New Zealand public attitudes towards genetically modified food

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Abstract of a thesis submitted in partial fulfilment of the
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Pastoral farming is the major land use in New Zealand, utilising about 40 per cent of the total land (Statistics New Zealand, 2009). Pastoral Genomics (PG), an industry-good organisation funded by the Ministry of Science and Innovation, DairyNZ, Fonterra, Beef and Lamb, Deer Research and Agresearch, is developing genetically modified (GM) ryegrass with increased biomass, drought tolerance and high sugar levels. PG is conducting field tests in North America in order to gather the data needed for submission of an application to the New Zealand Environmental Risk Management Authority (ERMA- now EPA) for permission for field trials. The purpose of this study was to see if the New Zealand public's attitudes towards GM food were changing, with the aim of understanding if such development will be acceptable to the public and become a commercial reality. The study was carried out using an online survey to track changes in public attitudes and, through the use of focus groups, to gain a deeper understanding of how, why, and if, attitudes were changing. The questionnaire was derived from Small's 2001, 2003, 2005 and 2009 studies. This study found that the NZ public's attitudes towards GM have remained negative. However, there was less opposition to GM food or applications that benefitted human health, compared to just GM food without any human health benefits. The level of opposition also depended on the organism that was being modified. GM animals had less support than GM plants. The implications of the findings of this study were that GM developers needed to engage and reassure the public about the safety of GM.

Keywords: Genetically modified food, public attitudes, pastoral genomics, pasture

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List of Abbreviations

Abbreviations used in this document.

AERU	Agribusiness and Economic Research Unit
ANZFSC	Australia New Zealand Food Standards Council
EPA	Environmental Protection Authority
ERMA	Environmental Risk Management Authority
FAO	Food and Agricultural Organisation
FDA	Food and Drug Administration
FSA	Food Standard Agency
FSANZ	Food Standards Australia and New Zealand
GE	Genetic Engineering
GM	Genetic Modification
GMO	Genetically Modified Organism
HSNO	Hazardous Substances and New Organisms
PG	Pastoral Genomics
PFIB	Pew Initiative on Food and Biotechnology
USA	United States of America

Chapter 1

Introduction

Farming that is now described as organic, was the conventional way of producing food for thousands of years ago. It became unconventional in the 18th century with the advance of industrialisation and the resulting population growth that saw an increased demand for food (Gow, 2009). The introduction of fertilisers, veterinary drugs, agricultural chemicals and, lately, genetic modification, has facilitated increased food production for the urban masses. Globally, an average hectare of arable land supported 2.4 persons in 1960, 4.5 persons in 2005, and will be required to support over six persons by 2050 (FAO, 2006). Thus, pressure will be put on sustainable production of enough safe and healthy food to meet this global demand. Currently, food production is facing serious challenges with land and water shortages, agro-chemicals polluting surface and ground water, and crop susceptibility to pests, diseases and weeds. In response biotech companies are attempting to use advances in biotechnology to genetically modify crops and animals to improve production, reduce use of agro-chemicals, enhance survival and produce a number of potentially useful proteins and vitamins for human consumption (Uzogara, 2000).

Biotechnology means the use or manipulation of living organisms to make or improve products, or develop or enhance processes (Hoban, 2004). It includes established biotechnologies like brewing and recent ones, such as genetic modification (GM). Genetic modification (GM) or genetic engineering (GE) refers to the technique of specifically altering the genetic make-up (DNA) of living organisms so that they are able to make new substances or perform new or different functions (Ministry for the Environment, 2007a). A genetically modified organism (GMO) is a plant, animal or other organism that has its DNA changed using genetic modification (Ministry for the Environment, 2007a). GM involves extracting the desired genes from one organism and inserting them into another. The inserted gene sequence (known as the transgene) may come from another unrelated plant, or from a completely different species. Transgenic Bt cotton, for example, which produces its own insecticide, contains a gene from a bacterium, *Bacillus thuringiensis.* Plants containing transgenes are often called transgenic crops. However, GM does not necessarily mean that a gene from another organism has to be used to create the GMO. GM can mean that the organism's own genes are changed (known as cisgenics)**.** A good example is gene silencing in Canola seed that turns off the activity of genes responsible for the production of unhealthy oils.

Pastoral Genomics (PG) an industry-good research consortium, funded by Fonterra, DairyNZ, Beef and Lamb New Zealand, Deer Research, the Ministry of Science and Innovation and AgResearch, has the goal of using biotechnology for the improvement of forage grasses to benefit New Zealand's pastoral farmers (Sustainability Council of New Zealand, 2011). PG has adopted a research strategy based on enhancing conventional breeding through marker-assisted selection and the use of cisgenics, so that new traits will only be introduced by moving genes from ryegrass into ryegrass and clover genes into clover. Marker-assisted selection uses tools called genetic markers to reveal the exact genes responsible for a particular trait. This lets breeders locate parents that are guaranteed to reproduce the qualities they want. GMOs produced by cisgenics are still considered 'new organisms' under the Hazardous Substance and New Organism (HSNO) Act, but PG believes products developed using cisgenics may be more acceptable to farmers and consumers. PG is hoping to develop a drought tolerant cisgenic ryegrass with increased biomass and sugar content. This will likely be attractive to farmers in New Zealand's North Island and Australia due to recent droughts (Sustainability Council of New Zealand, 2011). A drought tolerant variety has been modified so that a normally dormant gene is switched on during dry conditions, allowing the plants to continue growing well during early drought conditions. PG has been conducting a small field test of drought tolerant ryegrass in North America in order to gather the data needed for submission of an application to ERMA for permission to conduct field trials (Dunahay, 2010).

PGG Wrightson Seeds is another New Zealand company that is actively developing GM forage grasses. These GM grasses are being developed in Victoria, Australia, by Gramina, a joint venture between PGG Wrightson Seeds and the Australian Molecular Plant Breeding Cooperative Research Centre (Sustainability Council of New Zealand, 2011). The company is developing three major products: perennial ryegrass with high levels of sugars, tall fescue, and subtropical grasses with improved digestibility (Pollark, 2003).

1.1 Research context

New Zealand is recognised and admired internationally for its clean green image. In recent years issues of sustainably producing food and food safety have assumed greater significance due to their intrinsic economic importance and the need for long term sustainability. In New Zealand and around the World, GM has received a great deal of political and media attention and it is a topic of public interest. Research done around New Zealand (2001-2009) has shown little or no change in attitudes towards biotechnology (Fairweather, Campbell, Hunt, & Cook (2007), (Small 2001, 2003, 2005 & 2009). Pastoral farming is the major land use in New Zealand using about 40 per cent of total land (Statistics New Zealand, 2009).

Genetic improvement has already enabled NZ farmers to achieve significant gains and GM technology is said to have the potential to further increase these gains. In pastoral agriculture scientists argue GM has the potential to achieve both economic and environmental benefits. Perennial ryegrass has lower energy content as compared to other feed stocks and has relatively high level of protein content compared to its sugars and lipids levels. GM is now being used to develop ryegrass species with high lipid and sugar content levels. If more energy is available to the cows from sugars and lipids, there will be reduced degradation of excess protein by microbes in the rumen. Excess protein is excreted in urine as urea, which can be further broken down to nitrates or converted to nitrogen dioxide, a greenhouse gas. The environmental gains will include reduction in nitrogen leaching, 10% reduction in methane gas emission, 17% reduction in nitrogen dioxide emission. The species will also have increased growth rates of 25 to 50% with a 10% increase in metabolisable energy, an estimated increase of 6-12% for dairy milk solids (Bryan 2015).

The main goal of my research was to establish trends in public attitudes towards GM, to help to gauge the future of GM pasture in New Zealand. The research aim was to highlight how the current GM pasture research and development was likely to be accepted by the public and its likelihood for commercial application in the near future. Research undertaken around the world has, so far, shown that public attitudes differ sharply both between and within countries and continents and are changing over time (Hoban, 2004). Understanding the New Zealand public's attitudes and changing trends towards GM will provide valuable information to policy makers, scientists and biotech agribusiness companies.

1.2 Scope and research questions

This study was built upon previous work done by Small, in 2001, 2003, 2005 and 2009, looking at trends in the New Zealand public's attitudes towards GM food. The aim of the study is to determine the current New Zealand public attitude towards GM food, and to compare and track changes in attitudes over 2001, 2003, 2005, 2009 and 2013.

The main goal of the study will be achieved by answering three specific research questions:

1. Are attitudes towards GM food changing?
2. How are the attitudes changing?
3. Why are the attitudes changing?

Chapter 2

Literature review

2.1 Introduction

This chapter explores previous research undertaken on consumer attitudes towards GM food and develops a framework to analyse and compare that research with the current study. The chapter is divided into two major parts: 1) global trends on attitudes and consumer issues about GM; and 2) trends about attitudes and consumer issues with GM that are specific to NZ. GM has been an area of great controversy. While developers have highlighted potential benefits, consumers are still sceptical about the benefits. The greatest concern is about ethical and moral values, and environmental, human and animal health risks.

2.2 Global trends in perception of genetically modified food

2.2.1 Europe

A Euro barometer poll, undertaken by the European Commission, polled an EU-wide sample of 25,000 people, around 1,000 from each member state. The survey found that trends in optimism for biotechnology have been on a continual increase in recent years. For example, figures for those optimistic in the United Kingdom have shot up enormously, from 17 per cent, in 2002, to 50 percent, in 2005. The Euro barometer concludes that Europeans are as supportive of biotechnology as their US and Canadian counterparts (Gaskell, 2005).

The following 2010 Eurobarometer survey found that Europeans are focusing more on safety and usefulness of GM technology and alternatives with more acceptable ethical-moral implications. In the survey support for GM in general was 27% among those who expressed an opinion. However transgenic and cisgenic apples with attributes that included limited use of pesticides had 37% and 55% respectively. The results showed that consumers look at GM food safety and environmental benefits and are making rational decisions (Gaskell, 2010).

In March 2014, the British Department for Environment and Rural Affairs granted permission for Rothamsted Research Station to grow plants enhanced with the same omega-3 fatty acids found in fish oil in a decision branded as a milestone by scientists (Knapton 2014). Although omega-3 is often described as fish oil it is, in fact, made by microscopic marine algae that are eaten or absorbed by fish (Knapton 2014). The Rothamsted scientists have copied and synthesized the genes from the algae and then spliced them into a plant called *Camelia sativa*, known as 'false flax', which is widely grown for its seed oil. The crop is among the first 'nutraceuticals' generation, plants whose structure has

been altered to boost dietary supplements. The plant oil will be fed to fish such as farmed salmon, to boost their uptake, but it could eventually be used in oils and spreads, such as margarine. However, anti-GM critics claim that omega-3 fish oils have been implicated in raising the risk of prostate cancer and it is not clear whether GM-derived fish oils will be safe for human and animal consumption.

2.2.2 **United States of America**

Surveys conducted on behalf of the Pew Initiative on Food and Biotechnology (PIFB), from 2001 to 2006, resulted in six key findings:

1) Public knowledge and understanding of biotechnology remains relatively low

2) Consumers know little about the extent to which their foods include GM ingredients

3) While support for GM foods has been stable, opposition has softened and opinions on safety remain split

4) GM animals have much stronger opposition than do modifications of plants

5) Consumers look to those closest to them – especially friends and loved ones – as trusted sources of information on GM foods and biotechnology

6) While religious belief has some impact, it is not a key source of variation in public attitudes toward biotechnology.

2.2.3 **Japan**

Support for biotechnology in Japan has declined (1997 and 2000 polls), although it remains higher than in the US or Europe. The 2000 survey of the Japanese population reveals waning support for biotechnology and GM, in particular. Although a majority of people remain optimistic about biotechnology and its uses, a growing number of people feel that the risks associated with agricultural applications, and even environmental and health applications, are becoming increasingly unacceptable (Macer & Chen, 2000).

2.2.4 **China**

A consumer survey was conducted in August 2002. Consumers surveyed reported that they had little or no knowledge of biotechnology. Their attitudes toward GM foods were generally positive, especially for GM foods with product-enhancing attributes (Quan, Curtis, McCluskey & Wahl, 2002). Although China has had a strong commitment to biotech research since the early 1990s (Gale, Lin, Lomar, & Tuan, 2000), the country has imposed a regulation - *Regulation on the Safety*

Administration of Agricultural GM Organisms (published on 6 June 2001) - that requires all GM products entering China, for research, production or processing, to have safety certificates from the Chinese Ministry of Agriculture to ensure that they are safe for human consumption, animals and the environment. As of 20 March 2002, labelling is required by the Chinese Ministry of Agriculture's *Regulations on Labelling Agricultural GM Biological Products.* Implementation of these regulations has been widely reported in China's state-run media. Past experience in Chinese-biased media coverage requires us to take this statement with caution. There have been serious food safety concerns about China that have been played down in China, but well reported elsewhere; for example, the Fonterra Chinese melamine milk contamination scandal in 2008.

2.2.5 **Australia**

In Australia, attitudes towards GM in food and agriculture are less positive than attitudes towards GM in health and medicine. Many people tend to associate GM crops with commercial objectives. The public has shown great support for the development of GM crops that could contribute to humanitarian or environmental objectives. Survey results indicated significant increases in both awareness of and support for GM food crops since 2005(Mohr, Harrison, Wilson, Baghust & Syrette, 2007).

A minority remains strongly opposed to GM food crops, in particular. Their resistance is associated with a number of attitudes and beliefs, including a belief in natural farming practices; opposition to big business and the globalization of commercial agriculture; opposition to the release of unnaturally modified organisms into the ecosystem and health concerns about GM in the food chain. There is more opposition to GM animal products (Mohr, Harrison, Wilson, Baghust & Syrette, 2007) than GM plant products.

There was also a widespread misconception that GM foods are widely prevalent in the Australian food supply system, as well as an associated assumption and concern that GM products are not labelled as they should be and that consumers are being misled into buying GM inadvertently. Support is especially strong for GM biofuel crops, with people readily associating such crops with the looming fuel crisis and the need to combat global warming (Mohr et al, 2007).

2.2.6 **Trends in New Zealand**

The data from the research done by Small (2009), which included comparisons with surveys conducted by Small, in 2001, 2003 and 2005, indicated that NZ public's perceptions of GM have remained moderately stable, with little volatility over the period from 2001 to 2009. There was a significant increase in positive perceptions between 2001-03, another slight increase in positive perceptions between 2003-05 and an increase in negative perceptions between 2005-09 (back to

levels similar to 2003), although attitudes were still more positive in 2009 than in 2001. In general, the majority of the public have negative moral concerns regarding GM technology, concerns about the possible negative environmental impacts coupled with a degree of uncertainty about the technology. Nonetheless, the majority of the public consider that GM may have potential benefits and that both GM medicine and food are acceptable under some circumstances. Support for GM medicine is significantly greater than support for GM food (Small, 2009). One of the main arguments often raised in NZ when discussing GM is the possible detrimental effect GM could have on NZ's international image of being clean and green (Small, Wilson, & Parminter, 2002). NZ has managed to build a brand around its natural endowment, the clean green image. Both the tourism industry and exporters of NZ produce rely heavily on this international perception (Coyle & Fairweather, 2005).

The principal concerns of New Zealanders involve the concept of "interfering with nature" and the risks associated with the research and the release of new organisms into the environment. The Maori perspective is in many ways similar to the stewardship role of environmentalists but they also have deeply-held spiritual feelings for living things and the land (Roberts & Fairweather, 2004).

The Agribusiness and Economics Research Unit (AERU), which operates from Lincoln University, also undertook a series of reports with the aim of examining the perceptions and attitudes of the New Zealand public towards biotechnology by tracking change in its acceptability over time (2002-2006), and investigating reactions to possible new developments in biotechnology.

The first series of the study was carried out in 2002 with 115 participants from 11 focus groups, aimed at gathering the views and thoughts of New Zealanders about biotechnology. The study resulted in two reports that explored attitudes and values about medical, agricultural and environmental biotechnologies. The first report, by Coyle, Maslin, Fairweather & Hunt (2003), showed that the clean green image and the spirituality of the people was very significant in people's acceptance of biotechnology. New Zealanders are proud of their clean green image and anything that tarnishes this image faces backlash.

The second report, by Hunt, Fairweather & Coyle (2003), highlighted that advances in GM technology were perceived as not natural and, therefore, did not have much support.

Cook, Fairweather, Satterfield & Hunt, (2004) showed that over half the respondents were either concerned or very concerned about biotechnology and the use of GMOs in agriculture. Medical uses of biotechnology were more acceptable than agricultural uses, and biotechnologies that involved genetic modification were less acceptable. Concerns about GM included concerns about the cross contamination of seeds and possible negative impacts on exports. Aligned to this were the beliefs that it is wrong to eat GM food and wrong to mix plant and animal material.

The research continued with a national survey of New Zealanders' reactions (Cook & Fairweather, 2005). This survey concentrated on explaining the role emotions play on reactions to GM risks. The survey also had the objective of determining the amount of change over time in attitudes towards biotechnology. The estimation of change over time was based on a comparison with the previous national surveys. The main findings were that public reactions to biotechnology involved both affective and rational considerations. It was also found that beliefs about the protection of nature corresponded with a tendency to reject biotechnology. These two main findings were important because, together with evidence of a small positive shift in public attitude, the findings showed most New Zealanders have not changed their minds about biotechnology. AERU research shows that ethical/moral issues, spirituality and multiple perceptions of nature and New Zealand's clean green image are the key factors affecting New Zealand's negative consumer attitudes towards GM food. Around the globe, there is a commonly-held fear by many people that GM plants can cross pollinate with the wild plant population thereby resulting in the uncontrollable spread of the transformed gene throughout the plant population (Lassen et al., 2002; Snow & MorÃ¡n, 1997). By engineering crops with disease resistance and pest resistance one gives them an added competitive advantage to survive in nature. Another concern of environmentalists about GM crops is that, even if there is no risk of cross pollination with wild populations, GM crops may still become predominant in nature as they out compete their wild counterparts. An Australian farmer visiting New Zealand has described a nightmare caused by GM contamination. As a result of the contamination, this farmer had to change his canola crop rotation, herbicide regime and marketing as he was no longer confident that his farm was GM-free (Cronshaw, 2012).

In New Zealand, use of GM products is mainly through direct consumption of valuable components, such as insulin. No GM crops are grown commercially in New Zealand (Ministry for the Environment, 2007). No GM fresh fruit, vegetables or meat are sold in New Zealand. Some processed foods may contain approved GM ingredients that have been imported; a good example is the soy-based products derived from GM soya beans. These foods can be sold in New Zealand only if they have been assessed for safety by Food Standards Australia New Zealand (FSANZ) and approved by the Australia New Zealand Foods Standards Council (ANZFSC), a council of Australian and New Zealand Health Ministers. The main imported GM crops grown overseas are soybeans, canola, maize and cotton. The main processed products are soybean paste, canola oil and cottonseed oil. In Australia, food products from six GM commodities, derived from soybean, canola, corn, potato, sugar beet and cotton, may be in Australian supermarkets. Of these, only GM cotton and canola are grown domestically in Australia (Ministry for the Environment, 2007a). Even though New Zealand does not produce GM food commercially, approved experiments on GM plants and animals are being carried out in confined experimental stations (Ministry for the Environment, 2007a).

2.3 Consumer attitudes and perceptions

Costa-Font, et al (2007) argued that attitudes towards GM food are formed by a complex decision making process driven by three main dimensions: risk, benefit perceptions associated with GM food, and individual values and attributes. The individual attributes affecting consumer attitudes are age, level of education, present knowledge of GM technology, cultural background and religion. Hossain, Onyango, Adelaja, Schilling & Hallman *(*2002) also found that factors such as age, gender, education, political views, consumers' habits and income, were significantly related to consumer perceptions of food biotechnology. Consumer attitudes and their consequent acceptance of a GM technology have also been shown to depend on the purpose it is used for (Loureiro & Bugbee, 2005). Medical applications of GM are supported, whereas food applications are not as they are characterised as not useful and risky (Loureiro & Bugbee, 2005). Although some consumers appear to prefer GM products to be associated with a benefit that benefit does not necessarily imply a willingness to pay a premium for the product (Costa-Font et al, 2007). Perceived risks associated with GM food products appear to have a negative impact on consumers' willingness to accept it. Frewer, Scholderer & Brendahl (2003) argued that much of the controversy results from the failure of the relevant regulatory bodies to take full account of the concerns of the public and, hence, the public's distrust of regulators, science and industry. Costa-Font & Mossialos (2005a) highlighted that incomplete information may lead individuals to thinking the technology was not under their control, which might, in turn, exaggerate the risk perceptions.

Hunt, Fairweather & Coyle (2003) conducted a study on public perceptions of biotechnology. Eleven focus groups were conducted throughout New Zealand. Participants were asked to rank for acceptability five different exemplars of biotechnology:

- A treatment of sheep to reduce their methane emission using a GM bacterium-containing device for methane reduction in a sheep's stomach.
- A throat lozenge that placed beneficial bacteria in the mouth.
- A potato that was genetically modified, by the addition of a synthetic toad gene, to resist potato rot.
- The use of stem cells from embryos to treat Alzheimer's disease, the most common form of dementia.
- The use of a genetically modified bacterium to break down DDT residue in the soil.

Forty-three per cent of the participants ranked the throat lozenge as the most appropriate GM technology, followed by stem cells for Alzheimer's disease (26%), the reduction of methane production in sheep (26%), GM bacteria to clean up DDT (24%) and the toad gene in potato (6%). Participants did not see GM and other forms of biotechnology as being risk free. They were worried about the balance between cost and benefits. Participants could see the benefits that would come from GM but were also aware of, and concerned about, the possible risks it posed. Fears were centred about the risk of GM getting out of control and creating an unforeseen problem. Participants wondered what their children would say about the decisions they made now. Participants were more concerned about what might go wrong than who would be liable if it did go wrong. Most participants felt that when something did go wrong they would pick up the cost in monetary and health terms, both individually or through taxation. Participants wanted to find out more specific details about the GM technology. How was it made? What was it made of? Then, they wanted to know the reasons for having this GM technology. Why had the researchers become interested in it? What was its purpose? Who was going to benefit from it? Who was paying for it to be researched and developed? They wanted to know what research had been done on the risks surrounding it and who had undertaken this research.

2.4 Consumers purchasing decisions

In Australia, James & Burton (2004) argued that food purchasing decisions were considered to be a result of constrained choices. Consumers buy goods on the basis of the conditions under which they are offered. The argument was that the decisions were based on factors, such as the price relative to non-GM food, and any ethical and environmental factors associated with production of the food. In addition, the individual characteristics of the consumers themselves may influence the decision about whether to buy GM food or not. In their survey, respondents were not asked to report how much they preferred the alternatives, nor even how much they valued individual changes in an attribute; they were merely asked to identify which of a number of options they preferred. For example, the form of technology used to produce food (conventional or GM) and the size of the weekly food bill for the individual. In selecting between these two options the respondent was, essentially, being asked to compare the reduced food bill with a change in technology. The experiment followed a "main effects" design leading to 28 choice sets, each containing three options or "food baskets". Each choice set contained one basket, A, representing the *status quo*, defined as no change in the weekly food bill, level of chemical use, environmental risks or health risks while using conventional technology. The other two food baskets, B and C, were labelled according to the proportion of GM foods in that basket and contained different values for the other attributes, according to which choice set was generated. In addition to the choice sets, each survey contained two open-ended questions asking respondents to indicate how much they would be willing to pay

per week to, first, reduce their risk of food poisoning and, second, to guarantee their food was free of GM.

The results indicated that higher food bills and increased health risks both reduced utility and, hence, reduced the probability of an option being selected. The risk of gene transfer into the broader environment was seen to reduce utility. Reduced chemical use was favoured, while increased use reduced the probability of an option being chosen. Gender and age were the only socio-economic characteristics found to be significant determinants of attitudes towards GM technology. Foods containing GM using animal genes were resisted more by consumers than foods modified using only plant genes, a result that was also consistent with previous findings. GM medicine was regarded as acceptable because its development was responding to human needs (Marris, Wynne, Simmons & Weldon, 2001). Costa-Font, Gil & Traill (2007) highlighted that attitudes towards GM food were directly related to intentions towards GM, although people's/consumers' final actions were influenced by other elements, such as price.

2.5 Consumer's behaviour at the point of sale

Although consumer attitudes towards the concept of GM have been widely reported to be negative, research has shown that these attitudes sometimes do not translate directly into negative purchasing behaviour (Gaskell, et al., 2003). Even in the UK, where antagonism towards GM foods has been intense and highly vocal, huge amounts of clearly labelled tomato paste have been sold since its introduction in 1996 (Halford & Shewry, 2000). This product, made from GM slow ripening tomatoes, has a clear consumer benefit in that it was cheaper than its non-GM competitors and was of a thicker consistency (Halford & Shewry, 2000). Studies undertaken in France (2003) and the UK (2004) showed that a significant proportion (up to 50 per cent) of consumers may, in fact, be willing to buy GM foods if they were sufficiently discounted (Moon and Balasubramanian, 2003, Noussair, Robin & Ruffieux, 2004).

Mather, Knight & Insch (2011) found that consumers do not necessarily act in the way they say they will. People who say they would not buy GM foods when surveyed may, indeed, buy GM foods in real life. In one experiment, street side fruit stalls were set up in Belgium, France, Germany, New Zealand, Sweden and the UK, selling strawberries, grapes and cherries clearly displaying three different labels: "organic, Bio grow certified"; "low residue, local designation" and "100 per cent spray-free GM". If customers asked about the GM fruits, the vendors explained that they contained genes that made them produce their own natural insecticide. In reality, all the fruits were of the same local, low-spray non-GM varieties. In the hypothetical paper survey experiment, fruits labelled 'organic' were priced 15 per cent higher than market value and 'GM' fruits were discounted by 15 per cent. The most popular choice reported for New Zealander and Swedish customers was organic. However, at the

actual fruit stalls, GM-labelled fruit was most popular. German customers indicated in the survey that they preferred low residue fruit (priced at market value), but were also most likely to buy GM-labelled fruit at the stalls. Using the same pricing structure, GM-labelled fruit was the most, or second most, popular choice in three out of the five European countries' fruit stalls, despite GM being the least popular choice given in surveys in each country when all prices were set at market value. The problem with this approach is that it does not reflect attitudes towards the product. Consumers could be purchasing because for economic reasons, but once their financial situation changed they might not purchase again.

