'Maintaining Paradise'

Trusting a Biotechnology Future

Research Project
For the
Primary Industry Council/Kellogg Rural Leadership Programme

Murray Jagger 2002

Executive Summary

There is no doubt that New Zealand is a biodiverse-exporting nation.
The agricultural sector accounts for some 66% of New Zealand's export earnings
The international marketplace is both highly restrictive and competitive, and our competitors are gaining on our competitive advantage annually.

Biotechnology has the potential to offer New Zealand, and in particular the primary sector considerable opportunities.

Biotechnology is a set of precise and powerful set of tools, which is often misunderstood.
It is the precision and control, of these tools, and the manipulation of genes that excite scientists. It is also this same excitement that concerns some.
However there is no evidence to date that the technology is harmful.

Various surveys around the world have measured various acceptance of biotechnology, ranging from acceptance on a case-by-case basis to total rejection. Consumer attitude to acceptance of biotechnology often stems back to deep personal values. There is evidence that the more people are educated, are informed and have contact with biotechnology, the more accepting they are of it.

The consumers, generally distrusts, organisations, that are perceived to have vested interests in biotechnology, to a point that they expect to be exploited. Believing that organisations overstate the benefits and understate the risks.

The public needs to take responsibility themselves, to ensure to the best of their ability information they are exposed to is from substantiated researched evidence.

Organisations need to involve the public in the debate and submission system, this will lead it improved trust.
Trust is very easily lost but harder to build.

New Zealand has through the Environmental and Risk Management Authority, one of the strongest regulatory bodies in the world.
With improvements made from recommendation from the Royal Commission on Genetic Modification outcome, gives rigorous assessment for application approval.
The Environmental and Risk Management Authority should be independent, transparent and well funded to achieve the most effective outcomes, for New Zealand's best interest.
The Environmental and Risk Management Authority should earn the right from the public to be trusted and not assume it has public trust of right.

New Zealand's high values give it a unique opportunity to continue to be world leaders, as a competitive global marketeer.

Paradise then becomes an individual perception.

Table of Contents

Page No.

Introduction

The success of commercial use of Biotechnology depends on societies acceptance of crop plants, food products and animals derived from GE technology.

The purpose of this project is to improve the understanding and acceptance of Biotechnology by highlighting balanced and creditable information.

The focus will be on Genetic Engineering specifically, and the dairy industry outlining and explaining New Zealand as an Agricultural Exporter and the importance of this to our country's economy.

New Zealand is an exporting nation. The Agricultural sector accounts for some 66% of the total export revenue of the country.
The fact New Zealand is export dependent, it must stay ever vigilant on the expectation of customers, and must respond to market signals identifying the varying needs of them.

New Zealand has traditionally traded on the image as clean and green.
New Zealand's importance of branding that image on both International trade and cultural self-image should not be underestimated.

New Zealand – Clean, Green and Beautiful. It is practically a national mantra, a deeply imbedded cultural self-image. New Zealanders take pride in this image of clean, green and unspoilt land; it is also part of New Zealand's international reputation. Overseas consumers hold a favorable image of New Zealand as clean and green. (PA Consulting Group 2001).

So how does New Zealand 'Maintain Paradise' and also put faith in biotechnology which may, well become a critical tool in maintaining global competitiveness and improved national wealth.

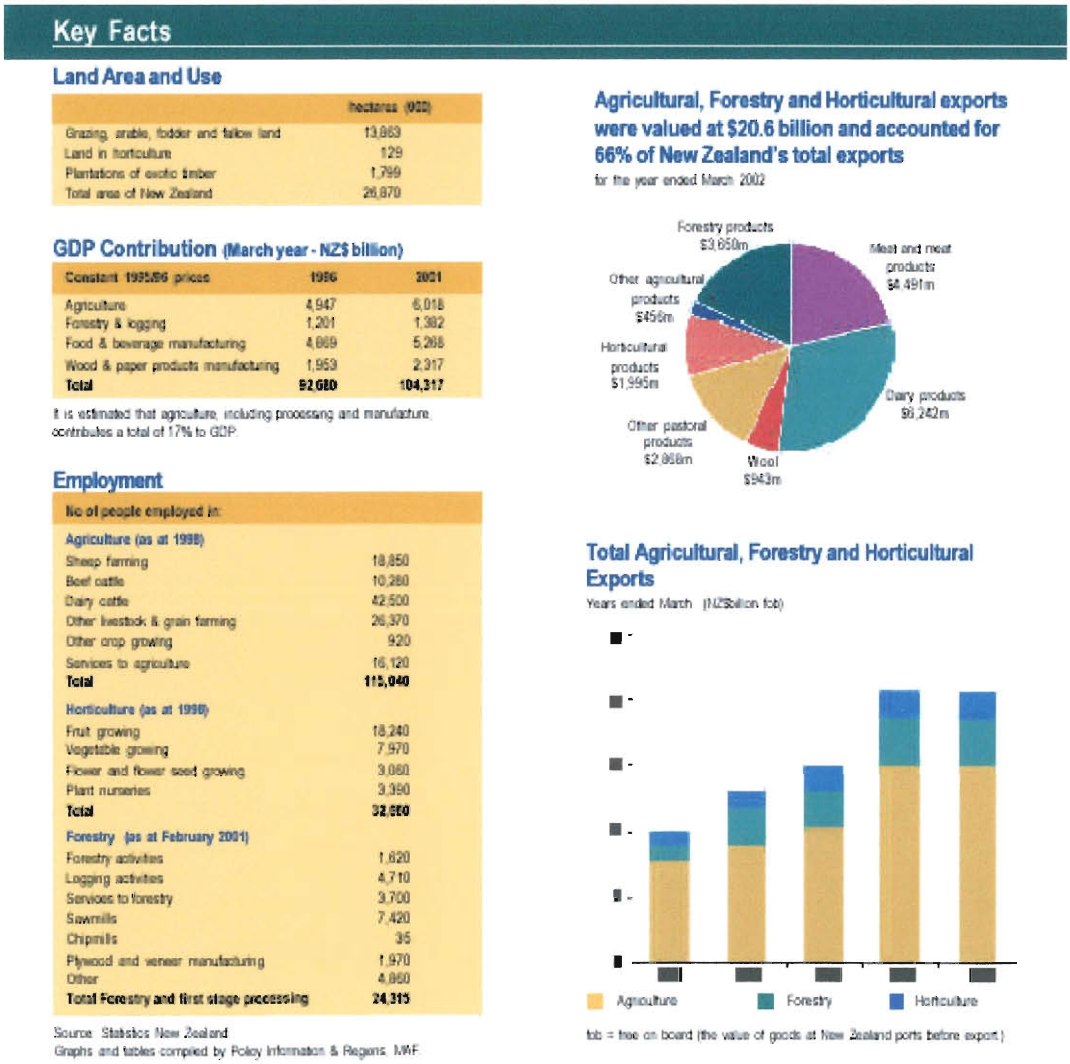
Paradise: *a place of ideal beauty or loveliness.*

