3.99	4	1.62
important technological development	159	4	6.36	7	1.30
price is the most important factor for organic consumers	158	5	5.22	6	1.67
environment is main concern for consumers	157	6	3.32	3	2.76
consumers never accept environmental damage	155	8	2.55	1	1.65
compatible with organic ag	161	2	6.51	7	1.09
beneficial to environment	162	1	6.2	7	1.34
economic advantages	158	5	4.44	7	1.98
farm for environmental reasons	159	4	2.04	1	1.34
lifestyle of organic farming	157	6	2.93	2	1.68
farm organically because it is better for health	159	4	1.99	1	1.32
environmental effects of GMOs in NZ	161	2	1.56	1	1.34
cross contamination is a large risk	161	2	1.48	1	1.29
pest resistance will become greater problem	158	5	2.08	1	1.53

GMOs will harm beneficial insects	161	2	1.73	1	1.28
GMOs on human health	161	2	1.58	1	1.20
not vital to feed the world	161	2	1.69	1	1.44
should be allowed to use GMOs	161	2	6.62	7	1.00
NZ govt should allow introduction of GMOs	162	1	6.64	7	1.07
expect food to be free from GMOs	161	2	1.19	1	0.57
if consumers were reassured they would accept GMOs	154	9	5.37	7	1.76
NZ farmers will have to use GM seeds	159	4	6.43	7	1.23
organic farmers do not want to use gm crops	161	2	1.68	1	1.64
would use them on my farm	158	5	6.38	7	1.33
multinationals too influential	159	4	1.74	1	2.12
important for NZ to keep up with developments	156	7	4.82	7	2.20
against my religious beliefs	154	9	4.26	4	2.04
not ethically acceptable	159	4	2.55	1	1.85

Exporter Likert Scale Responses

	N Valid	Missing	Mean	Mode	Std Deviation.
NZ organic food has good international reputation	19	0	2.16	2	1.30
NZ is perceived as being clean and green	19	0	1.89	1	0.94
NZ would lose clean green image if organic food contained GMOs	19	0	2.05	1	1.61
GMOs would have positive overall effect on local organic industry	19	0	5.74	7	1.97
international organic associations will accept GMOS	19	0	6.37	7	1.42
organic industry will be forced to accept GMOs	19	0	6.00	7	1.86
demand for organic produce has increased because of GMOs	19	0	1.89	1	0.94
international buyers want gm free produce	19	0	1.26	1	0.45
intl organic buyers care more about pesticide residues than GMOs	19	0	4.26	3	1.66
consumers purchase organic food mainly for health reasons	19	0	2.00	1	1.00
GMOs would make the organic industry more competitive	19	0	5.42	7	1.89
NZ would benefit if GMOs were commercially introduced	19	0	5.79	7	1.47
GMOs would lower the production costs for NZ organic farmers	19	0	5.05	7	2.07
price is the most important factor for organic buyers	19	0	5.37	7	1.61
NZ organic industry is technologically advanced	19	0	4.21	3	1.62
GE important technological development for organic industry	19	0	5.42	7	2.06
environment is main concern for consumers of organic food	19	0	3.58	4	1.26
consumers would never accept any environmental damage	19	0	3.00	1	1.76
GMOs could be compatible with organic agriculture	19	0	6.11	7	1.41
GMOs could be beneficial to the environment	19	0	5.00	7	1.83
NZs image has a positive impact on organic buyers	19	0	1.68	2	0.67
demand for NZ organic food depends on its image	19	0	2.11	1	1.10
demand for NZ organic food depends on its price	19	0	3.74	5	1.45
NZ organic industry is successful because of good marketing	19	0	3.95	4	1.39
the NZ organic industry is robust	19	0	4.37	5	1.46
NZ organic industry is successful due to low production costs	18	1	4.78	4	1.22