2.6 Issues with GM in New Zealand

New Zealand is recognised and admired internationally for its clean green image (Ministry for the Environment, 2007). In recent years issues about sustainably producing food, and food safety, have assumed greater significance due to their intrinsic economic importance and the need for long term sustainability. In New Zealand, and around the world, GM has received a great deal of political and media attention and it was a topic of public interest. Research carried out in different places around New Zealand (2001-2009) has shown little or no change in attitudes towards biotechnology (Fairweather, Campbell, Hunt, & Cook (2007), (Small 2001, 2003, 2005 & 2009). Public perceptions and attitudes have been based upon uncertainties surrounding the technology, lack of information, distrust of scientists, conflicting opinions and questionable ethics (Costa-Font & Mossialos, 2007b).

2.6.1 **Uncertainty**

New Zealand benefits from its geographic isolation that keeps out many agricultural pests and diseases. The country enforces strict biosecurity laws on its borders. Having evolved in isolation, New Zealand's many unique species of flora and fauna have been shown to be highly vulnerable to invasive pests. The first explorers and settlers brought exotic animal and plant species with them into the country. Today, New Zealand struggles to control a host of exotics species, such as the Australian possum, which spreads bovine tuberculosis and devours native plants; the varroa mite, which afflicts bees; the painted apple moth, which attacks plantation forests; and weeds such as broom, gorse, kikuyu grass and thistle (Dunahay, 2010). Also, after World War 2, DDT was used extensively in New Zealand to control an endemic pasture pest, the grass grub. In 1970 DDT was banned because its residues persisted in the soil. This has restricted the conversion of contaminated land for dairy production. A chemical that was welcomed in 1950s has been seen to produce problems that the following generations have had to deal with (Ministry for the Environment, 2007b). It is for this reason that New Zealand public is uncertain about the risks and benefits of GM technology. The creation of genetically modified organisms can lead to negative environmental impacts that might not be foreseeable now. Potential dangers included: unintended transfer of transgenes through

cross-pollination, the spread of pest resistance or herbicide tolerance to the wild, unknown effects on other organisms (for example, soil microbes) and loss of flora and fauna biodiversity.

2.6.2 **Conflicting opinions**

There are some discrepancies in information flow. Consumers believe GM producers stress the benefits of GM, but are reluctant to talk about risks and dangers (Small, Wilson & Parminter, 2002). New Zealand scientists recently reported their breakthrough in producing a GM cow that did not produce beta-lactoglobulin, a milk protein that causes allergic reactions in infants (Morton, 2012). There was a mixed reaction from the public to this; some hailed it as a good development, including New Zealand Federated Farmers (Perry & Ikin, 2012), some described it as a worrying development; also that transgenic cow was born without a tail. The public reactions pointed to genetic manipulation, but the scientists concerned ruled out the defect being due to genetic manipulation.

2.6.3 **Distrust**

There is a perceived lack of regulations and objective information available to consumers. Supporters for GM technology maintain that it is safe and will sustain food security around the world as the population increases*. Science cannot declare any technology completely risk free. Genetically engineered crops can reduce some environmental risks associated with conventional agriculture, but will also introduce new challenges that must be addressed. Society will have to decide when and where genetic engineering is safe enough (FAO, 2004, p.76).* The New Zealand public has shown mixed reactions not only to imported GM food but also to confined trials. On April 30, 2012, hundreds of GM trees were destroyed at the Crown Research Institute Scion site near Rotorua. The field trial site contained 375 radiata pine trees planted in 2010 following approval from ERMA, now the Environmental Protection Authority (EPA). The same site had 19 GM pine trees destroyed in a sabotage attack in 2008. The trees were destroyed in protest against the planting GM of plants in New Zealand. The main reason for the sabotage was the fear that some of the GM plants might escape into the wild. In another scenario that increases distrust, one of the largest biotech food companies, Monsanto, sells a GM bovine growth hormone which increases milk production by 15 per cent. Use of this GM hormone is banned in Europe and Canada. Health Canada claims that cows injected with this bovine growth hormone show high levels of insulin growth factor 1, a tumour-inducing substance. The Food and Drug Administration of the United States of America (FDA) claims that the hormone is safe for cows and humans. A long term study on the possible toxicity of the growth hormone has yet to be conducted. Distrust in scientific opinions about animals injected with the hormone has led many consumers in the USA switching to organic milk (Wang, 2012).

In its 2001 report, the Royal Commission on Genetic Modification, recommended that being GM-free is not an option; but New Zealand needs to proceed with caution (Eichelbaum, Allan, Fleming & Randerson, 2001). The Commission's report showed that 92 per cent of the respondents were opposed to GM, and 64.8 per cent could be categorised as "strongly against." Among the minority who noted some benefits of GM, most favoured contained use in the laboratory, primarily for medical uses. There was little support expressed for GM in food, plants or animals. Those who addressed economic issues usually saw New Zealand's economic future as being in organic and GM-free production, with 71.1 per cent saying they believed New Zealand would gain substantial competitive advantage from avoiding GM and developing its organic sectors.

2.6.4 **Lack of information**

The lack of information on food labels suggests a perceived lack of choice and control over GM food. According to the Australia New Zealand Foods Standards Council (ANZFSC), a GM ingredient does not have to be listed on the label (Ministry for the Environment, 2007a, para.5) when:

1. It is flavouring in the food and makes up less than 0.1 per cent of that food.

2. An ingredient unintentionally contains GM material at levels lower than 1 per cent of that ingredient.

3. When food has been processed to remove all GM DNA or protein, and does not have altered characteristics, the food does not need to be labelled as GM. A good example is canola oil. Meat and other products from animals that have been fed GM feed are not labelled as GM either. There are no labelling requirements for foods prepared in restaurants, as takeaways or at supermarkets.

2.6.5 **Ethics**

Critics of GM sometimes make arguments on ethical grounds. For example, some people feel it is unnatural or wrong to introduce the genes of animals into plants or from one plant to another, which may be likened to "playing God." In addition, animals used in GM procedures may be subjected to pain and stress. Some of the New Zealand public thinks GM food impacts negatively on New Zealand's clean green image (Small, Wilson & Parminter, 2002). Also, the idea of biotech companies creating and owning an organism is not accepted in many societies.

2.7 Summary

The full benefits and successes of GM food technology are only likely to be realised if consumers and food manufacturers considered it is safe and beneficial. GM has received a great deal of political and media attention and is a topic of public interest. However, attitudes towards GM have been cautious worldwide. Consumers are generally concerned with the risk and moral aspects of GM. The biggest concern is about the risks to the environment and human and animal health. Research carried out around the world has, so far, shown that public attitudes differ sharply both between and within countries and continents and are evolving over time (Hoban, 2004). The last study by Small was in 2009; it is high time to do another one to coincide with the current development of GM pasture. The largest benefit from this study will be to ascertain if there have been any trends in attitude change towards GM and how that fits with current GM developments.

Chapter 3

Methods

3.1 Introduction

This chapter covers the research methods that were used to answer the three key research questions:

1. Are attitudes towards GM food changing?
2. How are the attitudes changing?
3. Why are the attitudes changing?

This section outlines the strategies and tools employed in creating the questionnaire, sampling, data collection, conducting focus groups and statistical analysis.

3.2 Questionnaire survey

A questionnaire survey was adopted to establish the current attitudes towards GM food. An online survey was chosen over a postal survey as data collection was instantaneous because the results were automatically sorted by the program. This saved considerable time and money by eliminating the cost of posting a survey, as well as the cost of paper needed and the labour required. Data entry was eliminated and a researcher can quickly view the results of the survey and go directly to the data analysis. The questionnaire was derived from the questionnaires used by Small, in the 2001, 2003, 2005 and 2009 studies.

A questionnaire is an important tool in public opinion research where a representative number of people are asked to answer the same questions then a judgment can be made about what people think. Information generated can be used to plot trends and changes in public perceptions about a subject (Malhotra, 2006). The questions asked are standardised and, therefore, a questionnaire can be replicated to check for reliability. This meant that a second survey can repeat the questionnaire to check for reliability and consistency (Malhotra, 2006). If the results were consistent then the survey can be seen to be reliable and accurate. A survey was an effective instrument as it can produce: (a) quantitative data (numbers); or (b) qualitative data (statements of feelings/ thoughts) (Lydeard, 1991). However, questionnaires tended not to reveal the underlying reasons for the responses, why and how a person gave that response; hence, focus groups were used as a follow up to the survey.

The questionnaire for Small's 2009 study was used as a template for the 2013 study. One new question was added in the 2013 survey which measured respondents' familiarity with GM. Three

questions from 2009 were excluded in 2013. These questions measured what gender did most grocery shopping and respondents' concern about heart diseases and gastroenteritis, either to themselves or their family. These questions were not believed to provide any valuable information for this study.

Questionnaires were posted online to randomly-selected households in New Zealand using the Smile City online database. In 2009, Small also used the Smile City database. Smile City is one of the largest market research panels in New Zealand, with a current active panel of 247,675 (Smile City, 2013). The panel has been recruited from a wide range of offline and online media. Individuals were randomly selected from within quota groups that were already balanced by the company or, alternatively, from distribution percentages provided by the clients. Deployment and invitation to participate in the 2013 survey was based on a pre-defined stratification of the sample that enabled a fair representation of New Zealand population based on 2013 census information.

The 2013 questionnaire was split into four main sections: background information, general attitudes to GM, product-specific attitudes to GM, and attitudes towards within species (cisgenic) GM and across species (transgenic) GM.

3.2.1 **Background Information**

The background information (Qn1-10) covered demographics about the respondent's characteristics, such as age, educational level, geographic location (rural or urban), religion and ethnicity. These demographic characteristics can have an influence on attitudes towards GM. Comparing demographic and socioeconomic distributions over years, 2001, 2003, 2005, 2009 and 2013, will help explain if changes in the attitudes observed in the data across the years were, or were not, a result of variations in the sample.

3.2.2 **General attitudes towards GM**

In these questions, participants were asked to record their agreement with preconceived general statements about GM. At the beginning of this section the term genetic modification was defined as well as its potential and current applications. This section was sub-divided into two sections.
The first sub-section (Qn11-15) was concerned with support or opposition to the use of GM for particular applications and past experiences with GM technology. Here, participants were asked to tick the box of the answer that best described their feelings.

The second sub-section (Qn16-53) measured attitudes towards GM using a Likert scale ranging from 1 to 5 with 1 being “strongly agree” and 5 being “strongly disagree.” The optional answer, “don’t know” was included; this was appropriate for participants who could have been unsure or did not have enough information to satisfactorily answer the question. This helped with obtaining accurate responses as participants who didn’t know or were unsure may have felt obligated to select another category resulting in a misrepresentation of the results.

3.2.3 Product-specific attitudes to GM

This section measured the attitudes of participants to specific GM products. This section is further divided into three sub-sections: GM milk, GM pasture, products from animals fed on GM pasture.

3.2.4 GM milk product

In the first sub-section (Qn54-71) attitudes towards a hypothetical GM milk product were measured. At the beginning of this section the milk product was described. This description included the benefits of the milk product and how it worked. Answers were measured on a 1 to 5 Likert Scale with the additional “don’t know” option.

3.2.5 GM pasture

The second sub-section (Qn72-85) concerned attitudes towards GM pasture. It comprised two parts: thoughts on GM pasture and thoughts on products fed on GM pasture.

3.2.6 Thoughts on GM pasture

The first part (Qn72-79) looked at attitudes to GM pasture, including the ability to control the spread of the GM pasture, the acceptability of different potential benefits, and attitudes towards plant modification. This section also uses the 1 to 5 Likert Scale with the additional “don’t know “option.

3.2.7 Thoughts on products from animals fed on GM pasture

The second part (Qn80-85) was concerned with attitudes towards products from animals, such as milk or meat that have been fed GM pasture. This section also used the 1 to 5 Likert Scale with the additional “don’t know” option.

3.2.8 Attitudes towards cisgenic and transgenic organisms

Participants were asked to express their concerns about different types of gene transfer. The different gene transfers were cisgenic and transgenic. Here, the distinction between cisgenic and transgenic was explained to ensure it was clear to the participant what were meant by the terms. Answers were measured on a 1 to 5 Likert Scale with the additional “don’t know” option. In this

section the optional answer “don’t know” was also included as this was appropriate for participants who were unsure and did not have enough information to satisfactorily answer the question.

3.2.9 **Administration of the questionnaire**

There were 1649 respondents in 2001, 950 in 2003, 848 in 2005 and 1008 in 2009. In this 2013 study, 353 responded to the questionnaire. Fewer respondents were chosen in 2013 due to limitations in financial resources.

The sample population was drawn from Smile City online database. Smile City uses a real-time points-based reward model, together with entries to a competition for prizes. Panellists on Smile City receive guaranteed reward points in real time for providing their honest opinions for each survey they participated in. The issuing of guaranteed reward points for completion as well as screen-outs generally produced a superior response rate and more reliable data (Smile City, 2013). Points were issued to panellists for every survey completed and can be converted into rewards – cash, gifts vouchers, or panellists can also elect to make charitable donations with their points. Entries into a prize draw were also offered.

A total of 850 respondents were randomly selected from Smile City online database. The final response available for analysis was 353 participants around New Zealand, representing a response rate of 42 per cent compared to Small’s 34%, from 2009. Smile City collated the completed survey data and presented it in SPSS a format. The electronic survey made data collection more efficient as the questionnaires were sent out and returned more quickly, with no further data entry required. Responding to the questionnaire was by consent and optional. However, as a commercial resource it was not cheap. The overall cost of Smile City survey was $5500. To cover the costs $2000 came from the university research funds and the remaining balance came from my personal savings.

3.3 Statistical analysis

Statistical analysis focused on descriptive and comparative statistics. Descriptive statistics were computed with SPSS version 21 and frequency graphs were constructed using Microsoft Excel. Descriptive statistics included calculations of frequencies, means and standard deviations of all questions, which were then graphed. These results were compared across the years (2001, 2003, 2005, 2005, 2009 and 2013) allowing for quick identification of possible trends. Graphs were made for the key questions to compare the means across the years. The frequencies observed were also graphically represented in the form of histograms. Frequencies were particularly useful when there were several categorical responses available as they can provide information on trends which were not as obvious when observing means. Once the frequencies were calculated “don’t know”

responses were coded as missing data and, thus, omitted from statistical analysis of means. Mean calculations provided information on the average attitudes for that particular question.

Similar questions from the previous studies in 2001, 2003, 2005, 2009 were grouped into "intention to purchase", "social norms", "specific product approach", "risk", "benefits" and "image" categories, and a comparison was made over the five-year period. In order to make comparisons over the five years (2001, 2003, 2005, 2009 and 2013) of the studies, means from key questions in each group were averaged and compared over years. The same formula used in 2009 was used for these calculations.

$$Intention\ to\ purchase\ = \frac{Qn54\ Buy_{Self} + Qn55\ Buy_{Family}}{2}$$

Qn54. If GM milk product was available in the shops, I would definitely buy it for myself.

Qn55. If GM milk product was available in the shops, I would definitely buy it for my family or the people that I live with.

$$Benefits = \frac{Qn26\ GM_{diseases} + Qn27\ GM_{food} + Qn28\ GM_{environment}}{3}$$

Qn26. GM technology will help cure the world's major diseases.

Qn27. GM technology will help solve the world's food problems.

Qn28. GM products are environmentally friendly.

$$Risk = \frac{Qn16\ GM_{environment} + Qn17\ GM_{risk\ humans} + Qn18\ GM\ _{risk\ animals}}{3}$$

Qn16. GM poses a significant risk to the environment.

Qn17. GM poses a significant risk to the health and safety of humans.

Qn18. GM poses a significant risk to the health and safety of animals.

$$Trust = \frac{Qn30\ T_{Authorities} + Qn31\ T_{Scientists} + Qn32\ T_{Companies}}{3}$$

Qn30. I trust what the regulatory authorities say about GM technology.

Qn31. I trust what scientists say about GM technology.

Qn32. I trust what companies say about GM technology.

$$Social\ norms = \frac{Qn35\ SV_{Family+Friends} + Qn36\ SV_{New\ Zealand}}{2}$$

Qn35. The people important to me consider that GM technology is acceptable.

Qn36. Most New Zealanders consider that GM technology is acceptable.

$$Moral\ values = \frac{Qn21GM_{\ Cultural+Spiritual} + Qn42GM_{\ Animals}}{2}$$

Qn21. Using GM technology fits with my cultural and spiritual beliefs

Qn42. It is acceptable to genetically modify animals (e.g. cows, sheep) for human benefit.

$$Product\ Specific\ Attitude = \frac{Qn57\ A_{feel\ good} + Qn58\ A_{useful\ product} + Qn59\ A_{Trust} + Qn60\ A_{family+friends}}{4}$$

Qn57. I would feel good about purchasing GM milk for myself.

Qn58. GM milk will be a useful product to develop.

Qn59. I would trust the claims made about GM milk by the people selling it.

Qn60. The people important to me would want me to purchase GM milk.

$$\text{Image} = \frac{Qn37GM_{\ clean\ green\ image} + Qn38\ GM_{\ markerting\ health\ food}}{2}$$

Qn37. Producing GM products fit with NZ's clean green image.

Qn38. Producing GM products fit with NZ's image of marketing healthy food.

To make a statistical comparison of the means over time, one way analysis of variance (ANOVA) was used. One way ANOVA was used to test for any significant statistical difference in attitudes over the years (2001, 2003, 2005, 2009 and 2013). One way analysis of variance (ANOVA) is a technique used to compare means of three or more samples. The ANOVA test the null hypothesis that samples in three or more groups are drawn from populations with the same mean values. The hypothesis was that means from responses in 2001,2003,2005,2009 and 2013 were drawn from populations with same mean values, implying no changes in attitudes. The ANOVA produces an F-value, F critical value and P value. If the group means are drawn from populations with the same mean values, the F critical value should be greater than the F value and P alpha should be greater than the P value. When F critical value is greater than F value it implies the samples were drawn from populations with the same mean values and we accept the null hypothesis; therefore attitudes are not changing over the years. When the F critical value is less than the F value and P alpha (0.05) is smaller than the P value, the null hypothesis is rejected, implying the group means are drawn from populations with different mean values. A t-test was then used to test which years are showing the differences. The t-test assesses whether the means of two groups are statistically different from each other.

3.4 Focus groups

To answer the how and why attitudes were changing, focus groups were used. A focus group was a group of interacting individuals who, having some common interest or characteristics, were brought together by a moderator for the purpose of gaining some information on a specific topic (Stewart & Shamdasani, 1990). The great advantage of focus groups with regard to this research was on the depth and complexity of responses, which help establish how and why attitudes towards GM are changing. Focus groups allow detailed opinions, rather than simply whether people agree or disagree as would have happened in a survey (Marczak & Sewell, 2006). Group members also stimulated new thoughts for each other, which might not have otherwise occurred. Interesting points emerging during group discussions were then able to be explored in detail using some leading questions. Comparing different points of view from individuals in the groups provided a wealth of information on what people think about GM and why they think the way they do. Because focus groups were structured and directed, but also expressive, they yielded much information in a relatively short time. Despite its many advantages, the focus group method was not without its limitations. Findings from focus group discussions were not quantitative, nor can they be generalised to the target population as a whole (Marczak & Sewell, 2006).

3.4.1 **Selecting Participants**

Targeted participants were purposively sampled with the help of schools' Parent Teachers Associations (PTA) and Toastmasters clubs. Purposive sampling is a non-probability sampling, which is characterised by the use of judgment and a deliberate effort to obtain representative sample (Given, 2008). Each focus group, typically, had eight to twelve participants who were purposively sampled to help get diversity on age, gender, culture, profession and educational level. Four focus groups were conducted: in Te Awamutu, Hamilton, Putaruru and Te Pahu.

3.4.2 **Preparations for focus groups**

Preparation started with obtaining approval from the Lincoln University Human Ethics Committee. All participants signed a consent form prior to the discussion group (see Appendix 3). A pilot test focus group was conducted to test the timing, agenda and the guide for the discussion questions. Participants gave feedback on the process and their participation. The test group liked the discussion and thought it went quite well. Meeting times for the discussion were at the convenience of the participants. On-site preparations included, organising the discussion room, the room temperature and providing writing pads, flip charts, pens, tape recorder, name tags and pens and refreshments.

3.4.3 Approach to the focus group discussion

The groups met for at least 60 minutes. Agreed starting and ending times were strictly adhered to. Groups were conducted with a moderator and a note-taker. The discussions in all four focus groups were recorded by both a note-taker and a tape recorder. Participants filled out a short demographic questionnaire and signed a consent form before participating.

The discussion was undertaken in four stages. The first stage involved participants highlighting their current scenario with regard to GM. This included their familiarity and attitudes and perceptions on GM.

The second stage of the discussion focused on their preferred scenario in regard to GM. What was their preferred scenario with GM in their households, community and in New Zealand as a country? Why did they choose the preferred scenario?

The third stage, involved looking at the options available to get to the preferred scenario. Under this we looked at what individuals, communities and governments needed to do to get to the preferred scenario. Why did they choose those options?

The fourth stage, from the options available, explored what immediate actions needed to be taken to get to the preferred scenario. Judging from the first time they heard about GM and now how their perception had changed and how did they see GM in the future.

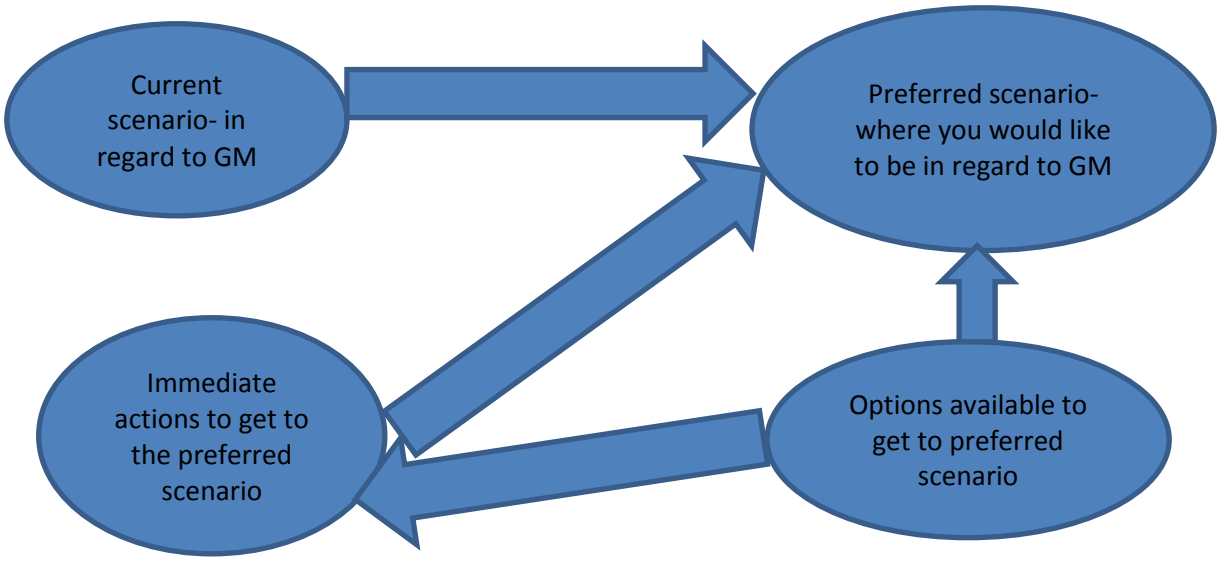


Figure 1 Illustration of focus group discussion framework

3.4.4 **Focus group data analysis**

Analysis of the focus group data was undertaken through thematic content analysis, which encompasses a procedure of dividing transcripts into segments, based on the identification of shifts in the topics. This was followed by coding the segments by assigning labels and identifying recurrent themes and sub-topics (Anderson, 2007).

Chapter 4

Results and data analysis

4.1 Introduction

In this chapter the results are presented and analysed in two parts; first the survey and then the focus group discussion. For the survey, frequency graphs and key descriptive statistics are presented to help with data analysis and for, focus groups, thematic content analysis is used.

4.2 Survey results

Results of the survey are presented in three parts. The first part describes the demographics of the sample, the second part analyses the responses to the survey questions, and the third part gives a statistical comparison with previous studies by Small in 2001, 2003, 2005 and 2009, to understand the trends. Particular attention was paid to the demographic and socio-economic composition of the sample and the consistency of responses, so that meaningful comparisons can be made with previous studies. There were 1649 respondents in 2001, 950 in 2003, 848 in 2005 and 1008 in 2009. For this survey (2013) a total of 353 people completed the online questionaaire. The relative response rates were 56 per cent for 2001, 48 per cent in 2003, 36 per cent in 2005, 34 per cent in 2009 and 42 per cent in 2013. There was a higher response rate in 2001, most likely due to the publicity of the Royal Commision on Genetic Modification consultations in 2000.

4.2.1 Gender

Of the 353 respondents, 52% were females and 48% males; the ratio is in alignment with New Zealand census statistics' ratio of 51.3% females to 48.7% males.

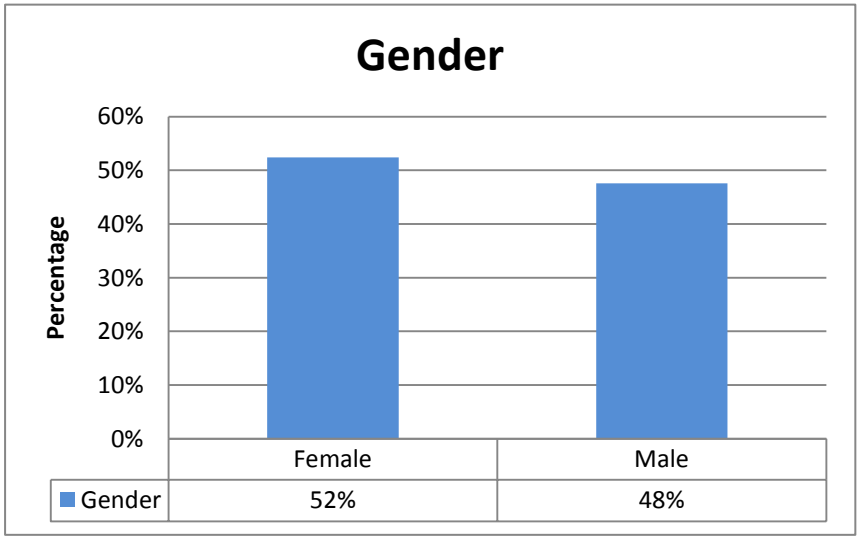


Figure 2 Respondents' gender ratios

4.2.2 Age

The age of respondents ranged from 16 to 80 years with a mean age of 44.44.