Industry Overview

The impact the agricultural sector has on the New Zealand economy should not be underestimated. New Zealand is a biological based exporting nation. Agriculture has been the key economic driver over many generations and as an industry prides itself as world leaders.

As identified agricultural based industry provides 66% of New Zealand's export revenues. This trend continues to increase with GDP in the June 2002 quarter being 6.2% up. The primary sector is the main contributor.

Some key facts are identified Fig 1- 5 taken from the 2002 annual MAF statistical report.



Key Facts

Land Area and Use

	hectares (000)
Grazing, arable, fodder and fallow land	13,863
Land in horticulture	129
Plantations of exotic timber	1,799
Total area of New Zealand	26,870

GDP Contribution (March year - NZ$ billion)

Constant 1995/96 prices	1986	2001
Agriculture	4,947	6,018
Forestry & logging	1,201	1,382
Food & beverage manufacturing	4,869	5,268
Wood & paper products manufacturing	1,953	2,317
Total	**92,680**	**104,317**

It is estimated that agriculture, including processing and manufacture, contributes a total of 17% to GDP.

Employment

No of people employed in:	
Agriculture (as at 1998)	
Sheep farming	18,850
Beef cattle	10,280
Dairy cattle	42,500
Other livestock & grain farming	26,370
Other crop growing	920
Services to agriculture	16,120
Total	**115,040**
Horticulture (as at 1998)	
Fruit growing	18,240
Vegetable growing	7,970
Flower and flower seed growing	3,060
Plant nurseries	3,390
Total	**32,660**
Forestry (as at February 2001)	
Forestry activities	1,620
Logging activities	4,710
Services to forestry	3,700
Sawmills	7,420
Chipmills	35
Plywood and veneer manufacturing	1,970
Other	4,860
Total Forestry and first stage processing	**24,315**

Source: Statistics New Zealand
Graphs and tables compiled by Policy Information & Regions, MAF

Agricultural, Forestry and Horticultural exports were valued at $20.6 billion and accounted for 66% of New Zealand's total exports

for the year ended March 2002

Total Agricultural, Forestry and Horticultural Exports

Years ended March (NZ$billion fob)

fob = free on board (the value of goods at New Zealand ports before export)

Fig 1.

Agriculture

- Agricultural exports totalled $15,091 million for the year ended March 2002.
- The major contributors were:

Dairy products	$6,242 million
Meat and meat products	$4,491 million
Pastoral based exports (casein, hides/skins, carpets, etc.)	$2,868 million
Wool	$ 943 million
Other agricultural products (cereals, meat meals, pet food, etc.)	$ 456 million

Total Livestock Numbers (000)*

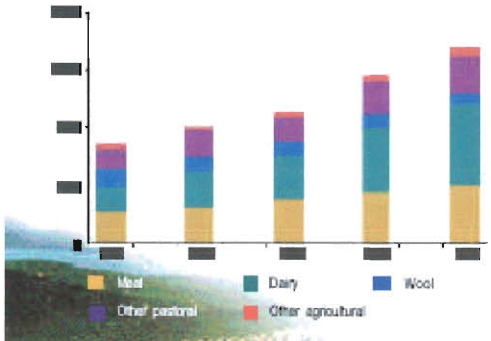
	1975	1980	1985	1990	1995	1999
Sheep	55320	68772	67854	57852	46816	45680
Dairy Cattle	2998	2989	3308	3441	4090	4316
Beef Cattle	6294	5162	4813	4593	5183	4644
Deer		104	320	976	1179	1677
Pigs	422	434	454	395	431	369
Goats		53	427	1063		186

Total Farms by Farm Type (as at 30 June 1999)*

Farm Type (ANZSIC)	Number of Farms
Grain Growing	543
Grain-Sheep and Grain-Beef Cattle Farming	2,085
Sheep-Beef Cattle Farming	10,911
Sheep Farming	9,417
Beef Cattle Farming	12,141
Dairy Cattle Farming	15,951
Poultry Farming (Meat)	123
Poultry Farming (Eggs)	84
Pig Farming	267
Horse Farming	621
Deer Farming	1,917
Mixed Livestock	4,329
Horticulture and Fruit Growing	1,917
Other	6,906
Unknown	13,176
Total	**80,376**