Table 1 Respondents' mean age

Year	N	Mean	Std. deviation
2013	353	44.44	17.803

4.2.3 **Religion**

The majority of the respondents had no religion (44.2%) or were Christians (38.5%), followed by Hindus (8.2%) and other religions (6.2%). Hindus were over represented in this survey; NZ statistics put Hindu at 2.02% in the 2013 census.

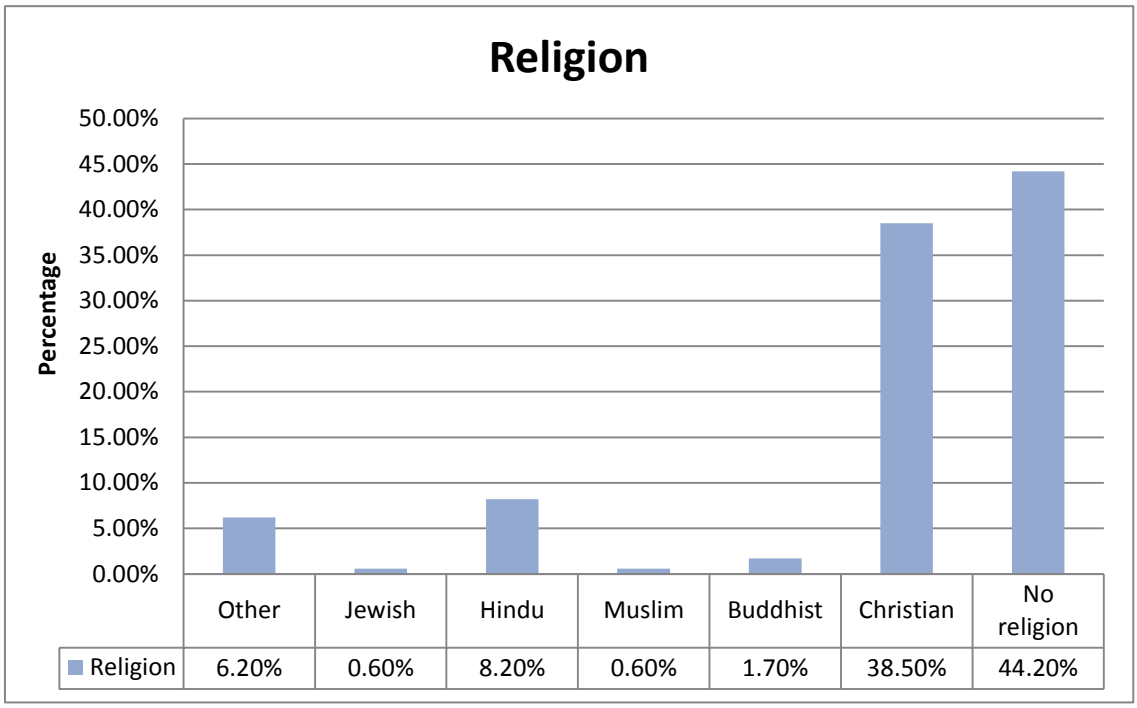


Figure 3 Respondents' religion

4.2.4 **GM food vs GM medicine**

Generally, GM medicine had more support than GM food, 21% of the respondents "totally support" GM medicine compared to 5% who "totally support" GM food. About 27% "totally oppose" GM food compared to 16% who "totally oppose" GM medicine. This showed that when there was a human health benefit GM was likely to gain support.

Almost equal numbers "support it in some circumstances" - GM food (47%) and medicine (45%)

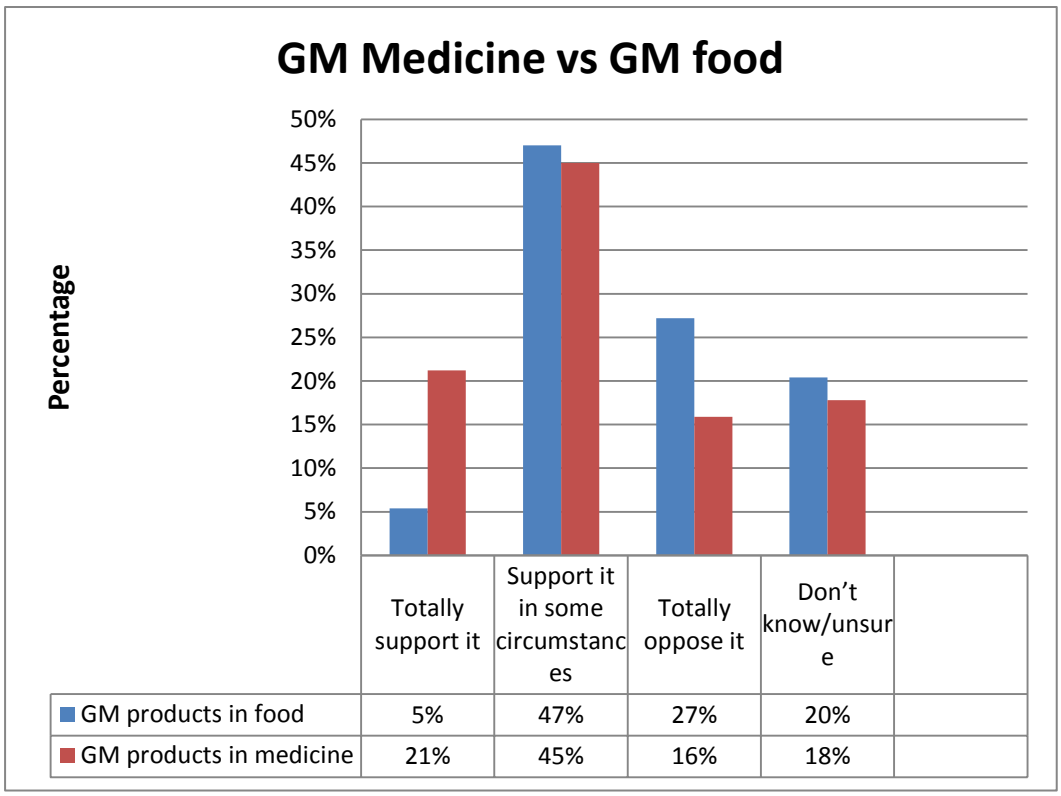


Figure 4 GM medicine vs GM food

4.2.5 **Familiarity**

A very small proportion of 8.5% had never heard of GM technology. The bulk of the respondents 41.4% were "familiar" with GM technology. Only 7.9% regarded themselves as "very familiar." Most of the respondents (49.3%) were either "familiar" or "very familiar" with GM. Familiarity will help us understand if respondents were making rational decisions. Respondents in the category "Never heard of it" were not likely to make rational decisions when they totally agree or disagree compared to "just heard of it", "familiar" and "very familiar."

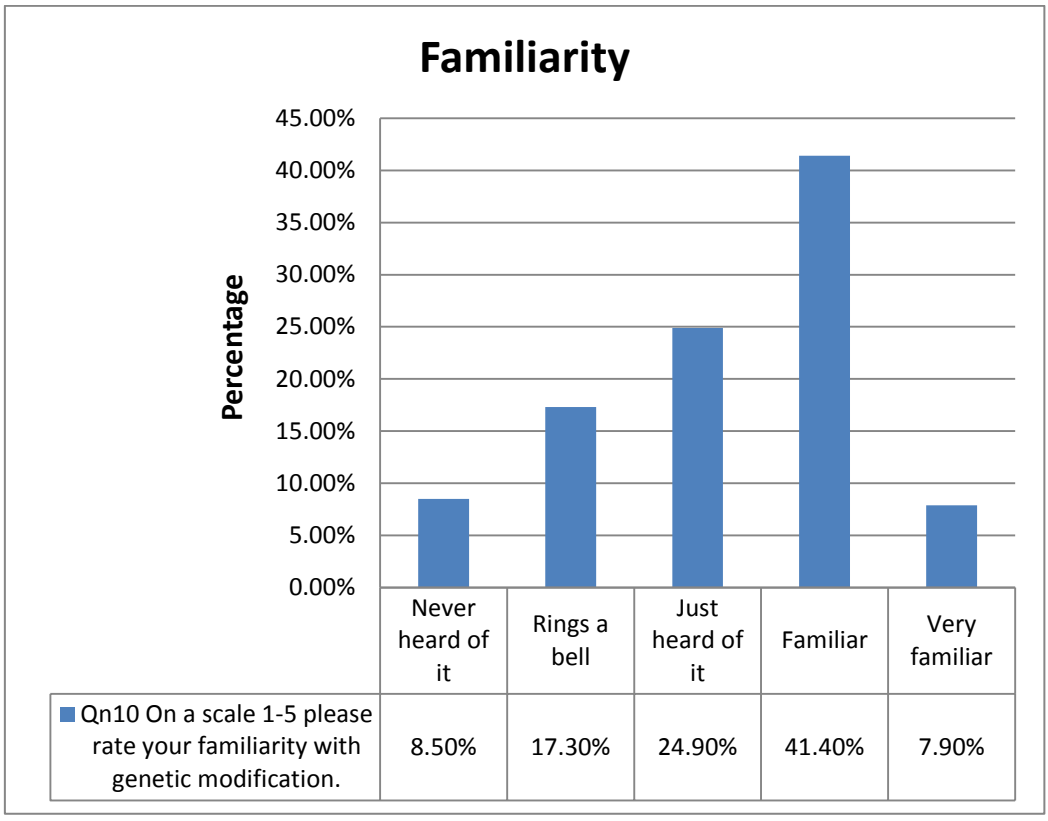
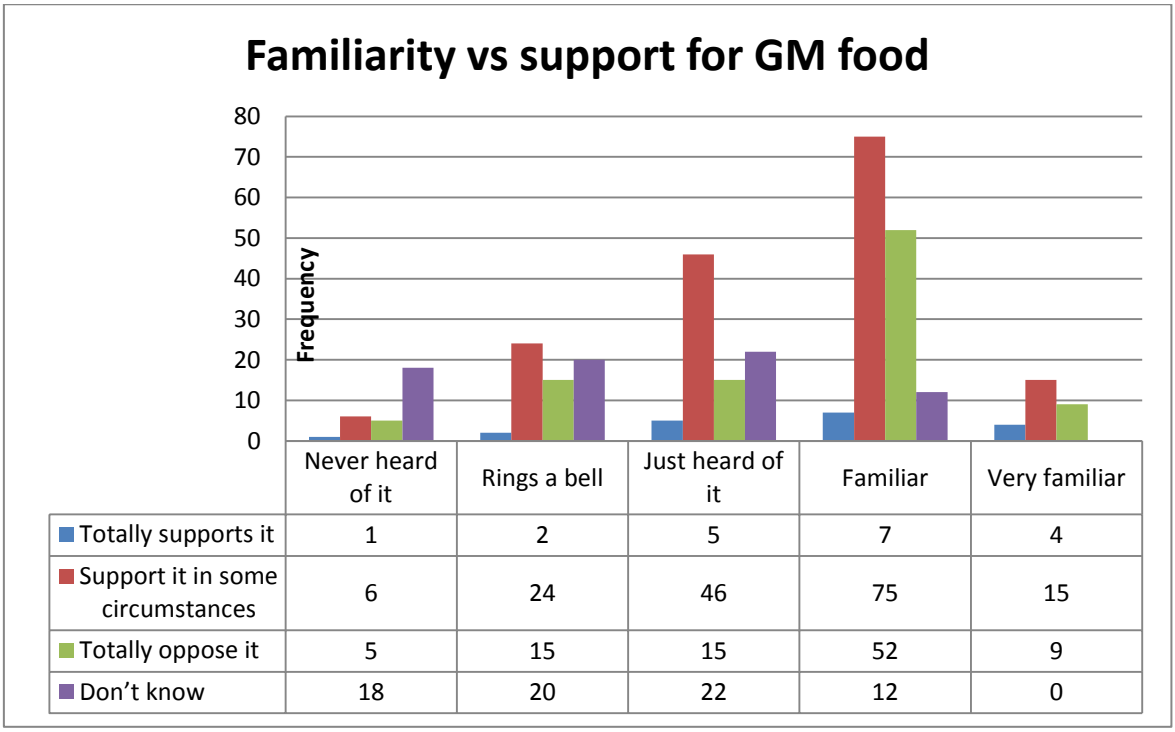


Figure 5 Respondents' familiarity with GM

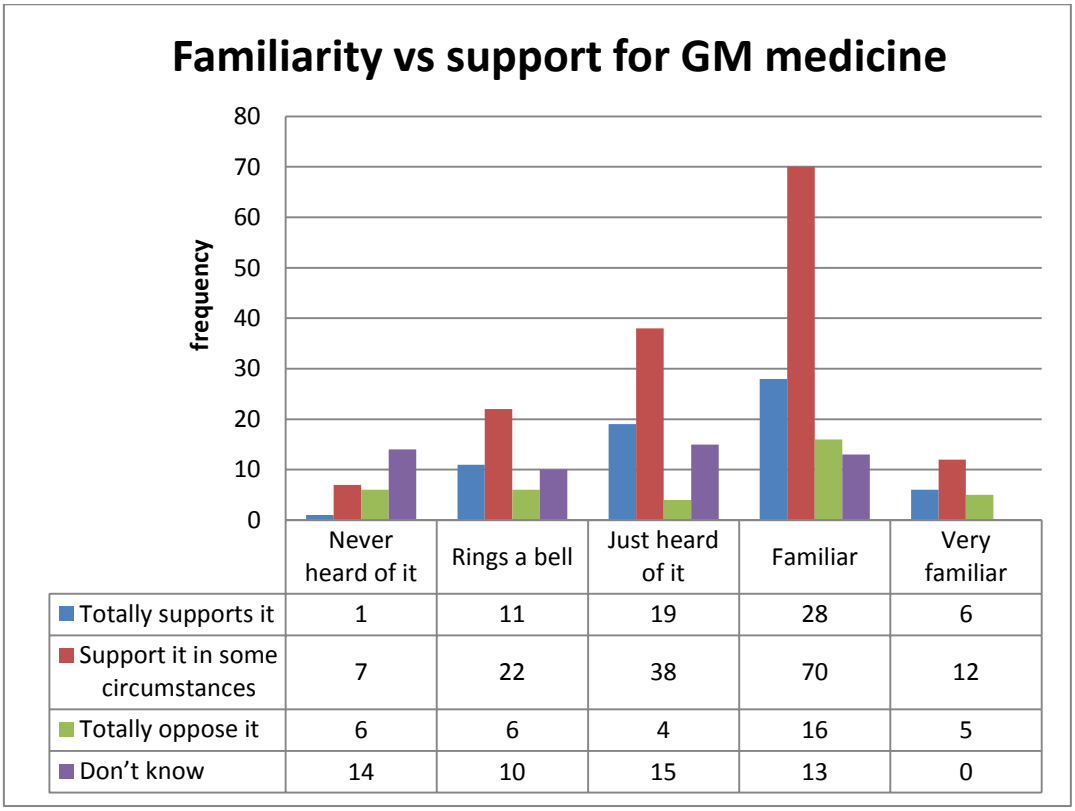
Figure 5 below compares respondent's support for GM food with their familiarity with GM. A total of 334 people responded to this question. Small percentages across all familiarity categories totally supported GM food. "Support it in some circumstances" was the most popular choice across all familiarity categories followed by "totally oppose it." The "don't know"/"unsure" frequencies were similar to "never heard of it", "rings a bell", "just heard of it," with fewer for "familiar" and none for the "very familiar" respondents. Respondents who were familiar with GM technology had lots of support compared to the rest of the familiarity categories.



	Never heard of it	Rings a bell	Just heard of it	Familiar	Very familiar
Totally supports it	1	2	5	7	4
Support it in some circumstances	6	24	46	75	15
Totally oppose it	5	15	15	52	9
Don't know	18	20	22	12	0

Figure 6 Familiarity vs support for GM food

Figure 6 below compares respondents' support for GM medicine with their familiarity with GM. A total of 303 responded to this question. Respondents who were "familiar" with GM, had the highest "support" or "totally support" GM medicines, followed by "just heard of it", "rings a bell", "very familiar" and "never heard of it." None of the "very familiar" respondent's chose the "don't know"/"unsure" option. The frequencies show that respondents were making rational decisions based on their level of familiarity.



	Never heard of it	Rings a bell	Just heard of it	Familiar	Very familiar
Totally supports it	1	11	19	28	6
Support it in some circumstances	7	22	38	70	12
Totally oppose it	6	6	4	16	5
Don't know	14	10	15	13	0

Figure 7 Familiarity vs support for GM medicine

Figure 7 below compares respondents' familiarity with GM to their educational level. A total of 353 people responded to this question. Respondents who are "very familiar" with GM had the least number of respondents with no qualification. Respondents who were "familiar" with GM mostly had either high school, technical or vocational or university qualifications. Respondents who had "never heard of GM" had the least technical or university education. From Figure 8 we can see that educational level appeared to have an influence on familiarity with GM.

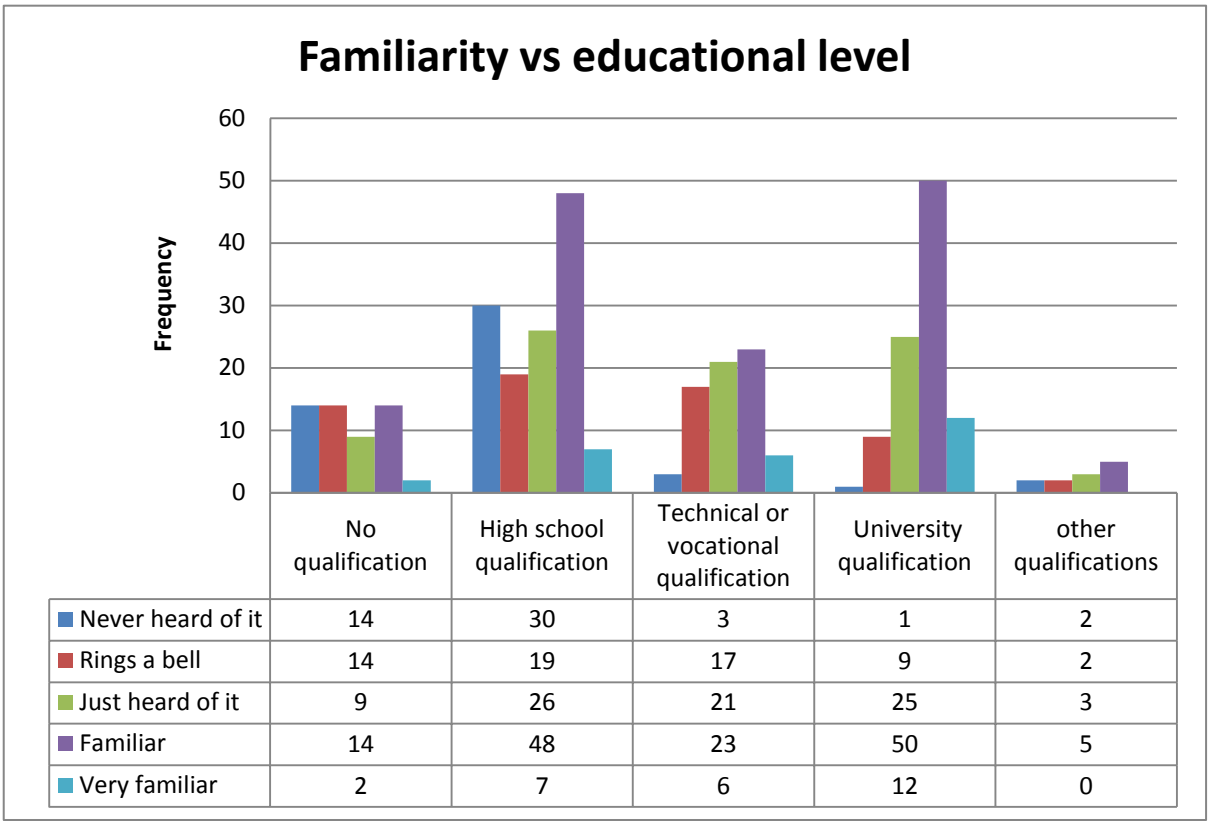
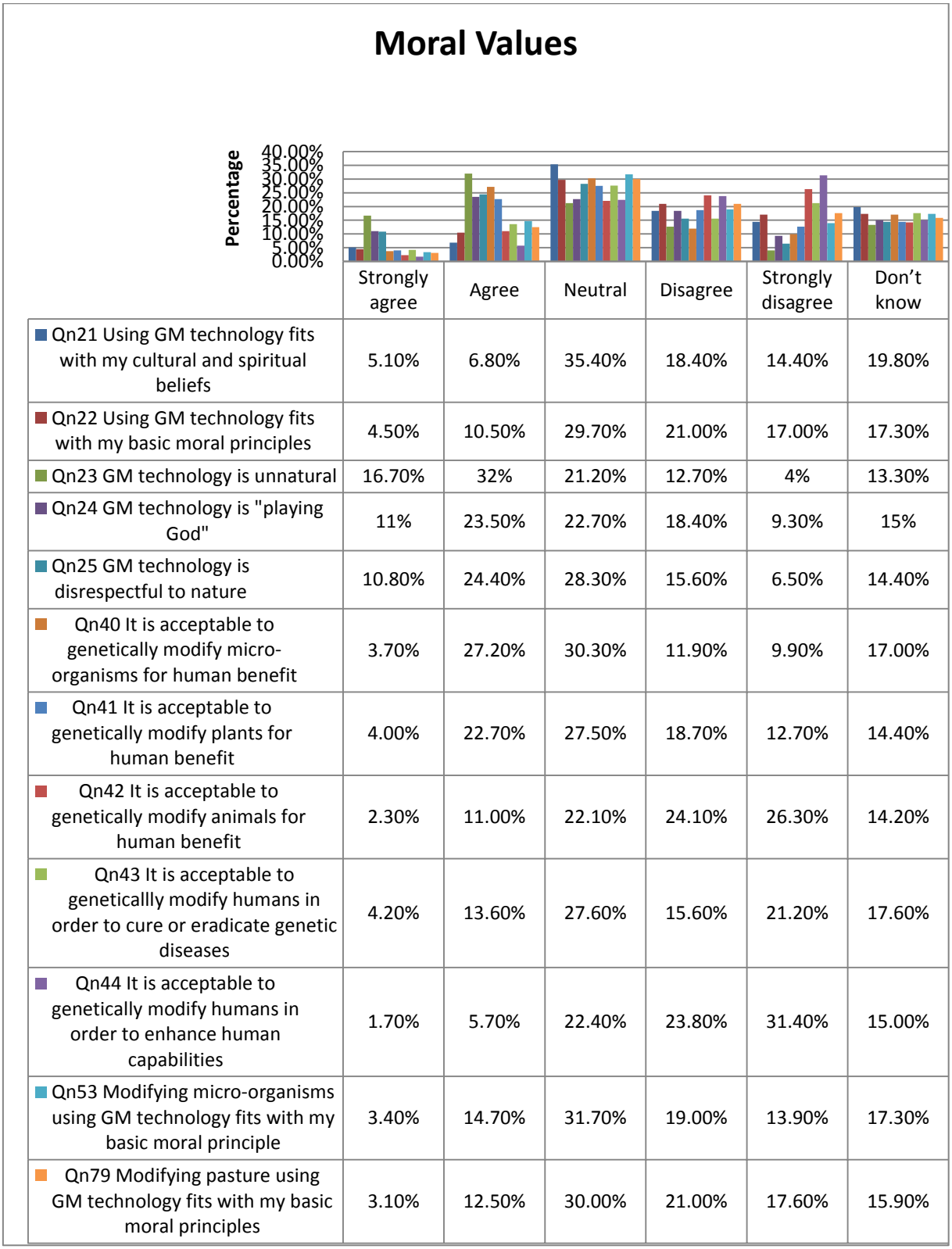


Figure 8 Familiarity vs educational level

4.2.6 **Moral values**

Moral values can be defined as personal beliefs on how one should live one's life (Thomas 2006). Overall responses for this category appeared to trend more towards a negative attitude, as shown in Figure 8 below. An exception was Qn40, "It is acceptable to genetically modify micro-organisms for human benefit" which took a neutral position. "Modifying animals and humans" had the most negative results. However, "genetically modifying humans to eradicate diseases" had fewer negative responses than "modifying humans to enhance capabilities." This showed that GM might gain support for applications where it enhanced human health. Questions 42, 43 and 44, which looked at genetically modifying animals and humans, had the most respondents saying they totally disagreed.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Qn21 Using GM technology fits with my cultural and spiritual beliefs	5.10%	6.80%	35.40%	18.40%	14.40%	19.80%
Qn22 Using GM technology fits with my basic moral principles	4.50%	10.50%	29.70%	21.00%	17.00%	17.30%
Qn23 GM technology is unnatural	16.70%	32%	21.20%	12.70%	4%	13.30%
Qn24 GM technology is "playing God"	11%	23.50%	22.70%	18.40%	9.30%	15%
Qn25 GM technology is disrespectful to nature	10.80%	24.40%	28.30%	15.60%	6.50%	14.40%
Qn40 It is acceptable to genetically modify micro-organisms for human benefit	3.70%	27.20%	30.30%	11.90%	9.90%	17.00%
Qn41 It is acceptable to genetically modify plants for human benefit	4.00%	22.70%	27.50%	18.70%	12.70%	14.40%
Qn42 It is acceptable to genetically modify animals for human benefit	2.30%	11.00%	22.10%	24.10%	26.30%	14.20%
Qn43 It is acceptable to geneticallly modify humans in order to cure or eradicate genetic diseases	4.20%	13.60%	27.60%	15.60%	21.20%	17.60%
Qn44 It is acceptable to genetically modify humans in order to enhance human capabilities	1.70%	5.70%	22.40%	23.80%	31.40%	15.00%
Qn53 Modifying micro-organisms using GM technology fits with my basic moral principle	3.40%	14.70%	31.70%	19.00%	13.90%	17.30%
Qn79 Modifying pasture using GM technology fits with my basic moral principles	3.10%	12.50%	30.00%	21.00%	17.60%	15.90%

Figure 9 Moral values

Descriptive statistics, such as the mean and standard deviation, were calculated in order to gauge current attitudes. The Likert Scale used ranged from 1-5 with 1 being strong agreement with a statement about GM and 5 being strong disagreement. A score of 3 would signify a neutral response. The responses "don't know" or "unsure" were excluded in the mean calculation. With the exception

of Questions 23, 24 and 25 values above three indicated negative attitudes towards GM and values below three indicated positive attitudes. For Questions 23, 24 and 25 the opposite was true.