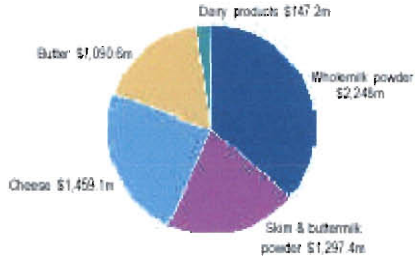
Main Agricultural Exports

Years ended March (NZ$million fob)



New Zealand's Dairy Exports

Year ended March 2002 (NZ$million fob)



For more Information visit: www.maf.govt.nz/statistics/primaryindustries/livestock

* In 1999 the Agricultural Production Survey population definition was changed to all farm units on AgriBase known to hold livestock and/or engage in grain/arable cropping. AgriBase is a national database of farms maintained by AgriQuality New Zealand Ltd

Fig 2

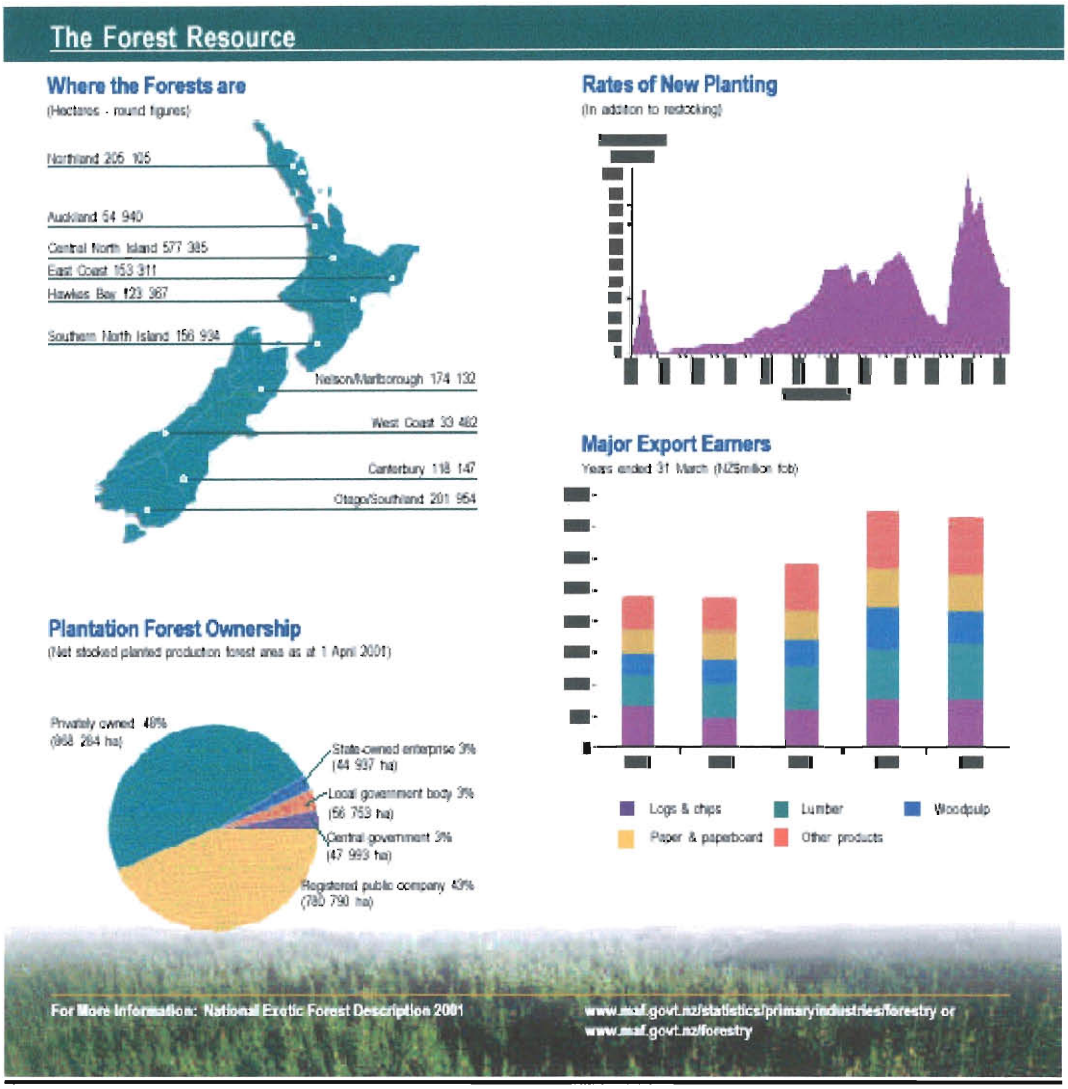

The Forest Resource
Where the Forests are
(Hectares - round figures)
Northland 205 105
Auckland 54 940
Central North Island 577 385
East Coast 153 311
Hawkes Bay 123 367
Southern North Island 156 934
Nelson/Marlborough 174 132
West Coast 33 462
Canterbury 118 147
Otago/Southland 201 954
Rates of New Planting
(In addition to restocking)
Major Export Earners
Years ended 31 March (NZ$million fob)
Logs & chips
Lumber
Woodpulp
Paper & paperboard
Other products
Plantation Forest Ownership
(Net stocked planted production forest area as at 1 April 2001)
Privately owned 48%
(868 284 ha)
State-owned enterprise 3%
(44 937 ha)
Local government body 3%
(56 753 ha)
Central government 3%
(47 993 ha)
Registered public company 43%
(780 790 ha)
For More Information: National Exotic Forest Description 2001
www.maf.govt.nz/statistics/primaryindustries/forestry or
www.maf.govt.nz/forestry

Fig 3.