Table 2 Descriptive statistics for moral values

Category	Key Questions	2013 Descriptive statistics				
		N	Min.	Max.	Mean	Std. Dev.
Moral Values	Qn 21 GM fits cultural and spiritual beliefs	283	1	5	3.4	1.1
	Qn 22 GM fits moral beliefs	292	1	5	3.4	1.1
	Qn 23 GM is unnatural	306	1	5	2.5	1.1
	Qn 24 GM is against God	300	1	5	2.9	1.2
	Qn 25 GM disrespects nature	302	1	5	2.8	1.1
	Qn 40 Acceptable to GM micro-organisms	293	1	5	3.0	1.1
	Qn 41 Acceptable to GM plants	302	1	5	3.2	1.1
	Qn 42 Acceptable to GM animals	303	1	5	3.7	1.1
	Qn 43 Acceptable to GM humans to cure disease	291	1	5	3.4	1.2
	Qn 44 Acceptable to GM humans for enhancement	300	1	5	3.9	1.0
	Qn 53 GM of micro-organisms fits my cultural and spiritual beliefs	292	1	5	3.3	1.1
	Qn 79 GM of micro-organisms fits my moral beliefs	297	1	5	3.4	1.1

4.2.7 Image

The image category referred to how GM was perceived to affect New Zealand's clean, green image and economic benefits associated the image. As shown in Figure 9, below, most respondents 50.1% "disagree" or "strongly disagree" with Qn37 that "producing GM products fits with NZ clean green image." Only 8.2% "agree" or "strongly agree" with this statement. Forty-nine per cent of the respondents "disagree" or "totally disagree" with Qn38, "producing GM fits with NZ's image of marketing healthy food." Only 10.8% "agree" or "strongly agree" with this statement. Most respondents' thought "GM does not fit with NZ clean green image."

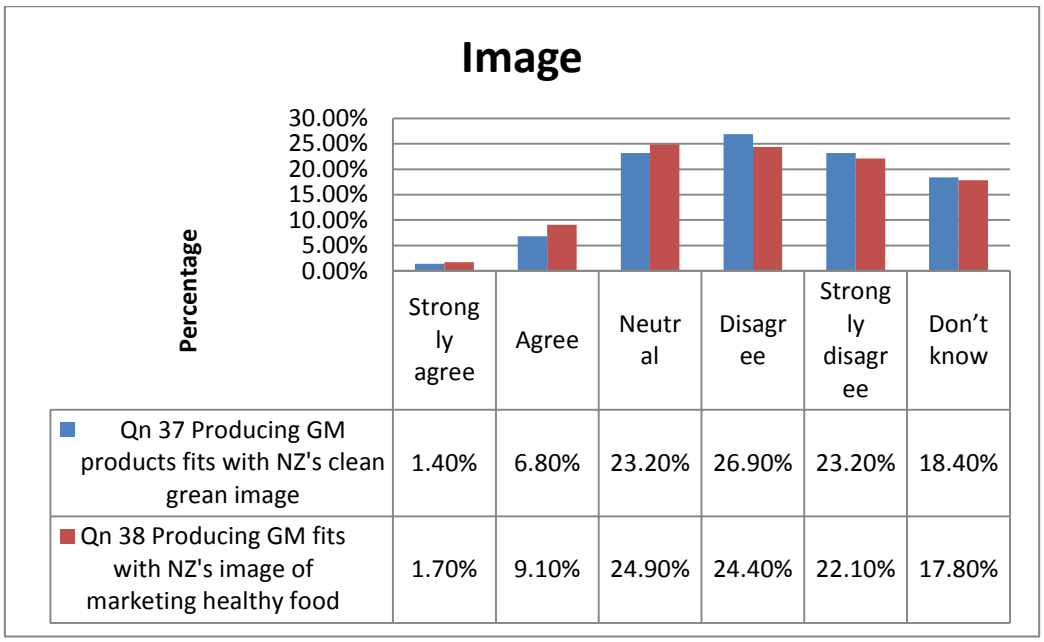


Figure 10 Perception about NZ's image

The Likert Scale used for the descriptive statistics for the questions in this category ranged from 1-5 with I being strong agreement with a statement about GM, 2 agree, 3 neutral, 4 disagree and 5 begin strong disagreement. A score of three would signify a neutral response. The responses "don't know"/ "unsure " were excluded in the mean calculation. For these two questions a mean greater than three represented a negative attitude, a mean less than three was a positive attitude and mean 3 was neutral.

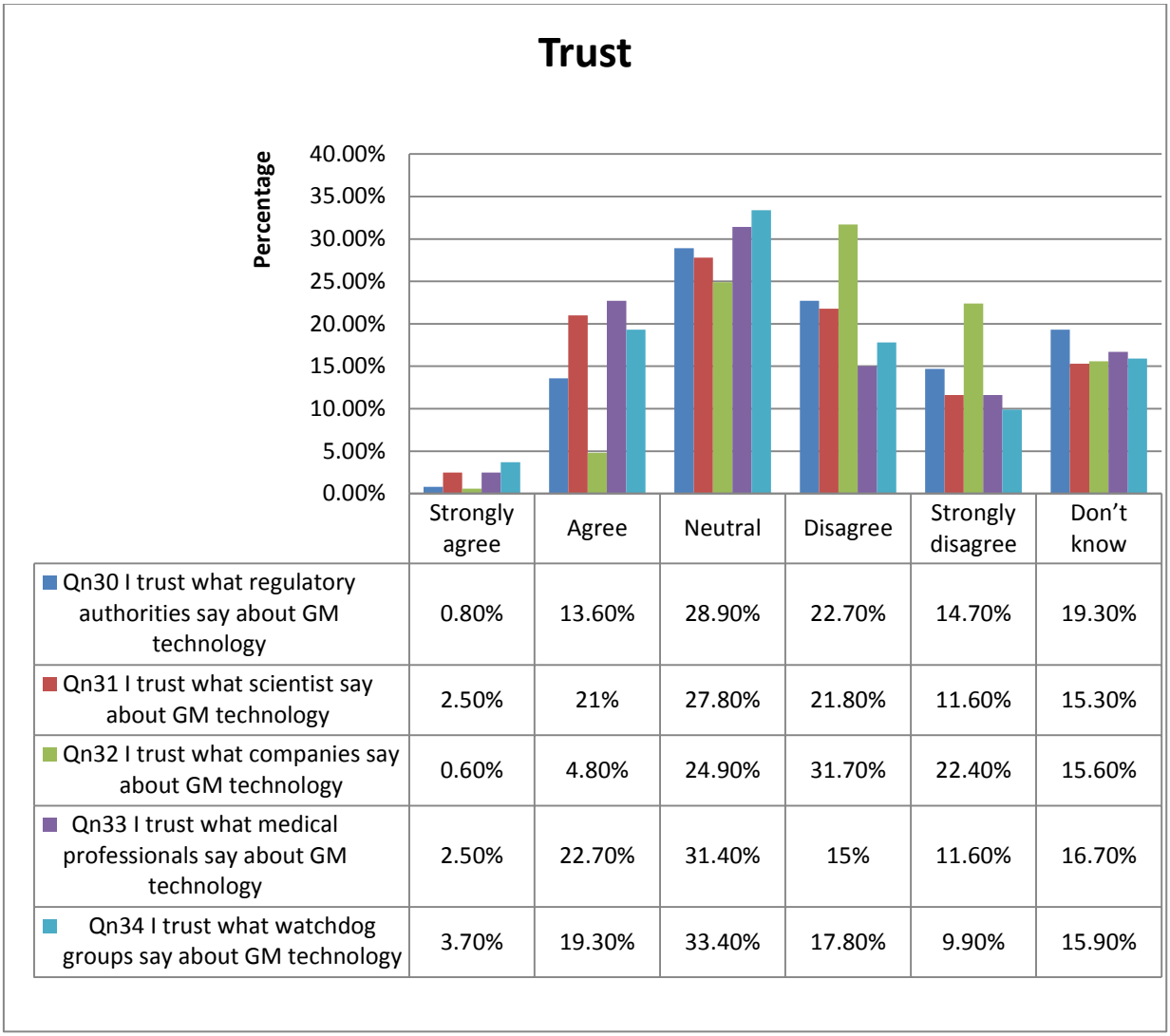
Table 3 Descriptive statistics for Image

		2013 Descriptive statistics				
Category	**Key Questions**	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Image	Qn 37 Producing GM products fits NZ's "clean green" image	288	1	5	3.8	1.0
	Qn 38 Producing GM products fits NZ's "healthy foods" image	290	1	5	3.7	1.1

4.2.8 Trust

Trust, by definition, referred to the firm belief in the reliability, truth or ability of someone or something (Collins, 2009). In this study, trust refers to the firm belief in the reliability and truth in the information provided by different stakeholders involved in GM. From Figure 11 below, it can be seen there are very low "strongly agree" responses for trust of authorities, scientist, companies, medical professions and watchdogs. The least trusted stakeholders were regulatory authorities and

companies behind the GM technology. The body that approved or disapproved the technology was not totally trusted by the people and so were the companies that sold the technology. About 19-22% of people agreed with trusting scientists, medical professions and watchdogs. The greatest negative response was seen in Qn32 on trusting companies. This reflected the public's distrust in biotechnology companies.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Qn30 I trust what regulatory authorities say about GM technology	0.80%	13.60%	28.90%	22.70%	14.70%	19.30%
Qn31 I trust what scientist say about GM technology	2.50%	21%	27.80%	21.80%	11.60%	15.30%
Qn32 I trust what companies say about GM technology	0.60%	4.80%	24.90%	31.70%	22.40%	15.60%
Qn33 I trust what medical professionals say about GM technology	2.50%	22.70%	31.40%	15%	11.60%	16.70%
Qn34 I trust what watchdog groups say about GM technology	3.70%	19.30%	33.40%	17.80%	9.90%	15.90%

Figure 11 Trust

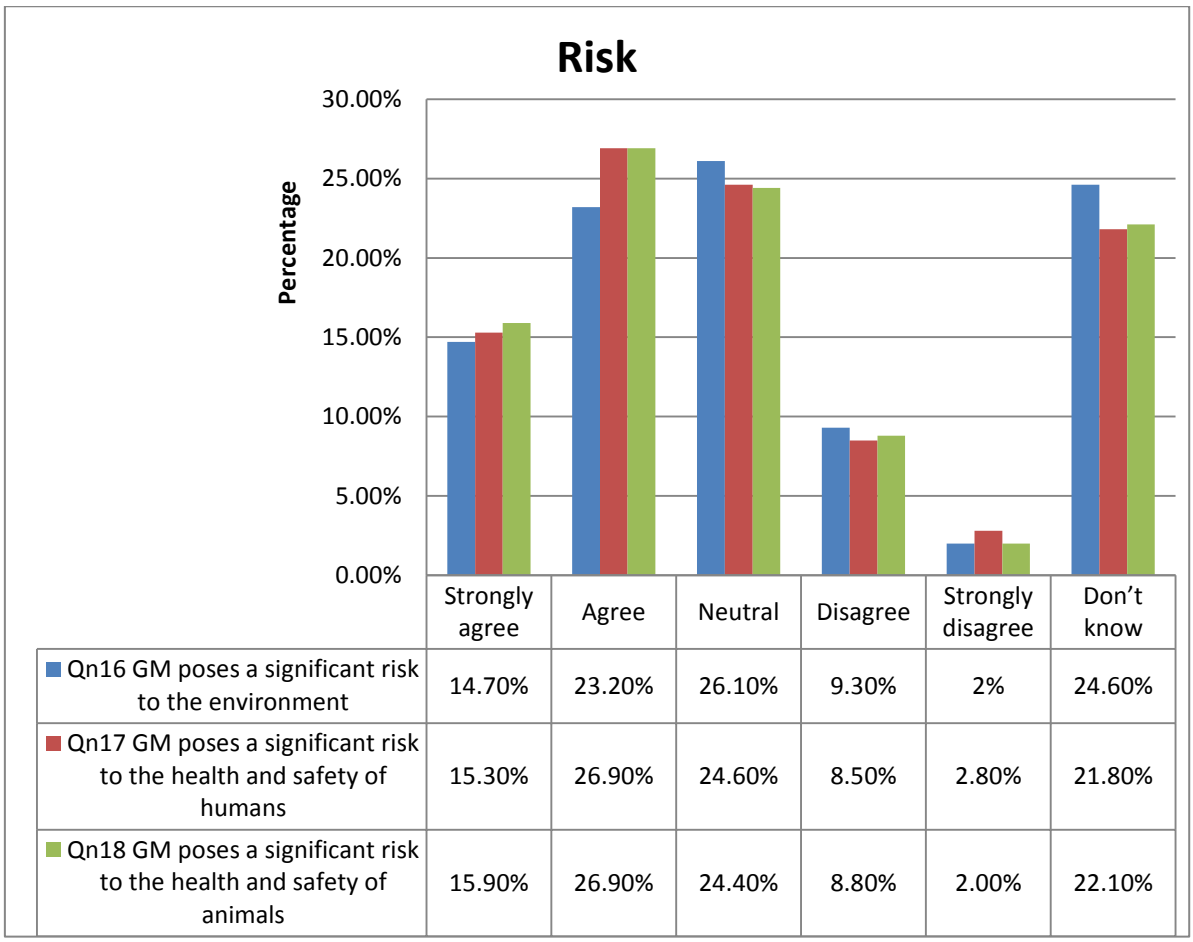
From the descriptive statistics in Table 4, below, trust for scientists, medical professions and watchdogs was much higher than trust for companies and authorities.

Table 4 Descriptive statistics for trust

Category	Key Questions	2013 Descriptive statistics				
		N	Min.	Max.	Mean	Std. Dev.
Trust	Qn 30 Trust authorities	285	1	5	3.5	1.0
	Qn 31 Trust scientists	299	1	5	3.2	1.1
	Qn32. Trust companies	298	1	5	3.8	0.9
	Qn 33 Trust what medical professionals say about GM technology	294	1	5	3.1	1.1
	Qn 34 Trust what watchdog groups say about GM technology	297	1	5	3.1	1.0

4.2.9 **Risk**

Risk can be described as a situation involving exposure to danger (Oxford, 2009). In this study risk meant the dangers animals, humans and the environment were likely to be exposed to as a result of GM. From Figure 12, below, about 40% of the respondents "agree" or "strongly agree" that GM posed significant risk to the environment, humans and animals. About 10% "disagree" or "strongly disagree" that GM posed risk to environment, humans and animals. About 22% were "unsure" or did not know if GM posed a risk to the environment, humans and animals. This showed a strong feeling that GM technology carried a significant risk to the environment, humans and animals.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Qn16 GM poses a significant risk to the environment	14.70%	23.20%	26.10%	9.30%	2%	24.60%
Qn17 GM poses a significant risk to the health and safety of humans	15.30%	26.90%	24.60%	8.50%	2.80%	21.80%
Qn18 GM poses a significant risk to the health and safety of animals	15.90%	26.90%	24.40%	8.80%	2.00%	22.10%

Figure 12 Risk

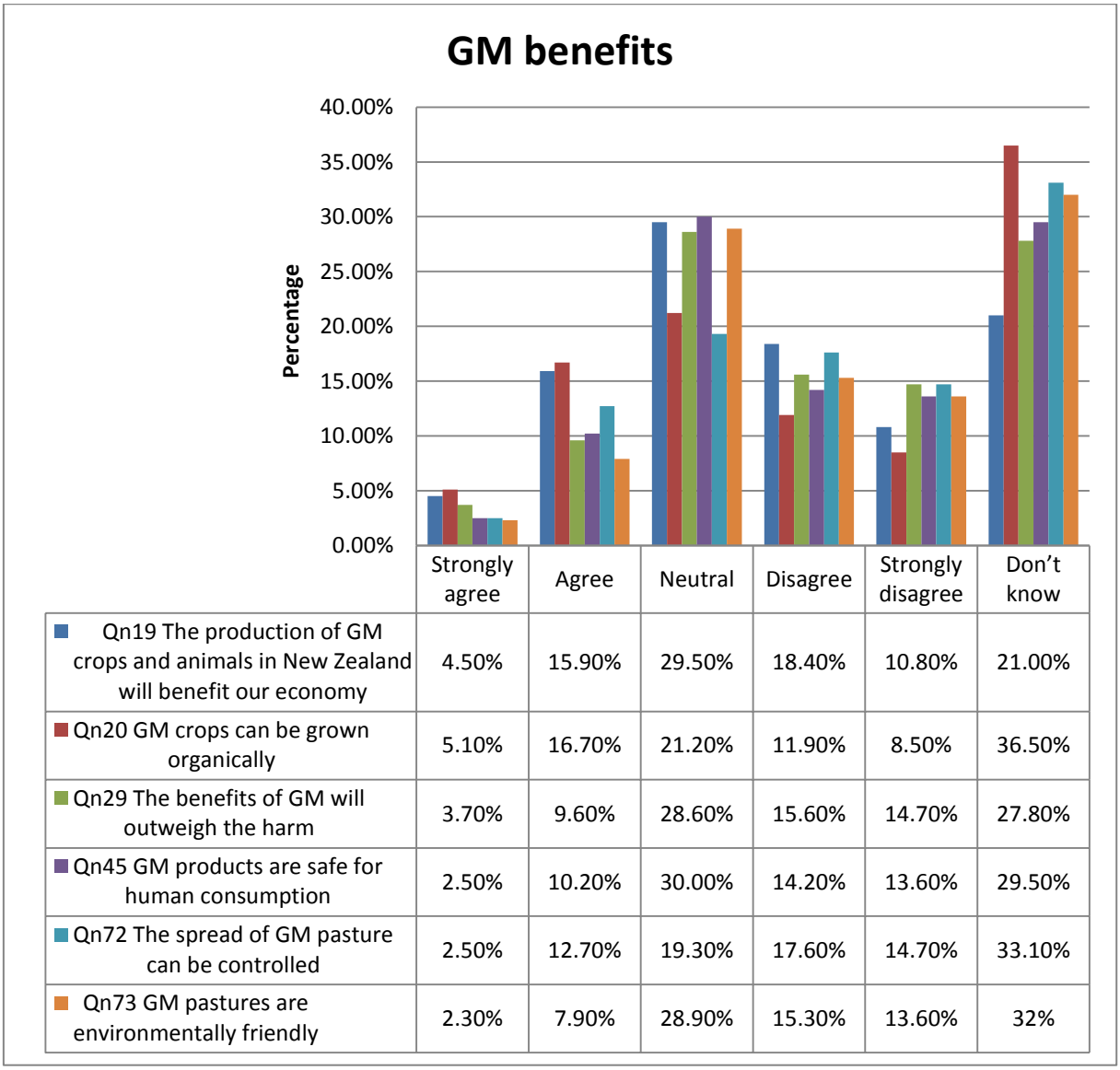
Table 5 Descriptive statistics for risk

Category	Key Questions	2013 Descriptive statistics				
		N	Min.	Max.	Mean	Std. Dev.
Risk	Qn 16 GM is a Risk to the environment	266	1	5	2.5	1.0
	Qn 17 GM is a health and safety risk humans	276	1	5	2.4	1.0
	Qn 18 GM is a health and safety risk animals	275	1	5	2.4	1.0

Respondents see GM being a risk to humans, animals and environment.

4.2.10 **GM benefits**

A benefit can be defined as an advantage or profit gained from something (Oxford, 2009). In this study a benefit can be described as an advantage gained from using GM technology. As shown in Figure 13, below, the bulk of respondents were either “neutral” or “don’t know” about the benefits. This suggested that despite being familiar with GM technology respondents were still unsure of the benefits.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Qn19 The production of GM crops and animals in New Zealand will benefit our economy	4.50%	15.90%	29.50%	18.40%	10.80%	21.00%
Qn20 GM crops can be grown organically	5.10%	16.70%	21.20%	11.90%	8.50%	36.50%
Qn29 The benefits of GM will outweigh the harm	3.70%	9.60%	28.60%	15.60%	14.70%	27.80%
Qn45 GM products are safe for human consumption	2.50%	10.20%	30.00%	14.20%	13.60%	29.50%
Qn72 The spread of GM pasture can be controlled	2.50%	12.70%	19.30%	17.60%	14.70%	33.10%
Qn73 GM pastures are environmentally friendly	2.30%	7.90%	28.90%	15.30%	13.60%	32%

Figure 13 GM benefits

From Table 6 below, Qn26, "GM will help cure major diseases" was positive; indicating that people believed there can be a benefit with GM. Qn27, "GM can help solve world food problems" took an almost neutral position. Qn29, "GM products are environmentally friendly" had a more negative response than Qn26 and 27. This showed that while the respondents might see the benefits, they were also quite sceptical about the safety of GM to the environment.

Table 6 Descriptive statistics on the benefits of GM

Category	Key Questions	2013 Descriptive statistics				
		N	Min.	Max.	Mean	Std. Dev.
Benefits	Qn26 GM will help cure major diseases	279	1	5	2.88	1.1
	Qn27 GM will help solve the world food problems	224	1	5	3.05	1.1
	Qn29 GM products are environmentally friendly	255	1	5	3.55	1.1

4.2.11 Social norms

Social norms can be described as what society perceived to be normal (Marshall, 1998). In this study social norms can be defined as the community's perception of GM. In Figure 14 below, society's general perception of GM was negative. However, about 53% of the respondents believed it was important to evaluate each potential on a case by case basis rather than totally supporting it or totally opposing all applications of GM. There was a very low percentage of responses in the "strongly agree" category, 1.4% for Qn35 and 0.6% for Qn36. The "strongly disagree" category had 11% for Qn35 and 9.3% for Qn36.

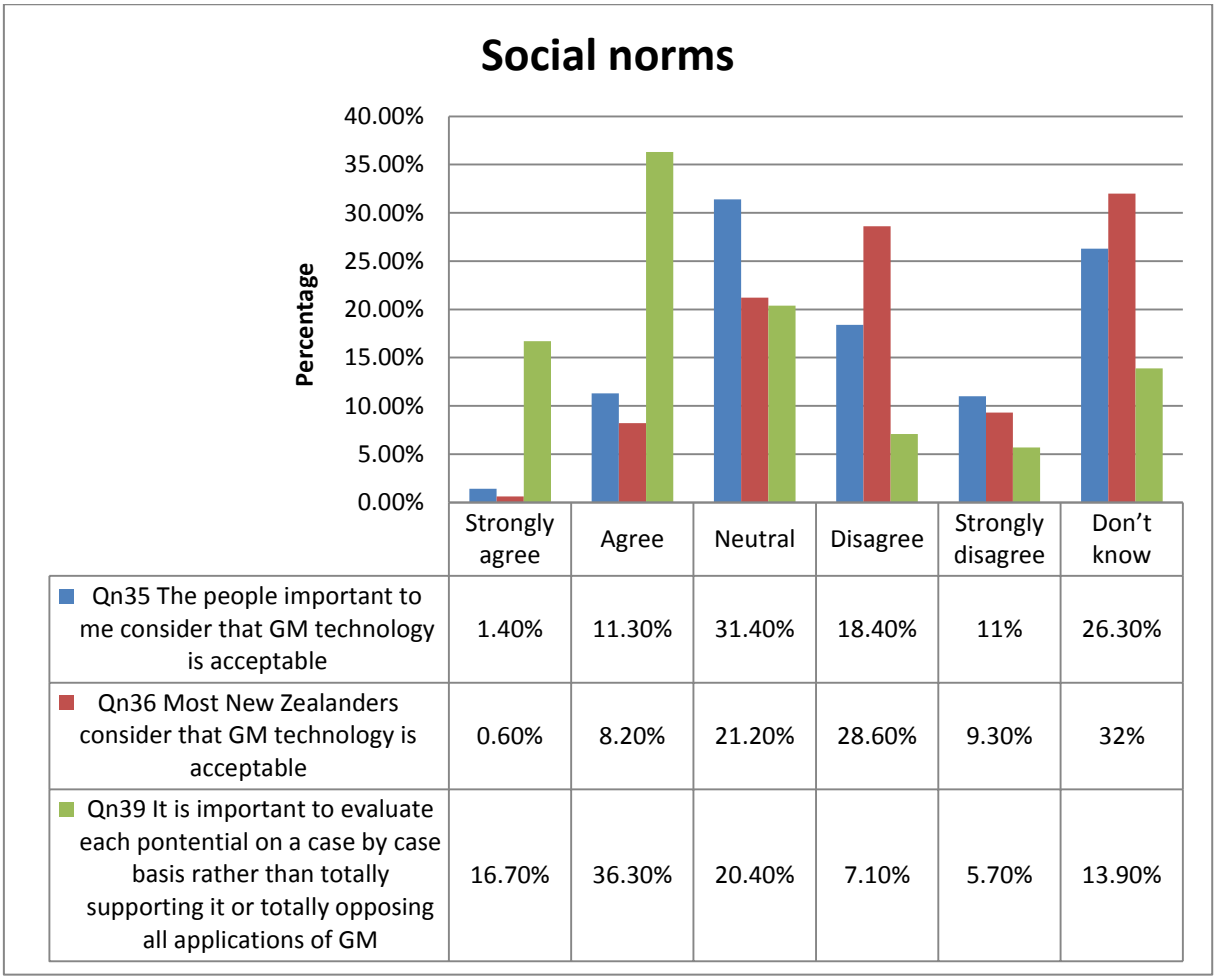


Figure 14 Social norms

Table 7 below shows that New Zealand's community had got a negative perception of GM.