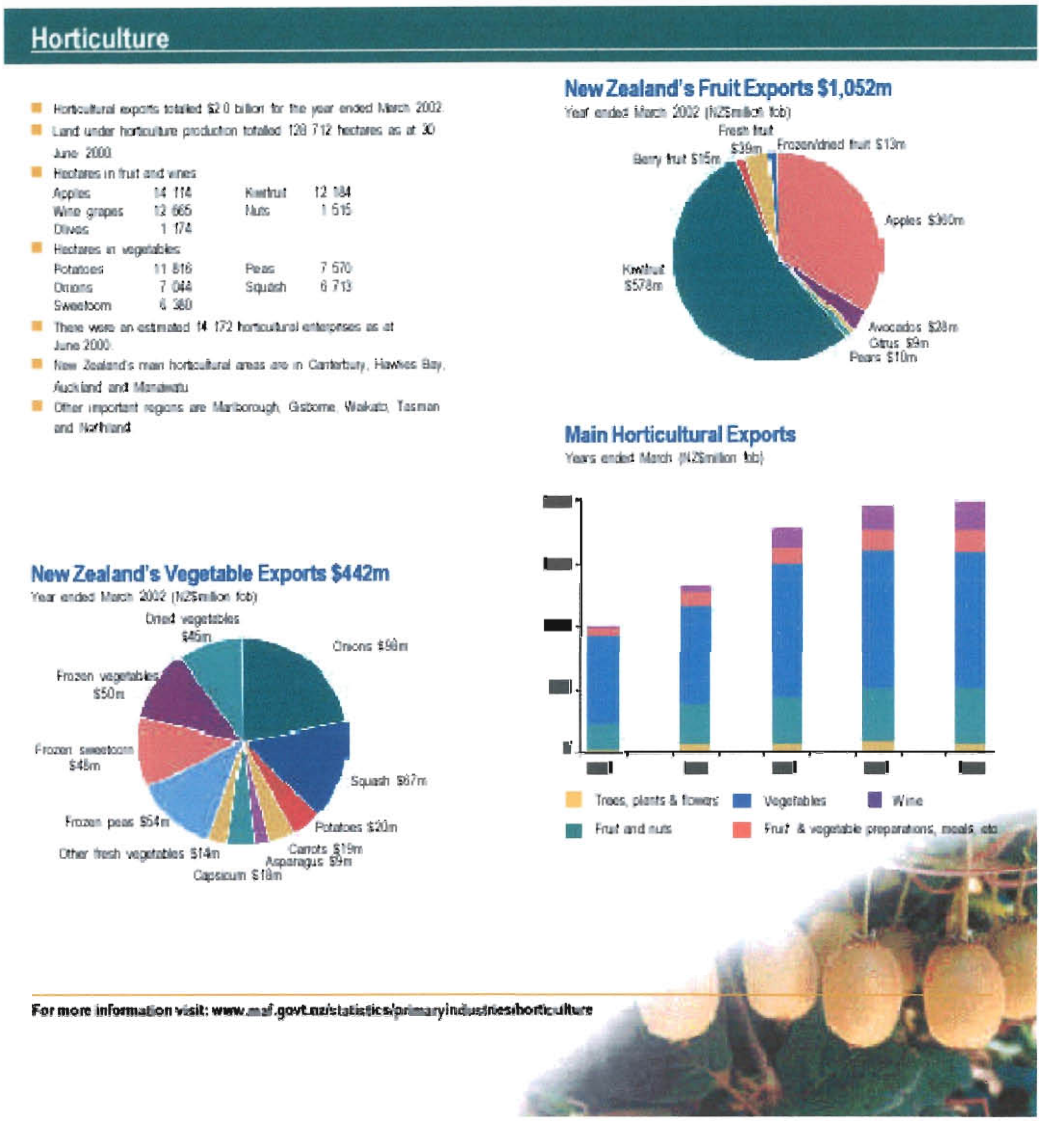


Fig 4.

The map (Fig 5) gives a graphic indication of New Zealand's wide spread export destinations.

If we focus now on the dairy industry much of its product is sold into the developing world

Trade restrictions constrain New Zealand's access to the wealthiest markets in the world
Due to these trade restrictions New Zealand must direct the majority of product by volume into the developing world. Fig 6. These returns tend to be lower.


Top Export Destinations
Year ended December 2001 (provisional - values in NZ$million fob)
Destination unknown EU
Horticulture $310m
Germany
Agriculture $659m
Forestry $0.7m
Horticulture $31m
Belgium
Agriculture $499m
Forestry $3.0m
Horticulture $7.5m
China
Agriculture $685m
Forestry $362m
Horticulture $16m
United Kingdom
Agriculture $1,046m
Forestry $3.4m
Horticulture $137m
South Korea
Agriculture $437m
Forestry $548m
Horticulture $22m
Canada
Agriculture $505m
Forestry $3m
Horticulture $1.8m
USA
Agriculture $2,615m
Forestry $491m
Horticulture $141m
Japan
Agriculture $1,248m
Forestry $767m
Horticulture $380m
Hong Kong
Agriculture $322m
Forestry $62m
Horticulture $42m
Mexico
Agriculture $511m
Horticulture $2.2m
Philippines
Agriculture $438m
Forestry $84m
Horticulture $14m
Taiwan
Agriculture $420m
Forestry $99m
Horticulture $61m
Singapore
Agriculture $139m
Forestry $28m
Horticulture $29m
Australia
Agriculture $953m
Forestry $917m
Horticulture $213m
Malaysia
Agriculture $472m
Forestry $48m
Horticulture $43m
Indonesia
Agriculture $426m
Forestry $68m
Horticulture $8m
As part of MAF's risk management, imports into New Zealand must meet strict biosecurity standards to be given clearance. Likewise countries we export to also require that our produce meets their required standards.
MAF provides assistance to exporters to gain access to markets by ensuring that requirements set by importing countries are met. Produce can be refused entry into a country if official requirements are not met.
Horticulture: Vegetables, fruit and nuts and preparations thereof.
Agriculture: Meat and meat products, dairy products, wool, and other pastoral based products, excluding horticulture.

Fig 5

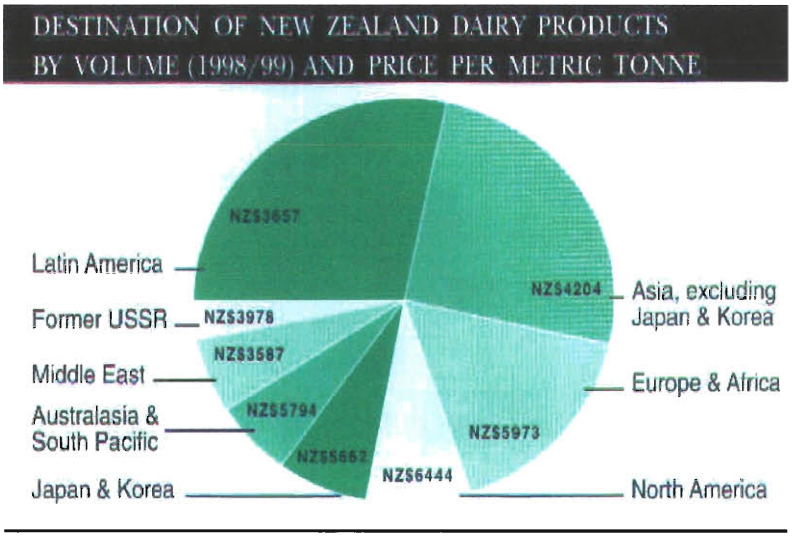

DESTINATION OF NEW ZEALAND DAIRY PRODUCTS
BY VOLUME (1998/99) AND PRICE PER METRIC TONNE
Latin America
NZ$3657
Former USSR
NZ$3978
Middle East
NZ$3587
Australasia &
South Pacific
NZ$5794
Japan & Korea
NZ$5662
NZ$6444
NZ$4204
Asia, excluding
Japan & Korea
Europe & Africa
NZ$5973
North America

Fig 6.

So how does New Zealand rate as a competitor globally? In fact it rates quite well.
New Zealand holds around one third of world dairy trade (Fig 7).

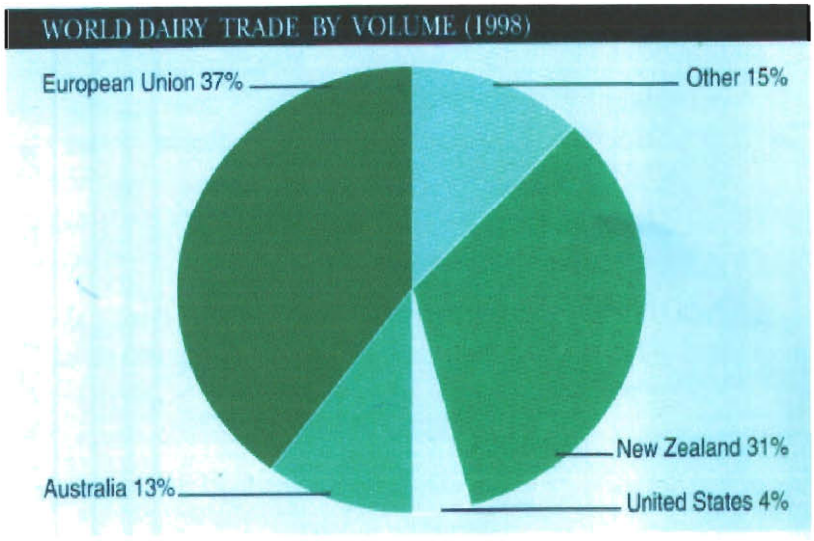


Fig 7.

New Zealand's competitive advantage has been its superior productivity in relation to the rest of the global competitors. (Fig 8.)
But that is changing. Competitors are making huge gains in productivity.

Also some hope was put into World Trade Organisation (WTO) to liberalise trade in Agriculture allowing New Zealand access to international markets and a reduction in subsidies.
This however has been slow with some reluctance to reduce support from a number of countries.

A trend of reducing productivity can be seen in a comparison between the traditional sharemilking system in New Zealand (farm owner/50/50 sharemilker) and Australia, which is New Zealand's closest competitor in terms of cost, Fig. 9, Shows New Zealand failing to maintain competitiveness.

In fact New Zealand's cost of production is rising by at least 2.3% per annum compared to the United States decrease in the cost of production by at least 1.8% per annum.
(*N.Z Dairy Board Stats1998/99*)

The New Zealand dairy industry response to improving productivity is to aim at an annual 4% productivity increase. This figure derived by predicting how much will be required to improve competitiveness with the global market.