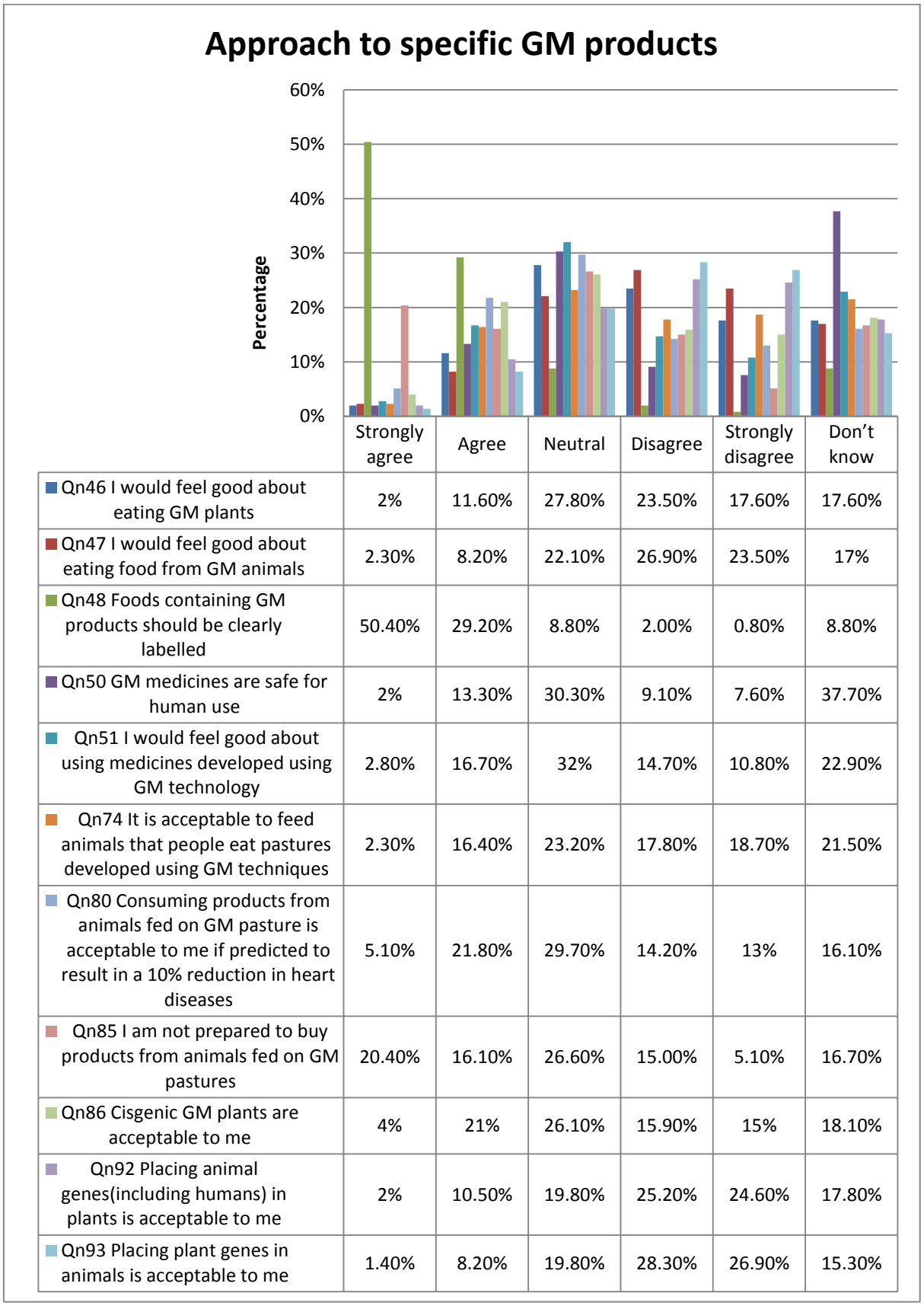
Table 7 Descriptive statistics for social norms

Category		2013 Descriptive statistics				
	Key Questions	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Social Norms	Qn35 People important to me accept GM	260	1	5	3.4	1.0
	Qn36 Most New Zealanders accept GM	240	1	5	3.6	0.9

4.2.12 Approach to specific GM products

Approach to specific GM products referred to how consumers make choices about GM products based on their attributes. In Figure, 15 below, the only positive response was Qn48 "Food containing GM products should be clearly labelled." The rest of the questions showed negative trends. However, Qn80 "Consuming products from animals fed on GM pasture is acceptable to me if predicted to result in 10% reduction in heart diseases" was the least negative followed by Qn86 "Cisgenic plants

are acceptable to me." This shows even if the attitudes were negative some GM applications can be more acceptable than others.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Qn46 I would feel good about eating GM plants	2%	11.60%	27.80%	23.50%	17.60%	17.60%
Qn47 I would feel good about eating food from GM animals	2.30%	8.20%	22.10%	26.90%	23.50%	17%
Qn48 Foods containing GM products should be clearly labelled	50.40%	29.20%	8.80%	2.00%	0.80%	8.80%
Qn50 GM medicines are safe for human use	2%	13.30%	30.30%	9.10%	7.60%	37.70%
Qn51 I would feel good about using medicines developed using GM technology	2.80%	16.70%	32%	14.70%	10.80%	22.90%
Qn74 It is acceptable to feed animals that people eat pastures developed using GM techniques	2.30%	16.40%	23.20%	17.80%	18.70%	21.50%
Qn80 Consuming products from animals fed on GM pasture is acceptable to me if predicted to result in a 10% reduction in heart diseases	5.10%	21.80%	29.70%	14.20%	13%	16.10%
Qn85 I am not prepared to buy products from animals fed on GM pastures	20.40%	16.10%	26.60%	15.00%	5.10%	16.70%
Qn86 Cisgenic GM plants are acceptable to me	4%	21%	26.10%	15.90%	15%	18.10%
Qn92 Placing animal genes(including humans) in plants is acceptable to me	2%	10.50%	19.80%	25.20%	24.60%	17.80%
Qn93 Placing plant genes in animals is acceptable to me	1.40%	8.20%	19.80%	28.30%	26.90%	15.30%

Figure 15 Approach to specific GM products

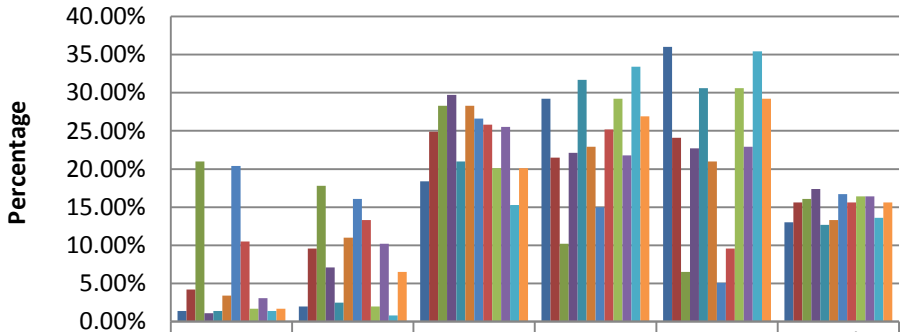
Table 8 Descriptive statistics about the approach to specific GM products

Descriptive Statistics						
	Key Questions	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Specific product approach	Qn 39 Important to evaluate each potential on a case by case basis	304	1	5	2.4	1.1
	Qn 46 Feel good about eating GM plants	291	1	5	3.5	1.1
	Qn 47 Feel good about eating food from GM animals	293	1	5	3.7	1.1
	Qn 48 Foods containing GM products should be clearly labelled	322	1	5	1.6	**0.8**
	Qn 50 GM medicines are safe for human use	220	1	5	3.1	1.0
	Qn 51 Feel good about using GM medicines	272	1	5	3.2	1.0
	Qn 74 acceptable to feed animals that people eat GM pastures	277	1	5	3.4	1.1
	Qn 80 GM acceptable if results in 10% reduction in heart diseases	296	1	5	3.1	1.1
	Qn 85 Not prepared to buy animal products fed GM pastures	294	1	5	2.6	1.2
	Qn 86 Cisgenic GM plants are acceptable to me	289	1	5	3.2	1.2
	Qn 92 Placing animal genes in plants is acceptable to me	290	1	5	3.7	1.1
	Qn 93 Placing plant genes in animals is acceptable to me	299	1	5	3.8	1.0
	Qn 69 prepared to buy GM milk at premium price	307	1	5	4.1	0.9

From Table 8 above for Qn39, 48 and 85, meant that a result lower than three was a negative attitude and a mean above three was a positive attitude. A mean of three showed a neutral response. The opposite was true for all other questions in this category. Acceptability of GM medicines (Qn50 and 51) was slightly negative but close to neutral. “Acceptability of GM if it results in 10% reduction in heart diseases” is almost neutral and so is the acceptability of cisgenics. This showed that when then was a health benefit GM will gain some support. However, consumers preferred GM to be clearly labelled and they evaluated each GM potential on a case by case basis.

4.2.13 **Intention to purchase**

Intention to purchase can be defined as an individual's intention to buy a specific product or brand (Hoad, 1996). In this study it was defined as an intention to purchase a specific GM food. The results in Figure 16, below, show there was a negative response from respondents when prompted with questions concerning purchasing GM products. Intention to purchase was characterised by very low "agree" and "strongly agree" responses, and high "disagree" and "strongly disagree" responses. This reflected the stronger feelings and sentiments attached to the purchasing of GM food products. Even though cisgenics were a preferred GM product to transgenic, on intention to purchase they showed no significant difference. This showed that as long as the DNA was altered some respondents have no intention to purchase GM products.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Qn69 I am prepared to buy GM milk at premium price	1.40%	2.00%	18.40%	29.20%	36%	13%
Qn70 I will only buy GM milk if it is cheaper than conventional products	4.20%	9.60%	24.90%	21.50%	24.10%	15.60%
Qn71 I am not prepared to pay any price for this GM milk	21%	17.80%	28.30%	10.20%	6.50%	16.10%
Qn82 If meat and milk products from animals fed on GM pastures were available in shops I would definetly buy them for my family	1.10%	7.10%	29.70%	22.10%	22.70%	17.40%
Qn83 I am prepared to buy milk or meat products from animals fed on GM pastures at a premium price	1.40%	2.50%	21%	31.70%	30.60%	12.70%
Qn84 I will only buy products from animals fed on GM pastures if it is cheaper than the conventional products	3.40%	11%	28.30%	22.90%	21%	13.30%
Qn85 I am not prepared to buy products from animals fed on GM pastures	20.40%	16.10%	26.60%	15%	5.10%	16.70%
Qn88 All forms of GM are unacceptal to me	10.50%	13.30%	25.80%	25.20%	9.60%	15.60%
Qn89 I am prepared to buy this GM product(Cisgenic) at a premium price	1.70%	2.00%	20.10%	29.20%	30.60%	16.40%
Qn90 I will only buy this product(Cisgenic) if it is cheaper than conventional products	3.10%	10.20%	25.50%	21.80%	22.90%	16.40%
Qn96 I am prepared to buy a transgenic product at a premium price	1.40%	0.80%	15.30%	33.40%	35.40%	13.60%
Qn97 I will only buy transgenic product if its cheaper than a conventional product	1.70%	6.50%	20.10%	26.90%	29.20%	15.60%

Figure 16 Intention to purchase

On the descriptive statistics Table 9 below, the most negative response is to the question "prepared to buy transgenic product at a premium price." It received a mean of 4.2 and "prepared to buy cisgenic at a premium price" had a mean of 4.0. Qn88, All forms of GM are unacceptable to me was slightly positive which was s not sufficient enough to suggest some forms of GM can be acceptable.

Table 9 Descriptive statistics for intention to purchase

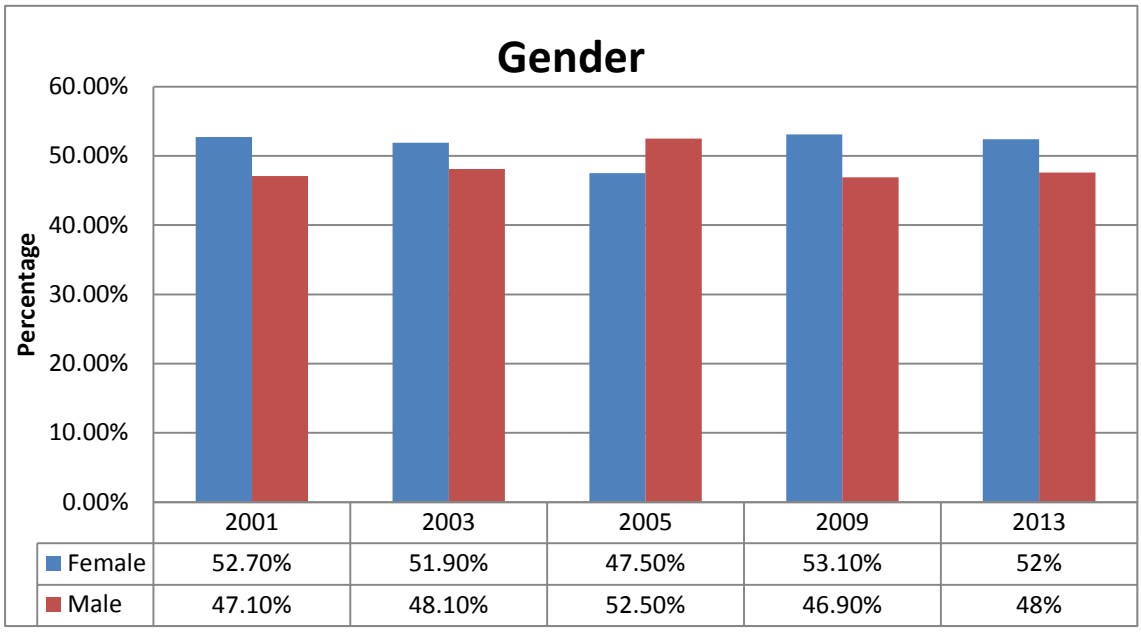
	2013 Descriptive Statistics						
	Key Questions	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Attitude**
Intention to purchase	Qn 70 Only buy GM milk if it is cheaper than conventional products	298	1	5	3.6	1.2	Negative
	Qn 71 Not prepared to pay any price for this GM milk	296	1	5	2.6	1.2	Negative
	Qn 82 Would buy products from animals fed on GM pastures	292	1	5	3.7	1.0	Negative
	Qn 83 Prepared to buy milk or meat from animals fed GM pastures	308	1	5	4.0	0.9	Negative
	Qn 84 Buy products from animals fed on GM pastures if cheaper.	306	1	5	3.5	1.1	Negative
	Qn 85 Not prepared to buy products from animals fed GM pastures	294	1	5	2.6	1.2	Negative
	Qn 88 All forms of GM are unacceptable to me	298	1	5	3.1	1.2	Positive
	Qn 89 Prepared to buy GM product (cisgenic) at a premium price	295	1	5	4.0	0.9	Negative
	Qn 90 Only buy this product (cisgenic) if it is cheaper	295	1	5	3.6	1.1	Negative
	Qn 96 Prepared to buy transgenic product at a premium price.	305	1	5	4.2	0.9	Negative
	Qn 97 Only buy transgenic product if it's cheaper	298	1	5	3.9	1.0	Negative

4.3 Comparison with previous studies

The results were compared with previous studies in two ways: the first way compared the demographic and socio-economic composition of the respondents in Small's surveys in 2001, 2003, 2005 and 2009 with this study. This enabled us to establish if a change in attitude over time was the result of changes in the sample demographics and social composition or not. The second way compared responses to the same GM questions asked in Small's study in 2001, 2003, 2005 and 2009 to this study.

4.3.1 Gender

The ratio of male to female respondents in this study was similar to the previous research by Small, in 2001, 2003, 2005 and 2009, as shown in Figure 17, below. The only year when more males responded to the survey than females was 2005.



	2001	2003	2005	2009	2013
Female	52.70%	51.90%	47.50%	53.10%	52%
Male	47.10%	48.10%	52.50%	46.90%	48%

Figure 17 Respondents' gender distribution

4.3.2 **Age**

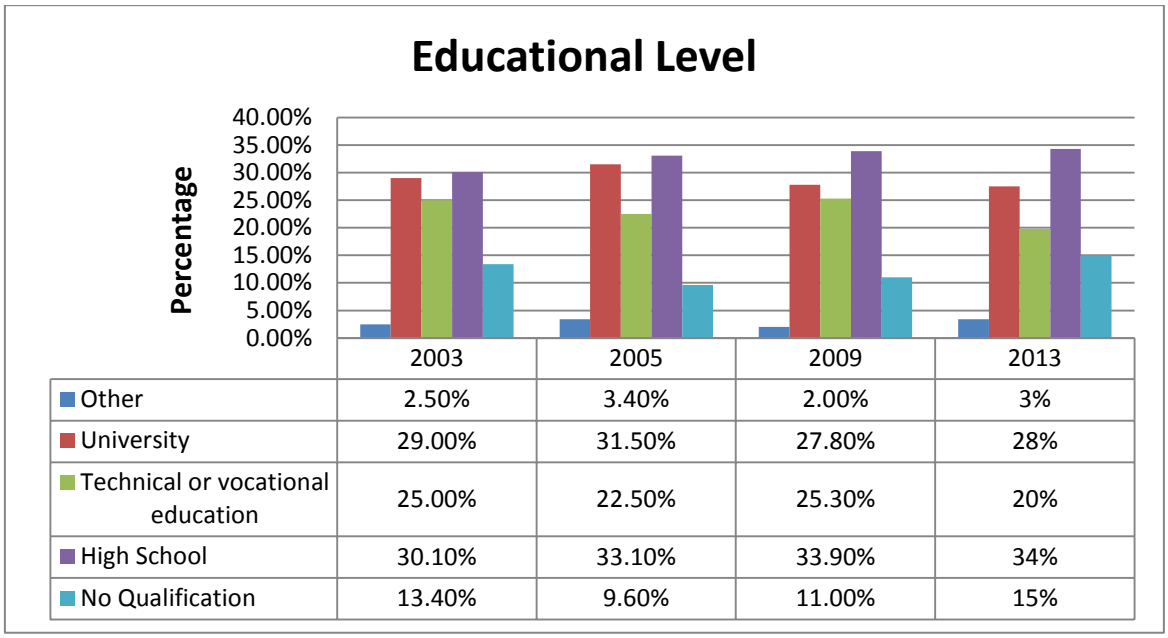
The age of respondents in 2013 ranged from 16 to 90, with a mean age was 44.44 and this was similar to the previous studies done by Small in 2001, 2003, 2005 and 2009, as shown in Table 10, below.

Table 10 Mean age of respondents

Descriptive	**Year**	**N**	**Mean**	**Std. Deviation**
Age	2001	1649	45.19	15.554
	2003	950	45.9	15.804
	2005	848	44.05	14.962
	2009	1008	45.34	14.819
	2013	353	44.44	17.803

4.3.3 **Educational level**

The respondent's educational levels were similar to previous studies, as shown in Figure 18, below. Across all four years the greatest number of respondents had a high school qualification as their highest qualification.

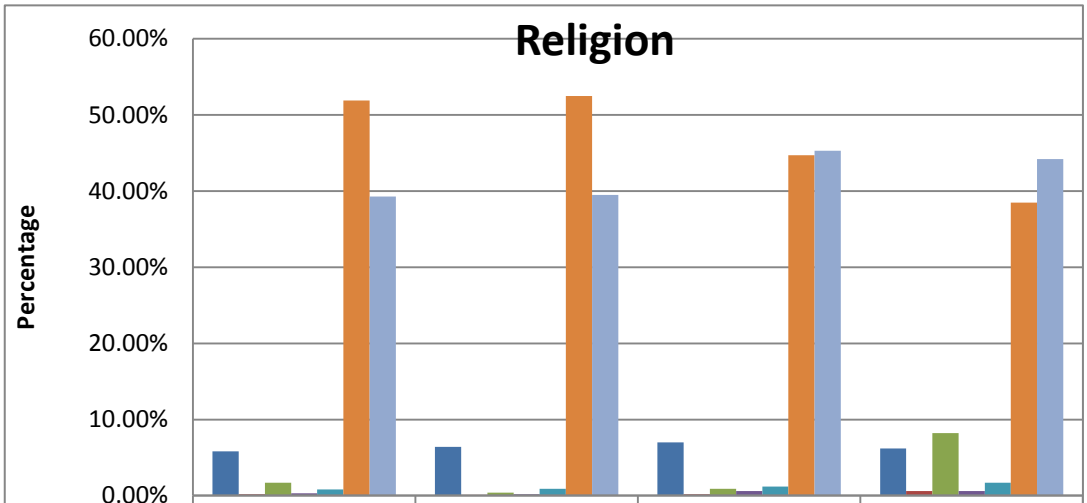


	2003	2005	2009	2013
Other	2.50%	3.40%	2.00%	3%
University	29.00%	31.50%	27.80%	28%
Technical or vocational education	25.00%	22.50%	25.30%	20%
High School	30.10%	33.10%	33.90%	34%
No Qualification	13.40%	9.60%	11.00%	15%

Figure 18 Respondents' educational levels

4.3.4 **Religion**

As shown in Figure 19, below, over the four surveys, the majority of people were in the Christian and no religion categories. There was a big increase in Hindu from 0.9% in 2009 to 8.2% in 2013. They could be over represented on the Smile City data base, as in the 2013 census Hindu constituted only 2.02% of New Zealand's religions. Christians have also dropped from 44.7% to 38.5%; this also could be an under representation on the Smile City data base as in the 2013 population census Christianity constituted 43.47% of New Zealand's religions. However, there were similarities with the rest of the religious categories over the ten-year period. No questions about the respondents' religion were asked in 2001.



	2003	2005	2009	2013
Other	5.80%	6.40%	7.00%	6.20%
Jewish	0.20%	0.10%	0.20%	0.60%
Hindu	1.70%	0.40%	0.90%	8.20%
Muslim	0.30%	0.20%	0.60%	0.60%
Buddhist	0.80%	0.90%	1.20%	1.70%
Christian	51.90%	52.50%	44.70%	38.50%
No religion	39.30%	39.50%	45.30%	44.20%

Figure 19 Respondents' religions

4.3.5 **GM Medicine vs GM Food**

Conditional support for GM food has gone down from 61%, in 2009, to 47%, in 2013. There has also been a notable increase in “don’t know”/ “unsure: responses, from 11% in 2009 to 20%in 2013. The data over the years have not been stable making it hard to draw conclusions – refer to Table 11.

Table 11 Percentage of respondents' support for GM products in food by year

Level of support (%)	**2001**	**2003**	**2005**	**2009**	**2013**
Totally support	3	9	9	7	5
Conditionally support	52	61	60	61	47
Totally oppose	36	26	26	21	27
Don’t know	8	4	5	11	20
Total	100	100	100	100	100

Just like GM food, as shown in Table 12, below, conditional support for GM medicine has also gone down from 55%, in 2009, to 45%, in 2013. There has also been a notable increase in “don’t know”/”unsure” responses, from 9%, in 2009, to 18%, in 2013. From 2003 to 2013 there was a gradual decline in support and a gradual increase in the opposition for GM medicine.

Table 12 Percentage of respondents’ support for GM products in medicine by year

Level of support (%)	**2001**	**2003**	**2005**	**2009**	**2013**
Totally support	16	32	33	26	21
Conditionally support	62	58	56	55	45
Totally oppose	14	7	7	9	16
Don’t know	8	3	3	9	18
Total	100	100	100	100	100

4.3.6 **Moral values**

Three key questions on moral values, Qn21, Qn22 and Qn42 had their frequencies and mean values compared to studies by Small in 2001, 2003, 2005 and 2009, as shown in Table 13, below. Genetically modifying animals had the most negative responses.

Table 13 Change in moral values attitude over time (2001 to 2013)

Question Item	Response (%)	2001	2003	2005	2009	2013
Qn21 GM fits with my cultural and spiritual beliefs	Strongly agree	3.92	11.36	6.4	4.17	5.1
	Agree	4.93	13.74	17.56	10.02	6.8
	Neither agree nor disagree	26.78	33.47	38.02	27.08	35.4
	Disagree	11.94	9.71	17.09	16.57	18.4
	Strongly disagree	47.57	27.17	17.67	25.2	14.4
	Don't know	4.45	4.24	6.4	16.96	19.8
	Mean	**3.99**	**3.29**	**3.23**	**3.59**	**3.4**
Qn22 GM fits with my basic moral principles	Strongly agree	4.51	14.05	7.09	3.97	4.5
	Agree	7.42	17.56	26.4	12.4	10.5
	Neither agree nor disagree	22.33	27.17	28.72	27.48	29.7
	Disagree	13.95	10.85	19.65	21.23	21
	Strongly disagree	47.45	26.76	15.7	20.24	17
	Don't know	3.92	2.69	7.09	14.68	17.3
	Mean	**3.97**	**3.19**	**3.11**	**3.48**	**3.4**
Qn42 It is acceptable to genetically modify animals for human benefit	Strongly agree	8.25	13.53	6.16	4.17	2.3
	Agree	12.35	16.84	21.4	10.71	11
	Neither agree nor disagree	15.97	21.28	18.37	22.02	22.1
	Disagree	14.67	11.67	26.74	22.42	24.1
	Strongly disagree	43.59	31.51	22.67	30.95	26.3
	Don't know	4.33	3.93	6.16	9.72	14.2
	Mean	**3.77**	**3.32**	**3.4**	**3.72**	**3.7**

The average moral mean values for 2001, 2003, 2005, 2009 and 2013 were plotted on a graph (Figure 20) to show the trends of changes in attitude. The greatest change in attitude (moral value) appeared to occur from 2001 to 2003, where this attitude moved more towards neutral. Overall, that attitude had remained negative. This shows that, overall, New Zealanders viewed GM as not being morally right.

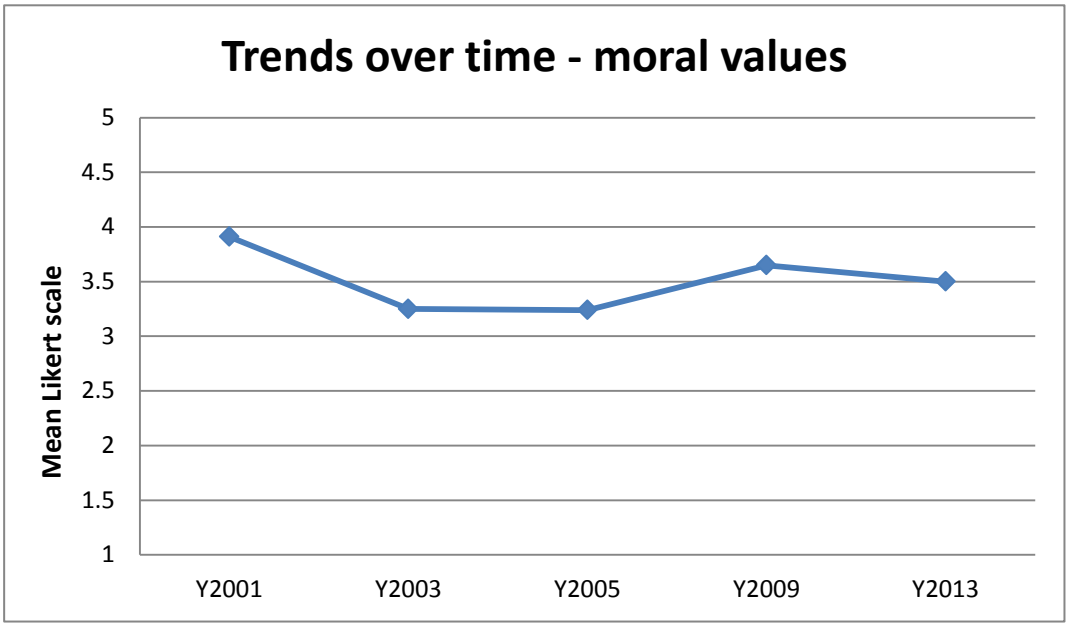


Figure 20 Change in attitudes over time (moral values)

The weighted average means plotted on the graph in figure 20 above went through a comparative statistical analysis using a one way ANOVA, to establish any significant statistical difference at 0.05 level in the means over the years.