It is unrealistic however to expect that use of traditional technologies will be enough to achieve the 4% target into the future.

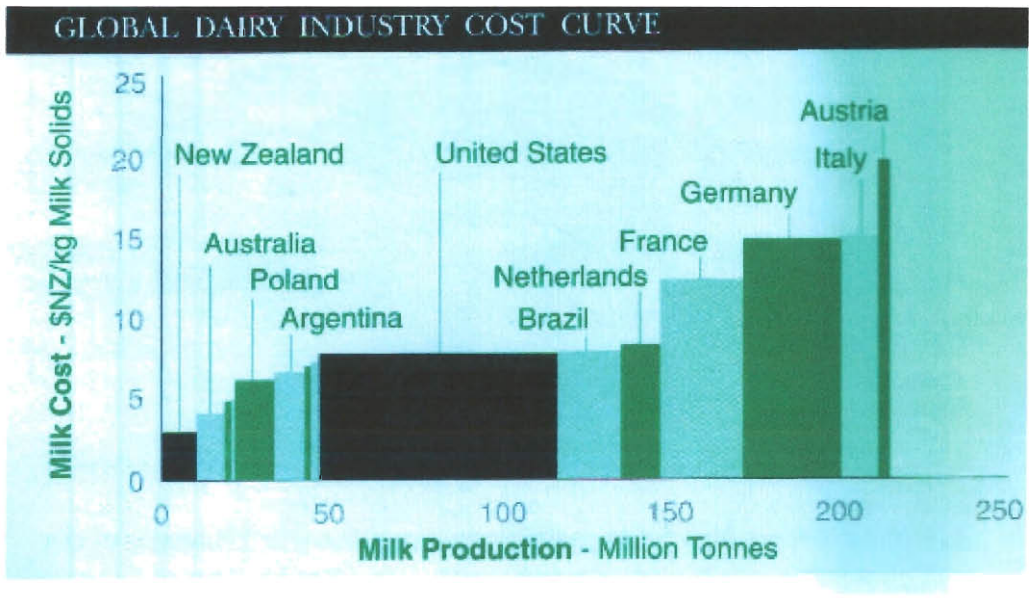


Fig 8

Dexcel is an organization set up by the New Zealand Dairy Board, which has been charged with the role of driving the 4% productivity targets.

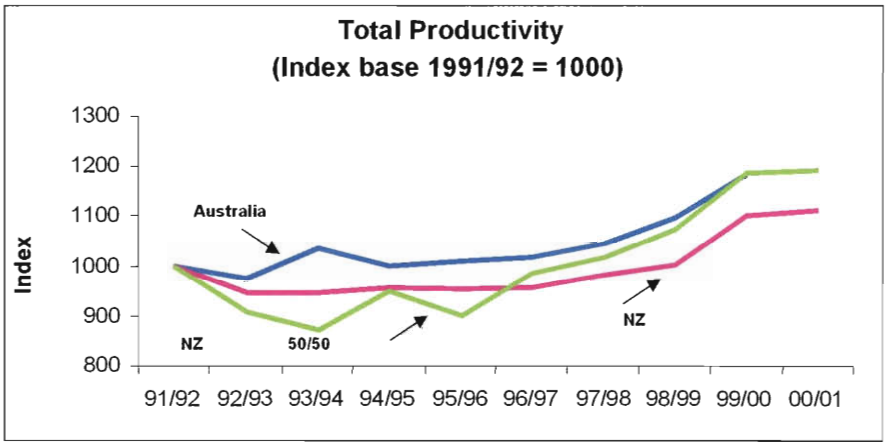


Fig 9. (Dexcel 2002)

The four strategic objectives of Dexcel are:

On-farm Advocacy & Representation
Co-ordinating industry activities in environment, animal welfare, animal disease, food safety and community perceptions.

Access to Technology
Breakthrough technologies for superior farm systems.

Adoption
Increasing farmer adoption rates of existing and new technologies and practices.

Capability
Education and training to provide quality people and to create a continual learning culture.

Significant technology breakthroughs will need to be made to achieve these objectives.

The dairy industry recognised that the long term trend of declining commodity prices was to have a major effect on the profitability of the industry and it had to change it's traditional farming systems to maintain it's efficiency against it's competitors.

Sustained improvement in farm productivity is unlikely to occur without the use of tools offered by biotechnology.
This improved productivity will focus on breeding and nutrition of both plants and animals having the potential to offer high value export products made from milk and offering farmers the ability to breed low maintainence animals.
The term low maintenance delivers an animal that displays improved traits in fertility, disease resistance, fitness and longevity, reduced metabolic stress and the ability to provide improved health and safety qualities of milk.
Mastitis, johnes disease, and methane output are some of the traits that will become key focuses into the future.

The primary sector will be an important part of the knowledge economy and uptake of technology. The New Zealand economy will need a strong biotechnology strategy.
The amount of revenue that the primary (industry) sector contributes, when the numbers in those sectors are analysed (in particular the dairy sector, with some 14–15000 dairy farmers), are contributing 20% of the country's wealth. How can these farmers have an impact on the country as a whole? Some would say that the industry should not uptake biotechnology at all, that the country needs to remain in the condition that it is at present, stating that the risk of implementing Biotechnology is too great.

So how do we as a primary sector ascertain risk and uptake this technology, and at the same give an indication to those somewhat cynical of biotechnology the ability to trust the technology.