Table 14 One way ANOVA analysis for moral values

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2001	3	11.73	3.91	0.0148
2003	3	9.8	3.266667	0.004633
2005	3	9.74	3.246667	0.021233
2009	3	10.79	3.596667	0.014433
2013	3	10.5	3.5	0.03

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.88796	4	0.22199	13.04289	0.000559	3.47805
Within Groups	0.1702	10	0.01702			
Total	1.05816	14				

The F critical value was smaller than the F value and P value was less than P alpha (0.05) so we rejected the null hypothesis that there is no difference between the means over the years. The ANOVA results showed that there is a significant statistical difference at the 0.05 level in mean values over the years, implying that attitudes have not remained the same. A t-test was then used to identify the years with different means.

The table 15 below show the t-test result for 2001 and 2003 means. The t critical is smaller than the t statistic, so we rejected the null hypothesis that there is no difference between the means. We concluded that means for 2001 and 2003 are statistically different. Therefore statistically attitudes changed towards neutral 2001 to 2003, then stabilise over 2003 and 2005.

Table 15 t-Test for 2001 and 2003 means

	2001	*2003*
Mean	3.91	3.2666667
Variance	0.0148	0.0046333
Observations	3	3
Hypothesized Mean Difference	0	
df	3	
t Stat	7.99324329	
P(T<=t) one-tail	0.00204328	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.00408655	
t Critical two-tail	3.18244631	

The table 16 below show the analysis of variance for the period 2005, 2009 and 2013. The F critical is greater than F value so we accepted the null hypothesis that there is no statistical difference in 2005, 2009 and 2013 means at 0.05 level. We concluded that the attitudes have statistically remained the same over the years 2005, 2009 and 2013.

Table 16 One way ANOVA test for 2005, 2009 and 2013 means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2005	3	9.74	3.246667	0.021233
2009	3	10.79	3.596667	0.014433
2013	3	10.5	3.5	0.03

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.196022	2	0.098011	4.477665	0.064575	5.143253
Within Groups	0.131333	6	0.021889			
Total	0.327356	8				

4.3.7 **Image**

Two key questions on image, Qn37 and 38, had their frequencies and mean values compared to studies undertaken by Small in 2001, 2003, 2005 and 2009, as shown in Table 17, below. Generally, the attitude has remained negative over the years.

Table 17 Change in attitude over time (image)

Question Item	Response (%)	2001	2003	2005	2009	2013
Qn37.Producing GM products fits with NZ's clean green image	Strongly agree	1.72	1.34	1.4	1.79	1.4
	Agree	2.2	7.23	7.56	4.27	6.8
	Neither agree nor disagree	10.39	26.65	21.4	18.15	23.2
	Disagree	17.16	21.9	35.7	23.41	26.9
	Strongly disagree	63.54	23.45	29.3	38.19	23.2
	Don't know	4.51	19.11	3.26	14.19	18.4
	Mean	**4.46**	**4.02**	**3.88**	**4.07**	**3.8**
Qn38.Producing GM products fits with NZ's image of marketing healthy food	Strongly agree	2.85	3.1	1.63	1.39	1.7
	Agree	3.21	5.37	9.77	5.36	9.1
	Neither agree nor disagree	11.88	22.31	20.12	19.05	24.9
	Disagree	18.05	18.7	34.19	23.21	24.4
	Strongly disagree	58.25	43.8	29.77	35.52	22.1
	Don't know	5.34	5.99	3.49	15.48	17.8
	Mean	**4.33**	**3.93**	**3.85**	**4.02**	**3.7**

The average image mean values for 2001, 2003, 2005, 2009 and 2013 were plotted on a graph to show the trends of change in attitude (Figure 21, below). The largest change in attitude (image) appeared to have occurred from 2001 to 2003, where the attitude continued to move more towards neutral. Overall, attitudes to the effect of GM on New Zealand's image have remained negative.

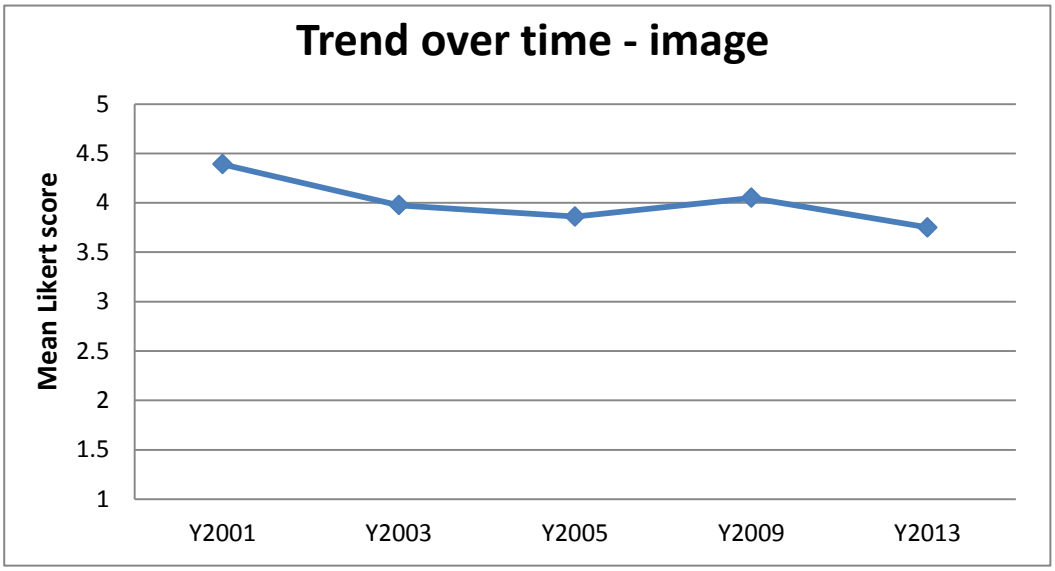


Figure 21 Change in attitude over time (image)

The weighted average means plotted on the graph in figure 21 above went through a one way ANOVA, to see establish any significant statistical difference in the means over the years.

Table 18 One way ANOVA test for image means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2001	2	8.79	4.395	0.00845
2003	2	7.95	3.975	0.00405
2005	2	7.73	3.865	0.00045
2009	2	8.09	4.045	0.00125
2013	2	7.5	3.75	0.005

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.47844	4	0.11961	31.14844	0.000995	5.192168
Within Groups	0.0192	5	0.00384			
Total	0.49764	9				

The F critical value is smaller than the F value so we rejected the null hypothesis that there is no difference between the means over the years. The ANOVA results showed that there is significant difference in mean values over the years, implying that attitudes have not remained the same. A t-test was then used to identify the years with different means.

The table 19 below show the t-test result for 2001 and 2003 means. The t critical is smaller than the t statistic, so we rejected the null hypothesis that there is no difference between the means. We

concluded that means for 2001 and 2003 are statistically different at 0.05 level. Therefore statistically attitudes change towards neutral 2001 to 2003, then stabilised over 2003 and 2005.

Table 19 t-Test for 2001 and 2003 means

	Variable 2001	*Variable 2003*
Mean	4.395	3.975
Variance	0.00845	0.00405
Observations	2	2
Hypothesized Mean Difference	0	
df	2	
t Stat	5.312626	
P(T<=t) one-tail	0.016826	
t Critical one-tail	2.919986	
P(T<=t) two-tail	0.033653	
t Critical two-tail	4.302653	

The table 20 below show the analysis of variance for the period 2005, 2009 and 2013. The F critical is greater than F value so we accepted the null hypothesis that there is no statistical difference in 2005, 2009 and 2013 means at 0.05 level. We concluded that the attitudes have statistically remained the same over the years 2005, 2009 and 2013.

Table 20 One way ANOVA for 2005, 2009, 2013 image means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2003	2	7.95	3.975	0.00405
2005	2	7.73	3.865	0.00045
2009	2	8.09	4.045	0.00125

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.032933	2	0.016467	8.591304	0.057308	9.552094
Within Groups	0.00575	3	0.001917			
Total	0.038683	5				

4.3.8 **Trust**

Three key questions on trust, Qn30, 31 and 32, had their frequencies and mean values compared to studies undertaken by Small in 2001, 2003, 2005 and 2009, as shown in Table 21, below. This attitude has remained constantly negative over the years.

Table 21 Change in attitude over time (trust)

Question Item	**Response (%)**	**2001**	**2003**	**2005**	**2009**	2013
Qn30.I trust what scientists say about GM	Strongly agree	8.49	10.54	3.26	2.68	2.5
	Agree	15.68	17.67	25.47	14.09	21
	Neither agree nor disagree	27.14	28.51	27.09	29.17	27.8
	Disagree	15.32	15.19	23.26	21.23	21.8
	Strongly disagree	26.37	23.35	15.7	19.05	11.6
	Don't know	6.65	4.24	4.07	13.79	16.7
	Mean	**3.38**	**3.24**	**3.24**	**3.46**	**3.2**
Qn31.I trust what companies say about GM	Strongly agree	2.26	2.27	0.93	1.29	0.6
	Agree	5.29	4.96	6.86	4.96	4.8
	Neither agree nor disagree	18.41	25.41	24.65	25	24.9
	Disagree	23.63	23.14	32.44	27.08	31.7
	Strongly disagree	43.88	39.26	30.23	27.88	22.4
	Don't know	6.06	4.55	3.84	13.79	15.6
	Mean	**4.09**	**3.97**	**3.89**	**3.87**	**3.8**
Qn32.I trust what regulators say about GM	Strongly agree	-	6.51	1.86	2.08	0.8
	Agree	-	12.81	17.44	11.01	13.6
	Neither agree nor disagree	-	28.1	25.58	27.98	28.9
	Disagree	-	17.98	29.53	24.6	22.7
	Strongly disagree	-	29.65	19.88	19.64	14.7
	Don't know	-	4.44	4.88	14.68	19.3
	Mean	**-**	**3.54**	**3.51**	**3.57**	**3.5**

Trust towards scientists, authorities and companies appeared to have stayed fairly constant over 2003, 2005, 2009 and 2013, as shown in Figure 22, below. The attitude has remained negative. Data were not available for 2001 as there were no questions regarding trust asked that year.

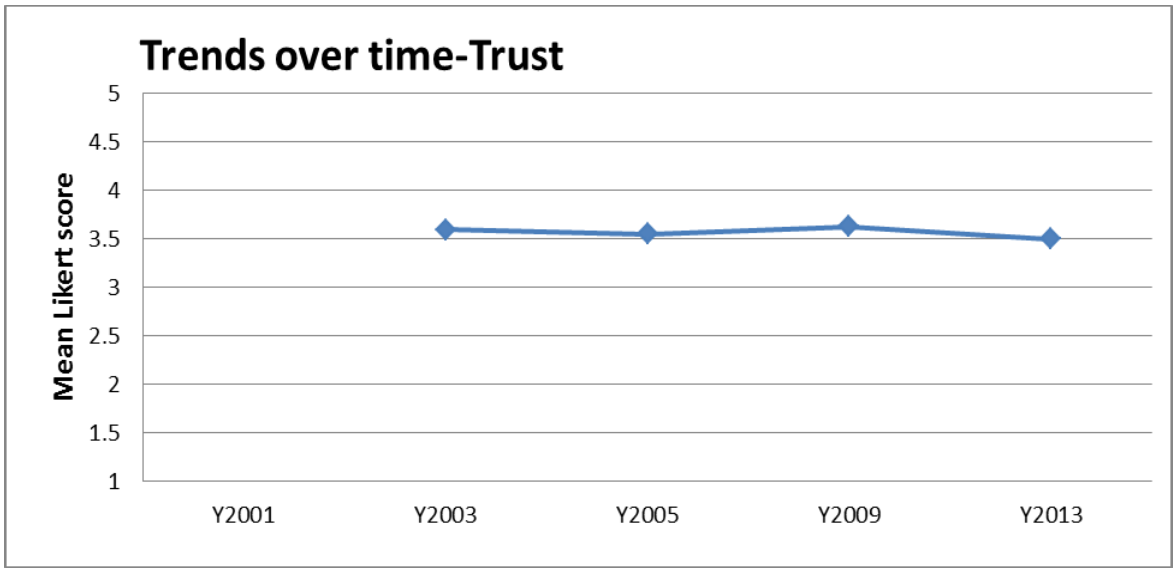


Figure 22 Change in attitude over time (trust)

The weighted average means plotted on the graph in figure 22 above went through a one way ANOVA; establish any statistical difference in the means over the years.

Table 22 One way ANOVA for test for trust means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2003	3	10.75	3.583333333	0.134633333
2005	3	10.64	3.546666667	0.106633333
2009	3	10.9	3.633333333	0.045033333
2013	3	10.5	3.5	0.09

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.02869	3	0.009563889	0.101662385	0.9567904	4.066180551
Within Groups	0.7526	8	0.094075			
Total	0.78129	11				

The F critical value is greater than the F value so we accepted the null hypothesis that the means over the years are the same. There is no statistical difference in means for trust over the years at 0.05 level. This implied that attitudes towards trust remained the same over the 2003 to 2013 period.

4.3.9 **Risk**

Three key questions on risk, Qn 16, 17 and 18, were only asked in 2009 and 2013. In 2013, the attitudes were trending towards negative. New Zealanders viewed GM as being risky, and those views seem to be getting more negative in 2013 compared to 2009.

Table 23 Change in attitude over time (risk)

Question Item	Response (%)	2001	2003	2005	2009	2013
Qn16.GM poses a significant risk to the environment	Strongly agree				10.9	14.7
	Agree				11.9	23.2
	Neither agree nor disagree				22.7	26.1
	Disagree				18.1	9.3
	Strongly disagree				8.9	2
	Don't Know				27.7	24.6
	Mean				**3.03**	**2.48**
Qn17. GM poses a significant risk to the health and safety of humans	Strongly agree				10.7	15.3
	Agree				12.09	26.9
	Neither agree nor disagree				24.1	24.6
	Disagree				17.1	8.5
	Strongly disagree				9.91	2.8
	Don't know				26.46	21.8
	Mean				**3.04**	**2.45**
Qn18. GM poses a significant risk to the health and safety of animals	Strongly agree				11.1	15.9
	Agree				12.98	26.9
	Neither agree nor disagree				23.3	24.4
	Disagree				17.9	8.8
	Strongly disagree				8.4	2
	Don't know				26.56	22.1
	Mean				**2.99**	**2.41**

The mean averages plotted on Figure 23, below, are mean averages of three key questions (Qn 16, 17 and 18) on risk associated with GM asked in 2009 and 2013. In 2009, risk took close to a neutral position but in 2013 it was trending towards a more negative position.

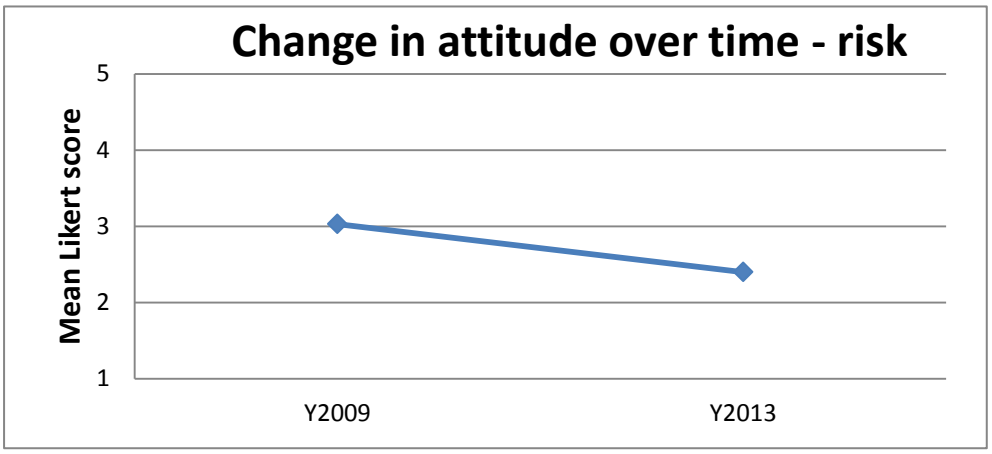


Figure 23 Change in attitude over time (risk)

Only measured over two year period 2009 and 2013 a t-test was used instead of ANOVA for the weighted means shown in figure 23 above.

Table 24 t-Test for 2009 and 2013 risk means

	2009	*2013*
Mean	3.02	2.446667
Variance	0.0007	0.001233
Observations	3	3
Pooled Variance	0.000966667	
Hypothesized Mean Difference	0	
df	4	
t Stat	22.58470645	
P(T<=t) one-tail	1.13817E-05	
t Critical one-tail	2.131846786	
P(T<=t) two-tail	2.27635E-05	
t Critical two-tail	2.776445105	

Since the t critical value is smaller than the t statistic we rejected the null hypothesis that the means are the same. The t-test result implied that there is a statistical difference in means for 2009 and 2013 at 0.05 level; therefore attitudes towards risk were trending towards negative.

4.3.10 **GM benefits**

Three questions, Qn26,Qn 27 and Qn28, were asked in 2001, 2003, 2005, 2009 and 2013 about the benefits of GM. "GM will help cure the world's major diseases" was trending towards positive, while "solve the world's food problems" was neutral and "GM products are environmentally friendly" remained negative.

Table 25 Change in attitudes over years (GM benefits)

Question Item	Response (%)	2001	2003	2005	2009	2013
Qn 26 GM will [help] cure the world's major diseases	Strongly agree	5.34	11.05	11.16	6.65	5.7
	Agree	15.14	19.42	34.3	19.94	20.1
	Neither agree nor disagree	19.12	24.48	26.05	25.89	31.7
	Disagree	14.79	11.05	11.16	12.3	9.3
	Strongly disagree	27.43	19.32	6.63	9.62	6.8
	Don't know	17.58	14.05	9.88	25.6	26
	Mean	**3.54**	**3.1**	**2.64**	**2.98**	**2.88**
Qn 27 GM will [help] solve the world's food problems	Strongly agree	6.77	10.54	9.42	7.04	5.7
	Agree	13.84	16.94	28.6	18.55	17.6
	Neither agree nor disagree	18.94	25.31	21.51	25	31.2
	Disagree	11.22	11.67	21.05	13.59	13
	Strongly disagree	32.19	24.69	11.28	15.08	9.9
	Don't know	16.63	10.43	7.33	20.73	23
	Mean	**3.58**	**3.26**	**2.96**	**3.14**	**3.05**
Qn 28 GM products are environmentally friendly	Strongly agree	2.38	3.41	2.09	1.09	2.5
	Agree	4.39	7.95	6.86	6.25	5.1
	Neither agree nor disagree	20.78	31.61	31.28	21.73	29.2
	Disagree	12.41	12.71	24.3	19.05	20.4
	Strongly disagree	32.19	27.27	17.79	17.96	14.2
	Don't know	27.38	16.53	16.74	33.93	29
	Mean	**3.94**	**3.63**	**3.59**	**3.7**	**3.55**

The trends seemed to show support for GM when it helped cure world diseases, but remained negative on GM being environmentally friendly. GM products that benefitted human health were likely to gain more support than just using GM as a source of food or for environmental solutions. The mean averages plotted on Figure 24, below, are mean averages of three key questions on GM benefits asked in 2001, 2003, 2005, 2009 and 2013 (Qn26, 27 and 28). There was a steady shift of attitude towards more of a neutral position from 2001 to 2005, with no significant changes in attitude since 2005.

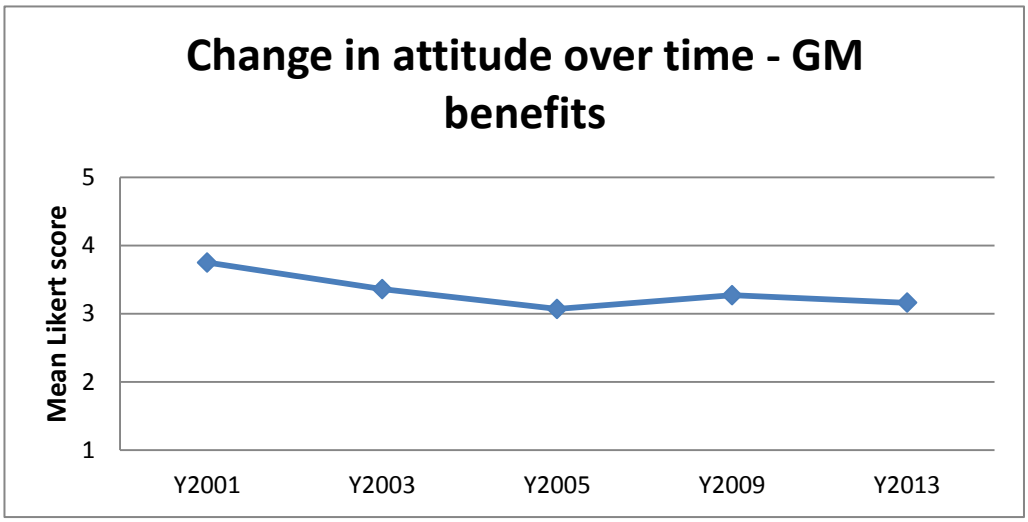


Figure 24 Change in attitude over time (GM benefits)

The weighted average means plotted on the graph in figure 24 above went through a comparative statistical analysis using a one way ANOVA, to establish any significant statistical difference in the trends over the years.

Table 26 One way ANOVA test for benefit means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2001	3	11.06	3.686666667	0.048533333
2003	3	9.99	3.33	0.0739
2005	3	9.19	3.063333333	0.233633333
2009	3	9.82	3.273333333	0.142933333
2013	3	9.48	3.16	0.1213

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.680093	4	0.170023333	1.370492772	0.311470578	3.478049691
Within Groups	1.2406	10	0.12406			
Total	1.920693	14				

The F critical value is greater than the F value so we accepted the null hypothesis that the means over the years are the same. There is no significant statistical difference in means at 0.05 level for benefits over the years. This implied that attitudes remained the same over that period.

4.3.11 **Social norms**

The attitudes for social norms had remained relatively constant and negative over the years, as shown in the Table 27, below, Question 35 was asked in 2001, 2003, 2005, 2009 and 2013. Question 36 was not asked in 2001.

Table 27 Change in attitude over time (social norms)

Question Item	Response (%)	2001	2003	2005	2009	2013
Qn 35 The people important to me consider that GM technology is acceptable	Strongly agree	2.02	5.89	1.98	0.99	1.4
	Agree	2.55	12.09	22.91	9.13	11.3
	Neither agree nor disagree	20.67	32.85	27.91	22.42	31.4
	Disagree	12.53	14.88	22.79	18.35	18.4
	Strongly disagree	44.83	21.9	9.77	17.76	11
	Don't know	16.86	11.88	13.6	31.35	26.3
	Mean	**3.96**	**3.4**	**3.18**	**3.62**	**3.4**
Qn 36 Most New Zealanders consider GM technology is acceptable	Strongly agree	-	1.34	0.12	0.89	0.6
	Agree	-	7.23	8.14	8.13	8.2
	Neither agree nor disagree	-	26.65	23.84	21.23	21.2
	Disagree	-	21.9	42.67	24.31	26.8
	Strongly disagree	-	23.45	10.12	18.95	9.3
	Don't know	-	19.11	14.3	26.49	32
	Mean	**-**	**3.73**	**3.64**	**3.71**	**3.6**

The mean averages were plotted on a graph, and there was not a large change in social norms overtime with a mean difference between 2003 and 2013 of 0.08. The attitude has remained relatively constant and negative over the ten year period.

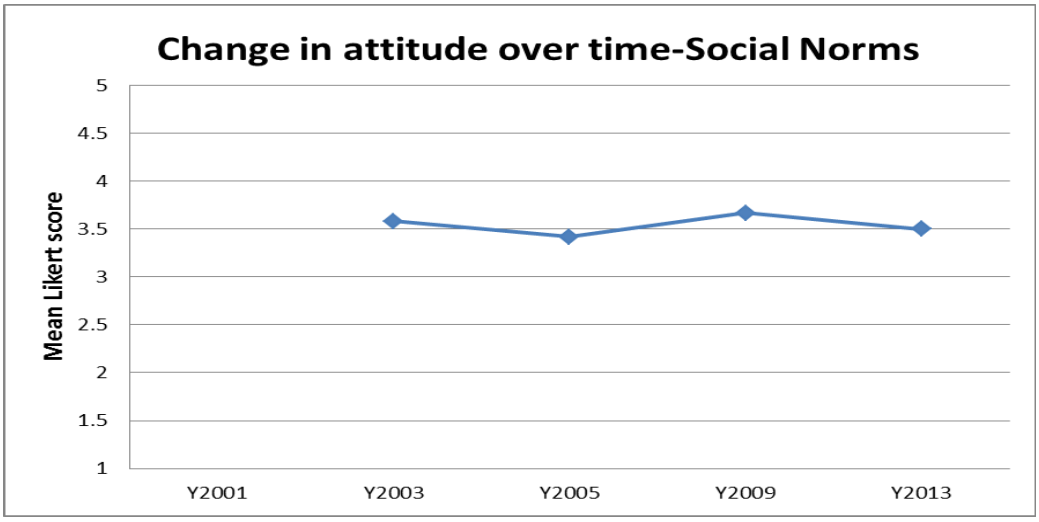


Figure 25 Change in attitude over time (social norms)

The weighted average means plotted on the graph in figure 25 above went through a comparative statistical analysis using a one way ANOVA, to establish any significant statistical difference in the social norms mean trends over the years.

Table 28 One way ANOVA for social norms means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2001	1	3.96	3.96	
2003	2	7.13	3.565	0.05445
2005	2	6.82	3.41	0.1058
2009	2	7.33	3.665	0.00405
2013	2	7	3.5	0.02

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.229856	4	0.057463889	1.247181528	0.417835533	6.388232909
Within Groups	0.1843	4	0.046075			
Total	0.414156	8				

The F critical value is greater than the F value so we accepted the null hypothesis that the means over the years are the same. There is no statistical difference in means for social norms over the years at 0.05 level. This implied that attitudes have remained the same over that period.