Biotechnology

Biotechnology is the use of living systems to develop products. Scientific structures are alluring us to better understand fundamental life processes at a cellular and molecular level. We are able to improve selected attributes of plants, animals or microbes for human use by making precise genetic change, which was not possible using traditional methods. These help us address problems related to human health, food production, and the environment.

> *"All the significant breakthroughs were breaks with the old ways of thinking"*
>
> - Thomas Kuhn

Biotenz, the New Zealand biotechnology Industry Organisation, defines biotechnology as:

"The application of scientific and engineering principals to the processing of material by biological agents and the processing of biological material to improve the quality of life."

Already, efforts to understand DNA - the stuff that genes are made of - and how gene expression affects the behavior of cells, the structure of tissues, the development of organisms, and the fate of individuals, has revolutionized our understanding of the natural world in which we have evolved and our relationships with it. Continued efforts to unravel these mysteries promise to provide answers to questions that will enable us to prolong our lives, enjoy our futures, and even to solve problems that we have caused through our own impetuosity and desire to improve our position in the world. (Frank F. Bartol, Carolyn E. Zorn, Donald R. Mulvaney, Jack Wower, Dept of Animal and Dairy Sciences, Auburn University.)

Biotechnology is a set of tools. The biotechnology toolbox contains an increasing number of very precise and powerful tools. It is a means to an end.
Biotechnology uses techniques, which provide much more understanding of and control over living processes.

There are three key terms or definitions in biotechnology.

- Finding Out About Genes or Gene Discovery
- Moving Genes Around or Genetic Engineering
- Growing New Tissue

Gene discovery means finding out about;

- The physical location of individual genes on chromosomes ("where genes are").
- The specific action of individual genes ("what genes do").
- Their role in determining the appearance or performance for a given trait.
- An analytical approach only ("look but don't touch")

Moving genes around or genetic engineering:

- Allows a gene or genes in any living thing to be removed, turned off or moved around.
- It allows transfer from one species to another ("transgenic modification").

Growing new tissue:

- Involve manipulation of living things at cellular and tissue level compared to sub Cellular or gene (DNA) level. This includes cloning.

It is the ability to transfer genes from one species to another that is so appealing and creates huge potential for modified living organisms. Biotechnology allows researchers to identify beneficial traits – qualities like added nutrition, increased flavour, and pest and disease resistance – and incorporate them into various organisms.

Biotechnology differs from conventional breeding techniques as it offers breeders more precision and control. Biotechnology offers the ability to introduce new genes and characteristics. Only the

desired genes are introduced into the target genome unlike traditional techniques that can introduce desired genes but also unintentionally and unavoidably introduce unwanted genes.
As a consequence of the precision less time is required for commercialization.

"It is also this ability to transfer from one species to another, which creates the greatest fears - interfering with nature and evolution. Making matters worse is the fact that GE is not really a distinct science. It is a rather nebulous collection of tools that often overlap with pre-existing procedures. From the emphatic literature handed out on street corners you wouldn't realise this fact. Genetic engineering is always portrayed as toad genes in potatoes or fish genes in strawberries. But what about apple genes in apples, or when GE is used as a more rapid pathway to a genetic change that can already be achieved (albeit more slowly) with standard breeding techniques? Distinguishing old and new technologies can be complex - it is a continuum with earlier, approved methods that can yield genetic alterations spanning from minor modification to more extreme forms of transgenics.

Like any box of tools, you can use it for achieving widely diverse outcomes. Many people maintain that if one GE crop is found in some way deficient or dangerous, then all become tainted and so opponents tirelessly hunt for proof that GE can produce dangerous food. This is unnecessary effort. It is an uncontested fact that genetic engineering can cause problems. But in the same way that all people are equal under the eyes of the law, all judgments made on safety must be consistent. If GE is judged dangerous because Brazil nut genes inserted into soy made it allergenic, then natural plant breeding is dangerous because plant breeders made a toxic potato. The real issue then becomes whether GE is a valid criterion for judging safety." (Dr *David Saul, School of Biological Sciences University of Auckland)*

These are real concerns and something that needs to be considered in the quest for improved lifestyles.
When manipulating genes there is the risk of unpredicted side effects as most genes have multiple functions. However, new technologies frequently raise questions from users and consumers and the current inquiries about biotech crops are not unexpected, given the novelty and complexity of genetic techniques.
In previous eras, consumer and industry concerns were raised about new technologies such as artificial breeding and the pasteurization of milk. As in those eras, the public ultimately will formulate opinions about this technology by considering current and ensuing public dialogue. Thus, it is critical for this dialogue to provide to the public unbiased and balanced educational information and resources on biotechnology.

> *"We have recently advanced our knowledge of genetics to a point we can manipulate life in a way never intended by nature. We must proceed with utmost caution in the application of this new found Knowledge."*
>
> - Luther Burbank 1906

A survey of consumers (*Hoban, 1996*) has indicated that less trusted sources of information about one application of biotechnology are self-interest groups such as biotechnology companies and grocers, and advocacy groups such as consumer and environmental groups. Groups identified, as more trusted information sources for this biotechnology application were doctors, scientists, farmers, nutritionists, and government agencies such as the Food and Drug Administration.

These survey results indicate that the public is seeking communication of unbiased information in its quest to understand biotechnology and its future promises. Moreover, the public remains optimistic about biotechnology, and in fact, acceptance can be improved by providing unbiased, factual information about biotechnology (*Hoban, 1999 and Katic, 1998)*

Advances in science and biotechnology are moving at a pace that challenges comprehension. The impact on such advances on our lives continues to be both exciting and sobering. Implemented wisely, new biotechnologies hold incredible potential for the advancement of humankind. (Frank *F. Bartol, Carolyn E. Zorn, Donald R. Mulvaney, Jack Wower, Dept of Animal and Dairy Sciences, Auburn University.)*

G.E. is portrayed by some sections of the community as a huge threat in fact the greatest threat to hit this planet
Recent food scares in our traditional European markets have eroded public confidence.