4.3.12 **Approach to specific GM products**

No questions about specific GM products were asked in 2001. The trend has been towards a negative attitude for the questions asked in this category.

Table 29 Change in attitude over time (approach to specific GM product)

Question Item	Response (%)	2003	2005	2009	2013
Qn57.I would feel good about purchasing GM milk for myself	Strongly agree	10.6	8.9	4.76	2.3
	Agree	13.95	24.9	12	7.4
	Neither agree nor disagree	23.97	22.3	22.9	28.9
	Disagree	11.16	20.5	18	21.8
	Strongly disagree	35.7	19.5	27.5	22.4
	Don't know	4.54	4.22	14.5	17.3
	Mean	**3.5**	**3.1**	**3.6**	**3.66**
Qn58. GM milk will be a useful product to develop	Strongly agree	17.87	10.6	7.9	1.4
	Agree	20.04	39	19.3	11.9
	Neither agree nor disagree	22.73	18.2	24.8	28.3
	Disagree	8.37	11.8	12.9	15.9
	Strongly disagree	24.79	10.7	17.3	17.8
	Don't know	6.2	6.2	17.5	24.6
	Mean	**3.02**	**2.77**	**3.15**	**3.49**
Qn59. I would trust the claims made about GM milk by the people selling it	Strongly agree	5.79	1.75	2.7	1.7
	Agree	10.64	10.7	8.9	3.4
	Neither agree nor disagree	27.27	25.08	23.5	23.5
	Disagree	16.43	33.6	23.2	28
	Strongly disagree	35.02	24.5	26.5	24.9
	Don't know	4.85	5.04	14.9	18.4
	Mean	**3.68**	**3.71**	**3.7**	**3.87**
Qn60.The people important to me would want me to purchase GM milk	Strongly agree	4.65	3.01	3.07	1.1
	Agree	7.23	15.9	14.2	3.4
	Neither agree nor disagree	28	25.7	19.5	27.5
	Disagree	12.5	23.9	16.1	21.2
	Strongly disagree	29.4	16.8	26.09	22.9
	Don't know	18.39	15	28.4	23.8
	Mean	**3.67**	**3.41**	**3.76**	**3.81**

The mean averages plotted on Figure 26, below, are mean averages of the four key questions (Qn57, 58, 59 and 60) in 2003, 2005, 2009 and 2013. There was a steady shift in attitude towards a neutral stance from 2003 to 2005 then it changed towards negative in 2009 and 2013.

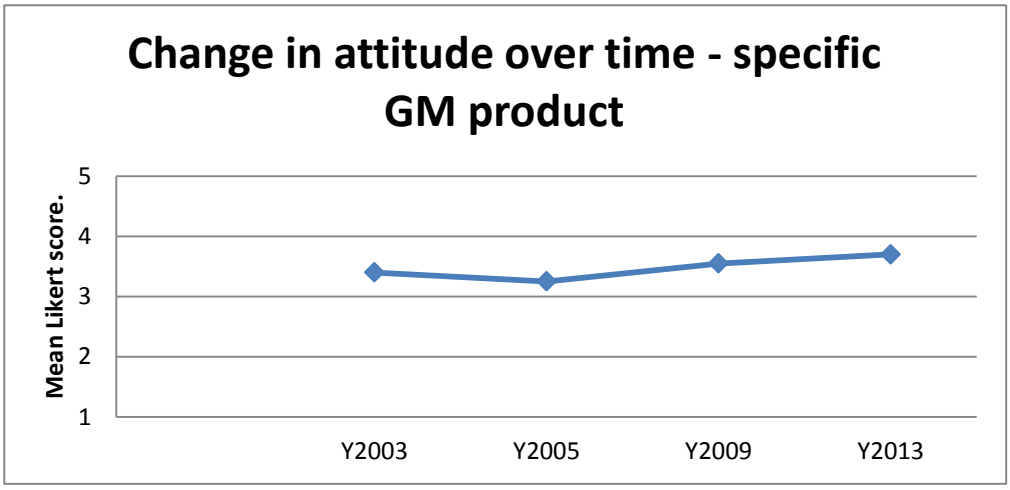


Figure 26 Change in attitude over time (specific GM product)

The weighted average means plotted on the graph in figure 26 above went through a comparative statistical analysis using a one way ANOVA.

Table 30 One way ANOVA test for approach to specific GM products means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2003	4	13.87	3.4675	0.095825
2005	4	12.99	3.2475	0.163358
2009	4	14.21	3.5525	0.076358
2013	4	14.83	3.7075	0.028825

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.441875	3	0.147292	1.616961	0.237352	3.490295
Within Groups	1.0931	12	0.091092			
Total	1.534975	15				

The F critical value is greater than the F value so we accepted the null hypothesis that the means over the years are the same. There is no statistical difference in means for approach to specific GM products over the years at 0.05 level. This implied that attitudes have remained the same over that period.

4.3.13 **Intention to purchase**

The trend seemed to be negative for all the same questions asked in 2001, 2003, 2005, 2009 and 2013. Table 31 below shows the trends.

Table 31 Change in attitude over time (intention to purchase)

Question Item	Response (%)	2001	2003	2005	2009	2013
Qn 54 If GM milk products were available in the shops, I would definitely buy it for myself	Strongly agree	7.48	10.74	5.23	4.17	1.4
	Agree	13.12	13.22	17.44	9.13	5.4
	Neither agree nor disagree	22.98	21.49	21.86	21.13	22.1
	Disagree	13.95	13.02	27.67	17.46	26.9
	Strongly disagree	40.8	35.12	23.84	31.94	28
	Don't know	0.83	5.89	3.6	16.17	16.1
	Mean	**3.69**	**3.52**	**3.49**	**3.76**	**3.89**
Qn 55 If GM milk products were available in the shops, I would definitely buy it for my family or the people who I live with	Strongly agree	5.82	9.81	3.84	4.17	1.1
	Agree	12.59	12.81	16.63	8.63	5.9
	Neither agree nor disagree	21.26	21.28	23.6	23.02	21.8
	Disagree	13.54	13.64	28.14	17.16	26.9
	Strongly disagree	40.2	36.05	23.6	30.46	27.8
	Don't know	5.88	5.89	3.72	16.57	16.4
	Mean	**3.75**	**3.57**	**3.53**	**3.73**	**3.89**
Qn 81 If meat and milk products from animal fed on GM pasture were available in the shops; I would definitely buy them for myself	Strongly agree	-	14.88	6.86	5.65	1.7
	Agree	-	15.91	24.42	12.8	8.2
	Neither agree nor disagree	-	22.93	19.77	22.02	28
	Disagree	-	8.06	22.67	17.46	23.2
	Strongly disagree	-	30.89	20.23	25.6	21.5
	Don't know	-	5.68	5	16.47	17.3
	Mean		**3.26**	**3.27**	**3.53**	**3.66**
Qn 82 If meat and milk products from animal fed on GM pasture were available in the shops; I would definitely buy them for my family or the people who I live with	Strongly agree	-	12.09	5.58	4.86	1.1
	Agree	-	14.67	22.67	12.7	7.1
	Neither agree nor disagree	-	23.35	20.81	23.12	29.7
	Disagree	-	9.19	23.49	15.67	22.1
	Strongly disagree	-	32.54	20.81	25.6	22.7
	Don't know	-	6.71	5.58	18.06	17.4
	Mean		**3.39**	**3.33**	**3.54**	**3.7**

Means for the same questions were averaged and plotted on a trend graph, as shown in Figure 27, below. Trends from 2001 until 2005 showed a slight movement towards the intention to purchase GM products. However, from 2005 to 2013 the trends shifted towards negative. The overall trend was towards negative as average mean values for 2013 (3.9) were higher than the value in 2001 (3.7).

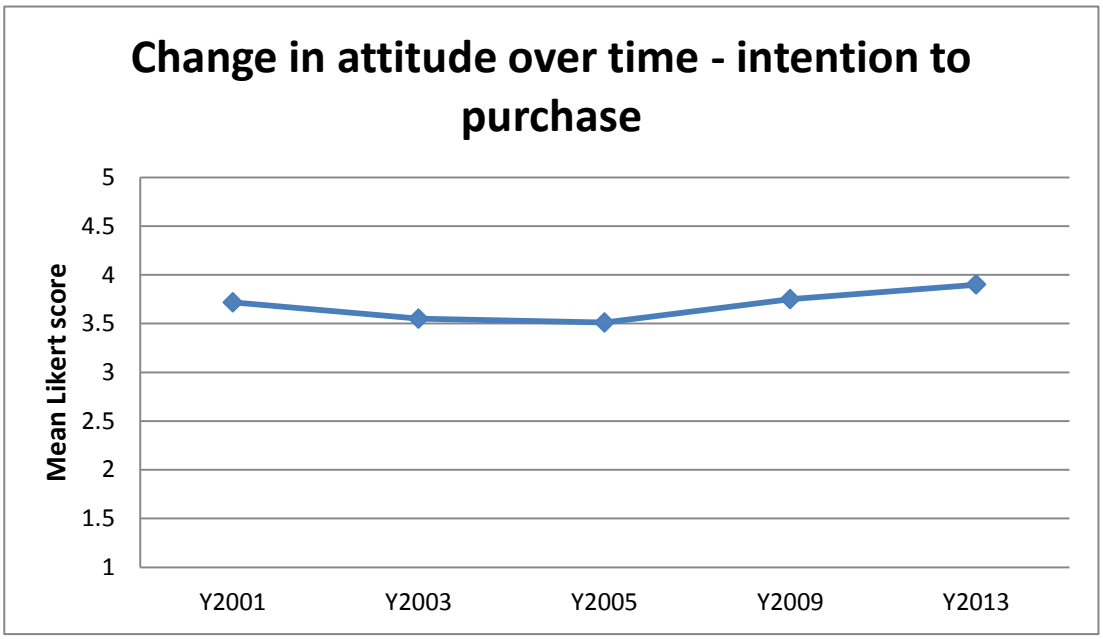


Figure 27 Change in attitude over time (intention to purchase)

The weighted average means plotted on the graph in figure 27 below went through a comparative statistical analysis using a one way ANOVA, to establish any significant statistical difference in the means over the years.

Table 32 One way ANOVA test for intention to purchase GM food means

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
2001	2	7.44	3.72	0.0018
2003	4	13.74	3.435	0.019367
2005	4	13.62	3.405	0.015567
2009	4	14.56	3.64	0.014867
2013	4	15.14	3.785	0.014967

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F critical*
Between Groups	0.4281	4	0.107025	7.094977	0.002941	3.179117
Within Groups	0.1961	13	0.015085			
Total	0.6242	17				

The F critical value is smaller than the F value so we rejected the null hypothesis that there is no difference between the means over the years. The ANOVA results showed that there is a significant difference in mean values over the years, implying that attitudes have not remained the same. This implies that attitudes towards purchasing GM food are trending towards negative over the years. Only two years 2003 and 2005 shows no significant statistical difference in their means at 0.05 level, the rest of the years 2005 to 2013 show a significant statistical difference, implying attitudes towards intention to purchase GM food is declining towards negative.

4.4 Focus group results

The focus group results are in two parts, the first part focuses on demographic and socio-economic characteristics of the participants. The second part focuses on participants' responses.

4.4.1 Participants' demographic data

This section provided a snapshot profile of the 40 New Zealanders who participated in the four focus groups conducted in Waikato. The number of participants in each focus group varied from seven to 12 people.

4.4.2 Participants' age

The majority of participants were aged between 31 and 50 years.

Twenty-three per cent of the participants were between 31 and 40 years of age and thirty-seven per cent of the participants were between 41 and 50 years of age.

Table 33 Age distribution

Age (years)	Frequency	Percentage
20 or younger	0	0
21-30	6	15
31-40	9	22.5
41-50	15	37.5
51-60	6	15
60 or older	4	10
Total	40	100

4.4.3 **Participants' gender distribution**

Fifty-seven per cent of respondents were female and 43 percent male.

Table 34 Gender distribution

Gender	Frequency	Percentage
Female	23	57.5
Male	17	42.5
Total	40	100

4.4.4 **Marital status**

The majority (63%) of participants were married people. Thirteen per cent of participants identified themselves as single and twenty per cent indicated that they had live-in partners and five per cent were divorced.

Table 35 Marital status

Marital status	Frequency	Percentage
Married	25	62.5
Partner	8	20
Single	5	12.5
Divorced	2	5
Total	40	100

4.4.5 **Ethnicity**

The majority of focus group participants (75%) identified themselves as New Zealand European. Eight per cent of respondents were New Zealand Maori. Eighteen per cent were Pacific Islanders and Asians. Europeans were over represented, at 75%, compared to the 2013 census where they were 64.7%, Maori were under presented, at 7.5%, compared to the 2013 census where they were 14.9%.

Table 36 Ethnicity

Ethnicity	**Frequency**	**Percentage**
NZ Maori	3	7.5
NZ European	30	75
Pacific Islander	1	2.5
Chinese	2	5
Indian	1	2.5
Filipino	2	5
Sri Lankan	1	2.5
Total	40	100

4.4.6 **Religion**

Most of the participants identified themselves as Christian (60%) and thirty percent had no religion. Four per cent of the participants were Buddhist and Hindu.

Table 37 Religion

Religion	**Frequency**	**Percentage**
Christian	24	60
No Religion	12	30
Buddhist	2	5
Hindu	2	5
Total	40	100

4.4.7 **Employment status**

Sixty-three per cent of respondents reported being employed full-time; twenty-five per cent were self-employed. Collectively, eighty-eight per cent of respondents were employed. Slightly fewer than thirteen per cent were not working, as shown in Table 38, below.

Table 38 Employment status

Employment status	**Frequency**	**Percentage**
Formerly employed	25	62.5
Self employed	10	25
Not working	5	12.5
Total	40	100

4.4.8 **Respondents' income levels**

Five per cent reported earning less than $25,000 per year and about twenty-three per cent reported earning between $25,000 and $50,000 annually. About twenty-eight cent reported earning between $51,000 and $70,000 annually and about eighteen per cent reported earning between $70,000 and $100,000 annually. About eight per cent of respondents were in the highest income bracket of more than $100,000 annually. Twenty per cent of respondents preferred not to say their income level. These income levels were not comparable to national levels, as shown by the 2013 census. In the 2013 census thirty-seven per cent earned less than $25,000, thirty-five per cent earned between $25,000 and $50,000, thirteen per cent earned between $50,000 and $70,000 and approximately six per cent earned more than $100,000. The respondents were over represented for income levels between $50,000 and $100,000.

Table 39 Personal income categories

Income Levels(NZ$)	**Frequency**	**Percentage**
Less than 25 000	2	5
25 000-50 000	9	22.5
50 000-70 000	11	27.5
70 000-100 000	7	17.5
More than 100 000	3	7.5
Prefer not to say	8	20
Total	40	100

4.4.9 **Respondents educational level**

Thirty-three per cent of participants had a secondary school education, twenty-three per cent had polytechnic training or a post-secondary certificate and twenty per cent had university education as their highest qualification. Twenty-five per cent had no formal qualifications, as shown in Table 40, below.

Table 40 Highest Level of education

Educational Level	**Frequency**	**Percentage**
No qualification	10	25
High school	13	32.5
Technical/Vocational	9	22.5
University	8	20
Total	40	100

In summary, the focus group participants tended to be married men and women aged between 30 and 60. The vast majority of participants were New Zealand born people of European descent, although efforts were made to include Asians, Pacific Islanders and Maori. Most of the respondents earned between $30 000 and $70 000 annually. Most of the participants had secondary school education as their highest qualification.

4.5 Focus group participants responses

The focus groups revealed insights into to participant's perceptions and beliefs about GM technology. The results were organised into four main themes:

1. Participant's current situation in regard to GM.

2. Participants' preferred situation.

3. Options available to get to the preferred situation.

4. Immediate actions available to get to the preferred situation.

4.5.1 Current scenario

The current situation in regard to GM reflected four sub-themes: what is GM; trust; lack of information; and fear of risk involved.

What is GM?

Participants wanted a deeper understanding of GM and why it was necessary in New Zealand.

What is GM, what is in it, and what's so special about it? Male, Te Awamutu

We are not running out of food in NZ, so why GM food now? Female, Te Pahu

The public don't know much about GM and that's a limiting factor. We can't eat what we don't understand. Female, Hamilton

What is GM and what is not GM? There should be a clear definition. Male, Te Awamutu

If we have GM ryegrass will that make our cows and milk GM? Female, Putaruru

Trust

Participants highlighted their lack of trust about the companies behind GM. The feelings were that information on GM was being withheld from the public; only advantages were highlighted and not much is given about disadvantages. Participants questioned if the companies involved will participate in correcting any negative effects emanating from using GM.

"It's like a secret, in the background a lot of things are happening. When probed; *We only hear about the dubious experiments in the newspaper and on TV. There are no official reports on these things.* Female, Te Awamutu

It's too commercial. Companies are driven by profits. I don't think they will fix any problems should they arise. Male, Te Pahu

I understand patents are involved and we can't reuse the seed. In the future biotech companies will control our food systems. Female, Hamilton

Companies are never going to advertise GM food. Why, because they know it's not safe. Female, Te Awamutu

Lack of information

Participants also highlighted that there was no information on side effects coming from the government and biotech companies. This created suspicions as consumers believed they were only told one side of the story.

The benefits could be there but we don't know the side effects. Male, Te Awamutu

DDT was good but now we know it's very dangerous. So who knows what's in store for us? Female, Te Pahu

Our cows are eating cotton seed; so who knows, it might be GM. So we are already eating it unknowingly. Male, Hamilton

Yes, we use far too much chemicals but the trouble is GM crops are not an option as we don't know much about them. Female, Putaruru

There could be a future in GM but the unknowns are just more terrifying than the benefits, and we don't want to be like guinea pigs. Male, Te Awamutu

GM is often talked about in a negative way; scientists should come out and publicly tell us about the good side of it. Male, Hamilton

Risk

Participants described the potential of losing the clean green image, and access to healthy food and pristine environment, as being risky. The general feeling was the harm will outweigh the gain.

Who is going to be responsible if 50 years from now cancer is out of control? Male, Te Awamutu

In Gisborne GM crops were planted by accident so not a good thing. Male, Te Pahu

What is the future with GM? Smoking cigarettes was cool over the years now is the most dangerous thing. Will that be the same with GM food? Female, Putaruru

This GM technology will affect our clean green image and our overseas markets. Male, Hamilton

Just supposing a big holocaust happens, how will the world survive with these terminator genes? People need to start keeping their own seed now. Female, Te Awamutu

With GM ryegrass; how are we going to label our milk, cows and meat, I think it's too dangerous. Female, Te Pahu

Look at how Fonterra botulism scandal affected both Fonterra and New Zealand reputation. Male Hamilton

4.5.2 **Preferred scenario**

Most of the participants preferred a total ban on GM. Other participants preferred a transparent and tightly regulated system. Only a few participants preferred continuing to explore innovations that arose out of GM.

Total ban

Most participants preferred a total ban on GM products and technology in New Zealand.

It's hard to participate in this discussion; my knowledge is very limited. We don't know much about what's going on, so my preferred scenario is not having GM at all. Female, Te Awamutu

New Zealand is beautiful and green and why damage it when we are not running out of food? So we should ban GM. Female, Te Pahu

New Zealand should be unique and different by being GM free and overseas markets will prefer our healthy products at a premium price. Male, Te Awamutu

What if GM works, will NZ lose out? No we will still sell our clean green image. Female, Putaruru

I don't believe there are any long term benefits; we don't need GM food in NZ. Male Te Awamutu

GM has been around for 10 years. If it was good everybody will be doing it, so it's failing. Female, Te Pahu

"Let's exhaust our traditional food path. If we are hungry GM should be our last resort. For now we don't need it. With ryegrass let's look for other ways not GM. Male, Hamilton

Transparency

Some participants believed that there was lack of transparency about GM products and the way research was being done in New Zealand.

GM food should have big and clear labels and sold on separate and labelled shelves. Female, Te Awamutu

"We need to know where our food is coming from and that should be transparent." Female, Hamilton

Accountability

Participants believed companies were after making money and will not commit themselves to unforeseen consequences. One possible option was for the government to introduce taxes and tariffs on GM products, to help with clean up should anything go wrong.

GM food and experiments should be taxed just in case something goes wrong. Male, Hamilton

Biotech companies should put money into research to investigate potential side effects of GM. Female, Te Awamutu

Regulations

Participants also felt that better and tighter regulations were needed to ensure safety to the people, animals and environment.

Why can't they be open talks and consultations and regulations, same as regional councils do on environmental issues? Male, Te Awamutu

There is no longevity in studies, but to get that longevity we need to do it to generate that longevity and that need to be tightly regulated by the government. Male, Te Pahu

"We need a clear understanding of GM so that only helpful products like GM medicines are allowed; we are not running out of food. Female, Hamilton

4.5.3 Options available to get to the preferred scenario

The preferred situation from the focus group was a total ban on GM products, taxing GM products, and GM products being sold on separate and labelled shelves in supermarkets. Some participants suggested that GM food can only be bought if it turned out cheaper.

"At cheaper price I can see myself buying GM, but that will be situational I doubt if we will buy when we are financially sound. So If GM doesn't work out cheaper no one will buy it. Female, Te Pahu

4.5.4 Immediate actions

Immediate actions suggested by the participants in all four groups included a total ban on GM and increasing government regulations. Other suggestions included making the GM companies accountable by taxing them to generate resources for correcting unforeseen consequences.

Participants in all four groups generally felt current regulations were not tight enough to protect people and the environment. Other suggestions included supermarkets coming up with GM shelves separate from non-GM. A few participants felt research on GM should continue.

GM grass might bring that competitiveness as a cheap way of growing grass, if we can't do it someone else will do it and our country will miss out. Male, Hamilton

NZ has got great scientists, maybe they can discover some good things about it, so they should keep researching. Male, Te Awamutu

4.5.5 **Changing attitudes over time**

Participants were also asked to rate their attitude over a period of time between the time they first heard about GM and the present. Most participants felt their attitude had not changed, the main reason being that there have not been any outstanding developments coming out of GM to influence a significant change in attitude. Some participants were surprised that people were still researching GM; they thought GM had died out.

4.6 Summary

Most of the participants preferred a total ban on GM, while a handful preferred tighter regulations that made biotech companies more accountable. Only a few participants were in totally in favour of GM.

The main reason why most people wanted a total ban was mainly to preserve New Zealand's clean green image and for the protection of non-GM markets. There was fear of environmental risks that come with GM crops as well as health and safety of people and animals. Tampering with DNA was thought to be unethical and too dangerous. There was also a question about the necessity for GM. Participants reasoned that New Zealand was not running out of food. Participants also felt that since GM involved patents, it might become too commercial and people will have to depend on multinationals for food.

Participants who preferred tighter regulations and accountability of biotech companies emphasised that it was taking too long to prove that GM was the ultimate technology as many scientists thought it would be. Therefore, there was a need for a cautious approach. It was also suggested that supermarkets should put GM products on separate shelves with clear labels so that people can make informed choices. Participants were quick to point to the presence of *Clostridium botulinum* in Fonterra's whey protein that caused a contamination scare in 2013, as a food safety and image issue. The contamination scare caused a lot of damage to both New Zealand and Fonterra. Participants highlighted how reputations can be easily eroded. Participants highlighted that, other than

medicines, there had been no public benefit from GM in New Zealand. They believed there was a need to engage in GM research and products that will benefit the public.

There were a few participants who were totally for GM. Their reasons included fear of being left out if GM turned out to be beneficial. New Zealand will play the catching up game they said. Therefore, they felt it was necessary to position ourselves to be competitive. Participants also highlighted that GM could turn out to be a cheap source of food, benefiting struggling families. While New Zealand was not out of food, not everybody can afford the available food.

Chapter 5

Discussion

5.1 Introduction

In this chapter, the survey and focus group results are analysed in detail. Analysis of the current survey and focus group results in comparison with the past studies will give us an indication on how the New Zealand public attitudes towards GM were trending.

5.2 Comparison of demographic information

Comparing the demographic and socio-economic distribution of data over the years (Small 2001, 2003, 2005, and 2009) with this study will help explain if the changes in attitudes observed in the data across the years were as a result of variations in the sample or not. Even though a small sample was chosen for the online survey, the sample compositions between years in terms of age and education showed no significant differences. Religion, however, showed a slight difference from the earlier years. The survey results showed that the 2013 sample had 8.2% Hindus, which was an over representation as the 2013 census showed that Hindus comprised only 2.2% of New Zealand's religions. Generally, the Hindu population had increased over the years. Christianity was also under represented (38.5%) compared with from the 2013 census (43.47%). Other religions were similar to the New Zealand census statistics. The differences in demographic composition were believed to be not significant enough to affect the results.

5.3 Moral values

The most common questions asked by focus group participants were, "Why do we really need GM and what kind of GM are necessary?" Most participants were accommodating production of GM medicine. Even with the online survey the level of acceptance was higher for medical purposes than for food. Participants tended to be influenced more by benefits toward human health than anything else. The most cited concerns were on food and environmental safety and harm to New Zealand's clean green image. The greatest opposition observed was on using GM to enhance human capabilities. However, genetically modifying humans to eradicate diseases had a less negative response than modifying humans to enhance their capabilities. Studies undertaken by Small in 2001, 2003, 2005 and 2009 had similar findings. Research by the AERU also had similar findings. Cook and Fairweather (2005) found that, for many respondents, their moral values affected their willingness to accept GM more than their specific knowledge about the technology. Overall, New Zealanders believed GM was morally wrong because it involved tampering with an organism's genetic makeup.

This was consistent with findings by the Royal Commission on Genetic Modification in 2001. *When writing about cultural and ethical concerns, public submitters variously argued from religious, ecological, ethical, moral and ethnic perspectives. However their messages were similar: GM is wrong because it's tampering with nature* (Appendix p.103).

The study by Small in 2001 showed attitudes about moral values were more negative than similar studies that followed in 2003, 2005, 2009 and 2013. The main reason could be that the 2001 study coincided with the Royal Commission on GM consultations when the topic had more press coverage. Pollark (2003) found that between January 2000 and June 2002, in Wellington alone, there were 550 press reports on GM compared to Dunahay's (2010) findings of 227 for January 2008 and February 2010 for the same area. In general, public attitudes on moral values regarding GM have remained constantly negative, with only small differences over the years, with the exception of Small's 2001 study. New Zealanders have not changed their attitudes and perceptions on the morality of GM.

5.4 Image

Most of the focus group participants believed New Zealand's agricultural products on international markets have an advantage because of the clean green image. The New Zealand public was proud of its clean green image. The images of cows and sheep grazing on pristine green pasture were iconic to New Zealand (Dunahay 2010). Participants who took part in the online survey overwhelmingly demanded labels for GM food. New Zealanders might find it hard to accept unlabelled milk coming from cows grazing GM pasture, and this could have some implications on other markets. New Zealand regulations did not demand milk coming from cows grazing GM forage was labelled, as the milk itself will not be considered GM by ANZFC. The Fonterra botulism milk contamination scandal was often cited by focus group participants as an example of how the country's image can be damaged. Over the years Small's, 2001, 2003, 2005, 2009 studies, and also this current study, have shown that the attitude towards GM's impact on the country's image was still negative. There was a big shift towards neutral between 2001 and 2003; however this could be as a result of GM publicity during the Royal Commission on GM in 2000, which had a measureable impact on the 2001 survey. The attitudes remained negative and almost the same through 2003-2009 and then the 2013 studies showed a slight trend towards neutral. This could be as a result the public's view of GM as a dying topic, as highlighted during focus group discussion. Cook and Fairweather (2005) also highlighted how New Zealanders viewed their clean green image as an achievement and had a desire to protect it. It was important to note that New Zealand considered GM to have a negative impact on its clean green image. Any GM technology that did not enhance the clean green image in New Zealand was likely to face public backlash if it were to be released for commercial use. This calls for the

government and developers to reassure and guarantee GM safety and no economic loss on the country's niche markets.

5.5 Trust

Trust was very important in GM technology. Consumers first needed to trust the scientists who were developing the technology and the companies who sold the products, and the government who regulated and approved the technology. From the online survey and focus the groups trust was one of the major reasons for participants' concern. It was shown over the years from Small's research (2001, 2003, 2005 and 2009) and from the current study that biotechnology companies were the least trusted, followed by government regulating authorities, scientists and, then pressure groups. The lack of trust in regulatory authorities and companies meant that whatever information was coming from developers was not likely to make an impact even if they had approval from the regulatory authorities. The main reason for not trusting companies was that biotechnology companies were viewed as focused only on making money. The government was not trusted; mainly because participants' believed the government was approving the technology and some products without rigorously testing it. *It seems there are far more researchers developing new modifications than there are researchers studying the potential impact of these organisms on the ecosystems into which they are to be released* (Roberts, 2000, p.1). The same view was still being shared today by the online survey and focus group participants. Over the years attitudes have consistently remained negative. New Zealanders were not likely to trust biotechnology companies and the government's ability to make good decisions for them about this technology.

5.6 Risk

The online survey and focus group results strongly indicated that New Zealanders considered GM to be very risky. GM was considered to be a health and safety risk to people and animals, a risk to the environment and also an economic risk. Focus group participants highlighted the Fonterra botulism scandal as an example of how New Zealand markets can be easily lost. Most participants considered GM a risk because of lack of data concerning its 100% safety, unknown future effects and that GM has not been around for a long enough period to see any side effects. Participants believed there was not enough evidence to prove GM safety. The Small (2009) survey and the 2013 study have shown that consumers increasingly perceived GM as risky.

While GM was considered risky it was interesting to note that consumers were more likely to accept GM that benefitted human health. It seemed consumers were making rational decisions by weighing benefits against harm. Consumers seemed likely to accept GM that will benefit human health, compared to ordinary GM food with no health benefits. Consumers were not willing to put

themselves to an unknown ordinary GM food risk when the country can easily grow or import food produced through conventional methods

5.7 Benefits

Focus group discussion participants highlighted that, while most people were comfortable with GM for medical purposes, many participants strongly opposed other uses. Most participants argued that the previous generation of GM crops had shown no obvious benefits for New Zealand. This seemed to confirm the study carried out by a team of scientists led by Professor Jack Heinemann, at the University of Canterbury, which showed that GM crops have not demonstrated exceptional yields, or significant reductions in environmental impact compared to non-GM products. *Despite the claims that GM might be needed to feed the world, we found no yield benefit when the USA was compared to Western-Europe other economically developed countries of the same latitude which do not grow GM crops. We found no benefit from the traits either*. (Heinemann et al., 2013, p.15). Participants surveyed shared the same feelings about GM food. Previous studies undertaken by Small in 2001, 2003, 2005 and 2009, showed more support for GM medicine compared to food. Over the years, support for GM food remained negative, but New Zealanders were more likely to tolerate GM food with health benefits more than just for food.

5.8 Social norms

Social norms can be described as what society perceived to be normal. One would expect individuals to comply with social norms so as to be accepted by society. Social norms can, to some extent, influence decisions made by individuals. This study's results showed that there was a general assumption that most New Zealanders have a negative attitude towards GM. Only 0.6% of respondents strongly believed that GM was acceptable by the majority of New Zealanders. This showed that most of New Zealanders were not expecting GM to be acceptable. Over the years (Small, 2001, 2003, 2005 and 2009), the impact of GM on social norms has remained negative, showing New Zealanders still believed GM was not accepted by the majority.

5.9 Specific product approach

The results showed that the public were sceptical about all forms of GM, even though they were likely to accept GM food that benefitted human health. Participants would not trust claims made by the sellers of GM products sellers. Participants in the online survey did not believe that those close to them would recommend they purchased GM products. The acceptability of GM also appeared to depend on the organism being modified. The use of the technology on humans and animals received

greater opposition than its use on plants and micro-organisms. Use of GM where it benefitted human health received less opposition. This showed that New Zealand could accept GM that benefitted human health. Over the years attitudes towards specific GM products have been trending more towards the negative (Small 2001, 2003, 2005 and 2009).

5.10 Intention to purchase

Intention to purchase can be used as an indication of the potential acceptance of GM products on the market. The online survey results showed that most of the online participants had little or no intention of purchasing GM products either for themselves or their families. The same idea was shared by focus group participants. The results showed that New Zealanders were not likely to knowingly purchase GM food unless it benefitted their health. This could be a challenge to companies developing GM pasture as the general public was expressing no intention to purchase GM food. As milk coming from cows fed with GM pasture can be viewed as GM food by the public, this might be met with serious resistance. The survey also showed that participants were not willing to purchase products coming from animals fed on GM pastures. Over the years (Small 2003, 2005, 2009) the attitude towards purchasing GM seemed to be getting more negative. This study has also shown that the trend was still negative.

5.11 Summary

The online survey and focus group results highlighted the main areas of concern as food safety risks, health risks, environmental risks and the wrongness of tampering with genetic makeup of an organism. Participants were also concerned with the impact of the technology on the economic advantage of New Zealand's clean, green image. There was a general fear that markets attracted by New Zealand's clean, green image will be lost. Participants believed that large biotechnology companies were out to make profits at the expense of the environment and public safety.

Focus group participants believed GM food had failed to produce any tangible benefits and was not a topic of concern at the moment. Most of the participants were unaware that the New Zealand Pastoral Genomics Group was making progress towards the use of GM technology in New Zealand pastures.

In a recent media release the Pastoral Genomics Consortium chair stated that, *At the present ryegrass are growing in containment and have come through a field trial in Florida. The next move would be to apply to the Environmental Protection Authority for field trials in New Zealand, but Pastoral genomics want to take one more step and do trials in South West Victoria. Trials in South West Victoria will be in an agricultural climate close to New Zealand* (Morgan, 2013). Most New

Zealanders, particularly in towns, viewed dairy farms as a source of pollution for the environment. The introduction of GM pastures was likely to generate a lot of debate and backlash. According to the Australia New Zealand Food Council, when food has been processed to remove all GM DNA or protein, and does not have altered characteristics, the food did not need to be labelled as GM. Meat, milk and other products from animals that have been fed GM feed were not required to be labelled as GM (Ministry for the Environment, 2007). There will not be any labelling requirements for milk from cows grazing on GM pasture. A lack of information on food labels was likely to give a perceived lack of choice and control over GM food.

Why are attitudes not changing?

The survey and focus group results have shown that public concern on GM pasture is mainly on safety, absence of benefits, uncertainty and trust. GM is perceived as un-natural and makes many consumers feel it is not good for human health and the environment also consumers don't trust the developers of the technology. Suspicions are that it is driven by big companies who are driven by profits. These are likely to be the main reasons why attitudes towards GM are not changing.

Chapter 6

Conclusions

The study found that the NZ public's attitudes towards GM have remained negative. However, there was less opposition to GM food, or applications that benefitted human health, compared to other GM food. The level of opposition also depended on the organism that was being modified; GM animals have less support than GM plants. Modifying humans to enhance their capabilities had the most negatives compared to modifications to eradicate diseases. The New Zealand public seemed to be making informed decisions about GM, given the fact that of the participants sampled, only 8.5% had never heard of GM, the rest had some level of familiarity with GM. The biggest issues that drew negativity toward GM were regarding trust, risk, social norms and intention to purchase GM food.

Trust has remained negative and appeared to be trending towards becoming more negative. It was going to be hard to generate positive attitudes without trust. This demanded that scientists, regulating authorities and companies be transparent and reassure the public about the safety of GM products currently under development. Information about the technology will need to be balanced, not only by showing the benefits but also by highlighting potential risks.

On social norms, the NZ public believed most that New Zealanders had a negative attitude towards GM. GM was viewed as a potential threat to NZ's clean, green image. Even GM crops or animals that were modified to be environmentally friendly were also regarded as threats to the clean, green image. New Zealanders believed GM was too risky as not enough tests had been done to test for any side effects. The public demanded rigorous testing to reassure them of its safety. While rigorous testing might give reassurance, more people also believed it was morally wrong to alter the genetic make-up of an organism. The pubic also showed no intention to knowingly purchasing GM products. The challenge that companies developing GM pasture were likely to face will be in trying to convince the public that feeding cow on GM pasture will not make their milk and meat GM. While attitudes towards cisgenic GM were less negative compared to transgenic GM the intention to purchase had negative attitudes whether it was transgenic or cisgenic GM. The public had no intention of purchasing food with altered DNA. While GM might present a great opportunity for the future public acceptability stands in its way. Commercialising cisgenic GM pasture will need outright public support and reassurance of its safety and that the country's clean green image will remain intact after its adoption.

6.1 Concluding remarks

Food safety and environmental protection were one of the main concerns. The New Zealand public did not appear to be willing to embrace genetically modified food products. Biotechnology companies, government regulating bodies and scientists have to address the issues highlighted about environmental concerns, food safety and economic risks to build positive attitudes.

6.2 Research Limitations

The only use of online respondents in the survey could have limited sampling to people with internet access only. However the research budget limited us to the cheap and faster method.

6.3 Future research

A research on New Zealand international meat and milk markets reaction to products from animals fed on GM pasture as a measure the economic risk will be of great interest. Also of great interest will be research on GM safety to environment, animals and humans.

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Appendix A

A.1 Research questionnaire

I am a student at Lincoln University conducting a survey. The purpose of the survey is to establish current New Zealand public attitudes towards Genetically Modified food. This survey will take about 20 minutes to complete.

- The questionnaire is anonymous, and you will not be identified as a respondent.
- Participation is voluntary and you may at any given time withdraw from participating.
- If you complete the questionnaire, however, it will be understood that you have consented to participate in the project and consent to publication of the results of the project with the understanding that anonymity will be preserved.

BACKGROUND INFORMATION (Please select the appropriate box)

1. **In which region do you live? :**

□	Northland	□	Auckland	□	Waikato
□	Bay of Plenty	□	Gisborne / East Cape	□	Hawkes Bay
□	Taranaki	□	Manawatu – Wanganui	□	Wellington
□	Tasman	□	Nelson	□	West Coast
□	Marlborough	□	Canterbury	□	Otago
□	Southland				

2. **Gender:** □ Male □ Female

3. **Age:** _____ years old

4. **Ethnicity:** (select one)

□ New Zealand European □ Maori □ Pacific Islander

□ Asian □ Other, please specify _____

5. **Religion:** (Select one)

□ No religion □ Christian □ Buddhist □ Muslim

□ Hindu □ Jewish □ Other, _____

6. **How important is religion in your life?: (Select one)**

□ Not applicable / of no importance □ Slightly important

□ Moderately important □ Very important

7. **How important is spirituality in your life?: (Select one)**

□ Not applicable / of no importance □ Slightly important

□ Moderately important □ Very important

8. **From all sources your personal before tax, income for the last tax year was : (Select one)**

□ Less than $25,000 □ $25,001 – $50,000 □ $50,001– $70,000

□ $70,000 - $100,000 □ More than $100,000 □ I prefer not to say

9. **What is your highest completed educational qualification? (Select one)**

- ❑ No qualification
- ❑ High school qualification (5^{th}, 6^{th}, or 7^{th} form)
- ❑ Technical or vocational qualification
- ❑ University qualification (Diploma, Bachelor's or higher degree)
- ❑ Other, please specify: _____

10. **On a scale 1-5, please rate your familiarity with genetic modification. 1- Never heard of it, 5- very familiar. (Please select one)**

- ❑ 1
- ❑ 2
- ❑ 3
- ❑ 4
- ❑ 5

Genetic Modification

Genetic Modification (GM) involves the chemical altering of an organism's genetic code in a laboratory. Using GM, scientists can alter plants, animals and micro-organisms to enhance desired qualities, remove undesired qualities, or to give them new qualities. Two main uses of GM technology have been in medicine (e.g. to produce insulin for diabetics) and in agriculture for food production (e.g. most widely used are GM Maize, Canola and soya beans).

Please select the box next to the statement that best represents your thoughts and feelings about Genetic Modification (GM)

11. **In terms of the use of GM products for food production, I …**

- ❑ Totally support it
- ❑ Support it in some circumstances
- ❑ Totally oppose it
- ❑ Don't know/Unsure

12. **In terms of the use of GM products for medical applications, I ….**

- ❑ Totally support it
- ❑ Support it in some circumstances
- ❑ Totally oppose it
- ❑ Don't know/Unsure

13. **What is your main concern about GM technology?**

- ❑ I do not have any major concerns about GM technology
- ❑ My main concern is that GM is in principle unethical, disrespects nature or is against God
- ❑ My main concern is the potential risk that GM poses to the health and safety of humans, animals, or the environment

14. **Have you ever consumed any GM food products? (select one)**

- ❑ Yes
- ❑ No
- ❑ Don’t know/Unsure

15. **Have you ever used any GM medicines? (select one)**

- ❑ Yes
- ❑ No
- ❑ Don’t know/Unsure

In the questions that follow, you are presented with a statement. Please indicate your level of agreement or disagreement with each of the statement by selecting the appropriate number on the scale.

Your thoughts about GM

Please indicate your level of agreement by selecting the most appropriate number

	Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**
18	GM poses a significant risk to the environment	1	2	3	4	5	dk
19	GM poses a significant risk to the health and safety of humans	1	2	3	4	5	dk
20	GM poses a significant risk to the health and safety of animals	1	2	3	4	5	dk
21	The production of GM crops and animals in New Zealand will benefit our economy	1	2	3	4	5	dk
22	GM crops can be grown organically	1	2	3	4	5	dk
23	Using GM technology fits with my cultural and spiritual beliefs.	1	2	3	4	5	dk
24	Using GM technology fits with my basic moral principles.	1	2	3	4	5	dk
25	GM technology is unnatural.	1	2	3	4	5	dk
26	GM technology is "playing God."	1	2	3	4	5	dk
27	GM technology is disrespectful to nature.	1	2	3	4	5	dk
28	GM technology will help cure the world's major diseases.	1	2	3	4	5	dk

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
29	GM technology will help solve the world's food problems.	1	2	3	4	5	dk
30	GM products are environmentally friendly	1	2	3	4	5	dk
31	The benefits of GM technology will outweigh any harm.	1	2	3	4	5	dk
32	I trust what the regulatory authorities say about GM technology.	1	2	3	4	5	dk
33	I trust what scientists say about GM technology.	1	2	3	4	5	dk
34	I trust what companies say about GM technology.	1	2	3	4	5	dk
35	I trust what medical professionals say about GM technology.	1	2	3	4	5	dk
36	I trust what watchdog groups (e.g., Greenpeace, Sustainability Council of NZ and GM free NZ) say about GM technology.	1	2	3	4	5	dk

	Statement	Strongly agree	Agree	Neutral	disagree	Strongly disagree	Don't know
37	The people important to me consider that GM technology is acceptable.	1	2	3	4	5	dk
38	Most New Zealanders consider that GM technology is acceptable.	1	2	3	4	5	dk
39	Producing GM products fits with NZ's clean green image.	1	2	3	4	5	dk
40	Producing GM products fits with NZ's image of marketing healthy food.	1	2	3	4	5	dk
41	It is necessary to evaluate each potential application of GM on a case-by-case basis rather than totally supporting or totally opposing all applications of GM.	1	2	3	4	5	dk
42	It is acceptable to genetically modify micro-organisms (e.g. bacteria) for human benefit.	1	2	3	4	5	dk
43	It is acceptable to genetically modify plants for human benefit.	1	2	3	4	5	dk
44	It is acceptable to genetically modify animals (e.g. cows, sheep) for human benefit.	1	2	3	4	5	dk
45	It is acceptable to genetically modify humans in order to cure or eradicate genetic diseases.	1	2	3	4	5	dk

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
46	It is acceptable to genetically modify humans in order to enhance human capabilities (i.e. physical and mental attributes or abilities).	1	2	3	4	5	dk
47	GM food products are safe for human consumption.	1	2	3	4	5	dk
48	I would feel good about eating food from GM plants.	1	2	3	4	5	dk
49	I would feel good about eating food from GM animals.	1	2	3	4	5	dk
50	Foods containing GM products should be clearly labelled.	1	2	3	4	5	dk
51	New Zealand should not plant commercial GM food crops for at least the next five years.	1	2	3	4	5	dk
52	GM medicines are safe for humans to use.	1	2	3	4	5	dk
53	I would feel good about using medicines developed using GM technology.	1	2	3	4	5	dk
54	Modifying micro-organisms (e.g. bacteria) using GM technology fits with my cultural and spiritual beliefs.	1	2	3	4	5	dk
55	Modifying micro-organisms (e.g. bacteria) using GM technology fits with my basic moral principles.	1	2	3	4	5	dk

Your thoughts on a GM Milk Product

Scientists in New Zealand are researching on possibility of producing cows that produce milk tailored to be an equivalent of approved human therapeutic drug.

Please answer the next set of questions about the GM Milk product described above.

	Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**
56	If GM milk product were available in the shops, I would definitely buy it for myself.	1	2	3	4	5	dk
57	If GM milk product were available in the shops, I would definitely buy it for my family or the people that I live with.	1	2	3	4	5	dk
58	If I suffered from a disease that can be treated by GM milk, I would definitely buy this product.	1	2	3	4	5	dk
59	I would feel good about purchasing GM milk for myself.	1	2	3	4	5	dk
60	GM milk will be a useful product to develop.	1	2	3	4	5	dk
61	I would trust the claims made about GM milk by the people selling it.	1	2	3	4	5	dk

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
62	The people important to me would want me to purchase GM milk.	1	2	3	4	5	dk
63	Thinking about GM milk makes me feel happy.	1	2	3	4	5	dk
64	Thinking about GM milk makes me feel sad.	1	2	3	4	5	dk
65	Thinking about GM milk makes me feel pleased.	1	2	3	4	5	dk
66	Thinking about GM milk makes me feel angry.	1	2	3	4	5	dk
67	Thinking about GM milk makes me feel hopeful.	1	2	3	4	5	dk
68	Thinking about GM milk makes me feel disgusted.	1	2	3	4	5	dk
69	Modifying animals using GM technology fits with my cultural and spiritual beliefs.	1	2	3	4	5	dk
70	Modifying animals using GM technology fits with my basic moral principles.	1	2	3	4	5	dk
71	I am prepared to buy GM milk at a premium price.	1	2	3	4	5	dk
72	I will only buy GM milk if it is cheaper than the conventional products.	1	2	3	4	5	dk
73	I am not prepared to pay any price for this GM milk.	1	2	3	4	5	dk

Genetically Modified pasture

A New Zealand research consortium is developing a genetically modified rye grass pasture that produce 25% more feed, more protein for livestock and have improved drought resistance. The trials are being done overseas.

Your thoughts about GM Pastures

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
74	The spread of GM pasture can be controlled.	1	2	3	4	5	dk
75	GM pastures are environmentally friendly.	1	2	3	4	5	dk
76	It is acceptable to feed animals that people eat (e.g. cows, sheep) pastures developed using GM techniques.	1	2	3	4	5	dk
77	Feeding animals GM pasture with high levels of available energy is an acceptable way to increase animal production.	1	2	3	4	5	dk
78	Feeding animals GM pasture is acceptable if it results in human health benefits.	1	2	3	4	5	dk
79	Feeding animals GM pasture is acceptable if it reduces the production of greenhouse gases (methane) responsible for climate change.	1	2	3	4	5	dk
80	Modifying plants using GM technology fits with my cultural and spiritual beliefs.	1	2	3	4	5	dk
81	Modifying plants using GM technology fits with my basic moral principles.	1	2	3	4	5	dk

The following questions seek your thoughts about the products (e.g., milk and meat) from animals fed on GM pastures.

	Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**
82	Consuming products from animals fed on GM pastures is acceptable to me if predicted to result in reduction in of health issues.	1	2	3	4	5	dk
83	If milk and meat products from animals fed on GM pastures were available in the shops, I would definitely buy them for myself.	1	2	3	4	5	dk
84	If meat and milk products from animals fed on GM pastures were available in the shops, I would definitely buy them for my family or the people that I live with.	1	2	3	4	5	dk
85	I am prepared to buy milk or meat products from animals fed on GM pastures at a premium price.	1	2	3	4	5	dk
86	I will only buy products from animals fed on GM pastures if it is cheaper than the conventional products.	1	2	3	4	5	dk
87	I am not prepared to pay any price for products from animals fed on GM pastures.	1	2	3	4	5	dk

Transgenic and Cisgenic Genetic Modification

Genetic Modification involves transferring genes from one organism and inserting them into another, the inserted gene sequence may come from another related species, or from a completely different species.

Cisgenic refers to the process which genes are artificially transferred between organisms that are sexually compatible or belong to the same species. For example transferring genes from one ryegrass plant to another.

Transgenic refers to the process by which genes are transferred between totally unrelated species that are not sexually compatible, for example transferring human genes into a cow.

Your thoughts about cisgenics

	Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Don't know**
88	Cisgenic plants are acceptable to me.	1	2	3	4	5	dk
89	Cisgenic animals are acceptable to me.	1	2	3	4	5	dk
90	All forms of GM are not acceptable to me.	1	2	3	4	5	dk
91	I am prepared to buy this GM product at a premium price.	1	2	3	4	5	dk
92	I will only buy this GM product if it is cheaper than conventional products.	1	2	3	4	5	dk
93	I am not prepared to pay any price for this GM product.	1	2	3	4	5	dk

Your thoughts about transgenics

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
93	Placing animal (including human) genes in bacteria is acceptable to me	1	2	3	4	5	dk
94	Placing animal (including human) genes in plants is acceptable to me	1	2	3	4	5	dk
95	Placing plant genes in animals is acceptable to me	1	2	3	4	5	dk
96	Any GM organisms is acceptable to me	1	2	3	4	5	dk
97	I am prepared to buy a transgenic product at a premium price.	1	2	3	4	5	dk
98	I will only buy a transgenic product if it is cheaper than a conventional product.	1	2	3	4	5	dk
99	I am not prepared to pay any price for this GM product.	1	2	3	4	5	dk

We would like to thank you for taking your time to complete our survey. Your opinions and responses are gratefully received and extremely important to us. Click the submit button to send your survey then close the window to exit.

Focus group discussion

A.2 Invitation to a focus group discussion

Dear Sir/Madam

You are invited to participate in a focus group discussion for a project entitled: New Zealand public attitudes towards Genetically Modified (GM) Food. Participation in the focus group is voluntary.

The project is being carried out by: Taisekwa Lordwell Chikazhe (Lincoln University student).
Contact details: 61 Ngahape Road, RD 3 Te Awamutu, 3873. Phone 07 871 - 1744

The project is supervised by Dr Rupert Tipples and Dr Kevin Old (Lincoln University lecturers)
Contact Details: P.O Box 84, Lincoln University, Lincoln 7647. Phone 03 423 - 0280

The main goal of the project is to establish current public attitudes towards genetically modified food in New Zealand. The discussion is expected to last at least 30-40 minutes.

Notes taken from the discussion will ensure that anonymity is retained and no names will be published in the findings. The notes will remain confidential. The results of the project may be published, but you are assured of your anonymity in this investigation. Your identity will not be made public, or made known to any person other than myself and my Lincoln University supervisors Dr Rupert Tipple and Dr Kevin Old. The project has been reviewed and approved by the Lincoln University Human Ethics Committee.

Regards

Taisekwa Lordwell Chikazhe

A.3 Consent form

Consent Form

Name of Project: New Zealand attitudes towards Genetically Modified Food.

I have read and understood the aim and purpose of the focus group discussion. On this basis I agree to participate in the discussion, and I consent to publication of the results of the project with the understanding that anonymity will be preserved. I understand also that I may at any time withdraw from the discussion.

You can withdraw from participation before and during discussion, however after discussion comments, comments made during the discussion cannot be withdrawn.

Name: _____

Signed: _____ Date: _____

A.4 Focus group demographic questionnaire

1. Gender**:** □ Male □ Female

2. Age: _____ years old

3. Marital Status**:** (Tick one)

□ Married □ Single

□ Partner □ Divorced

4. Ethnicity**:** (Tick one)

□ New Zealand European □ Maori □ Pacific Islander

□ Asian □ Other please specify, _____

5. Religion**:** (Tick one)

□ No religion □ Christian □ Buddhist □ Muslim

□ Hindu □ Jewish □ Other please specify, _____

6. Employment Status: (Tick one)

□ Formally employed □ Self employed

□ Not working

7. From all sources your personal before tax, income for the last tax year was: (Tick one)

□ Less than $25,000 □ $25,001 – $50,000 □ $50,001– $70,000

□ $70,000 - $100,000 □ More than $100,000 □ I prefer not to say

8. What is your highest completed educational qualification? (Tick one)

- ❑ No qualification
- ❑ High school qualification (5^{th}, 6^{th}, or 7^{th} form)
- ❑ Technical or vocational qualification
- ❑ University qualification (Diploma, Bachelor's or higher degree)
- ❑ Other, please specify: _____