So how do you trust this technology that has the ability to provide the technological requirements to keep us competitive into the future.

Trusting Biotechnology

> **Trust**: *1.Reliance, confidence in and reliance on good qualities, especially fairness, truth, honour or ability.*
> *2.Hope for the future: hopeful reliance on what will happen in the future.*

If the consumer do not support or accept the use of biotechnology in the development of, and production of food and related animal products then resistance will take place.

Trust can be viewed as an expectation, that one would not be exploited, by another (*James, 2002a*). This "uncertainty and vulnerability are the core elements of trust relations" (*Heimer 2001;pg. 43*)

To say that trust affects the public support of biotechnology means that individuals who trust biotechnology institutions in the development of agricultural products or applications will not expect to be exploited in the sense that such products or applications are ultimately determined to be unsafe or ineffective. This expectation is based on the perceived trust-worthiness (i.e. the "reporting bias") and competence (i.e. the "knowledge bias") of the biotechnology institutions (see *Jones, 2002a; Levi, 2000*). That is if the public is confident that it would not be exploited (e.g. the public perceives biotechnology institutions to be trust-worthy and competent) then the public would be more likely to trust and in turn, support biotechnology institutions. However, if the public expects to be exploited (e.g. public perceptions are that biotechnology institutions have a vested interest to misrepresent the safety and efficiency of biotechnology or have insufficient knowledge to conduct biotechnology-based research and development), then the public would be less willing to trust and hence support biotechnology institutions (*see Hunt and Frewer 2001*)

Consumers perceive that Biotechnology institutions have a "reporting bias" (i.e. an incentive to overstate benefits and understate risks and a "knowledge bias" (i.e. an inability to fully anticipate all contingencies) when publicly communicating the risks and benefits of biotechnology research (see *Dholakia and Sternthal 1997; Eagly, Wood and Chaiken, 1978*)
As a result, the public will discount information reported by biotechnology institutions, especially statements regarding possible risks associated with consumer application of Biotechnology research. Because public perceptions of risks and benefits affect the confidence consumers place in emerging technologies (*Kasperson, Golding and Tuler, 1992; Peters, Covello, and Mc Callum 1997*), such perceptions also affect the public's willingness to support institutions developing new technologies, such as Biotechnology industries (*Frewer, Howard and Aaron 1999*)

Previous research has shown consumers to be highly sceptical about GE in food production. However, very little research has tried to explain how consumers form attitudes and make decisions regarding GE foods.
Between countries it appears that attitudes toward GE toward food production were deeply embedded in more general attitudes held by consumers, in particular toward nature and attitude towards technology.

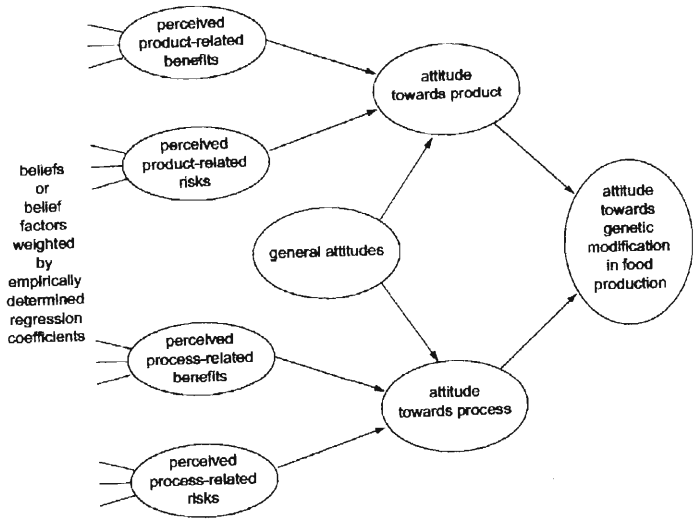
For example in a survey done in Denmark, Germany, United Kingdom and Italy (*as reported Lone Bredahl 1999*), Denmark, Germany and the United Kingdom perceived risks of applying G.E. in food production in themselves prevented the perception of benefits, this is somewhat similar to New Zealand. While in Italy the impact of perceived risks and benefits on attitude were identified as entirely additive .At the time results identified their consumer acceptance of G.E. foods was low. The strong links of attitudes towards G.E. foods to higher-order attitude and knowledge domains suggest that attitudes towards G.E. foods are quite strong, despite a lack of product experience. Likewise, the strong relation of product -specific attitude to overall attitudes towards G.E. in food production suggests that consumers tend to reject the technology overall rather than consider the product on a case-by-case basis.

This may change by a possible increase of G.E. products on the market.

G.E. has shown to be one of great social and individual involvement, especially because the technology offers barrier-crossing possibilities for developing products, which may significally, transform our future life. Attitudes that are powered by such high involvement are generally found to be quite deeply embedded in higher order life values (*Ostrom & Brock 1968; Thomson Borgida & Lavine 1995*) Values can be characterized as enduring beliefs about desirable goals that serve as guiding principles in peoples' lives (*Rokeach, 1973*)

Models developed by (*Bredahl, Grunert and Frewer 1998*) estimate the attitude and purchase intention of consumers towards GE in food production.
These models can apply to the theory of planned behavior of the consumer to any GE technology.

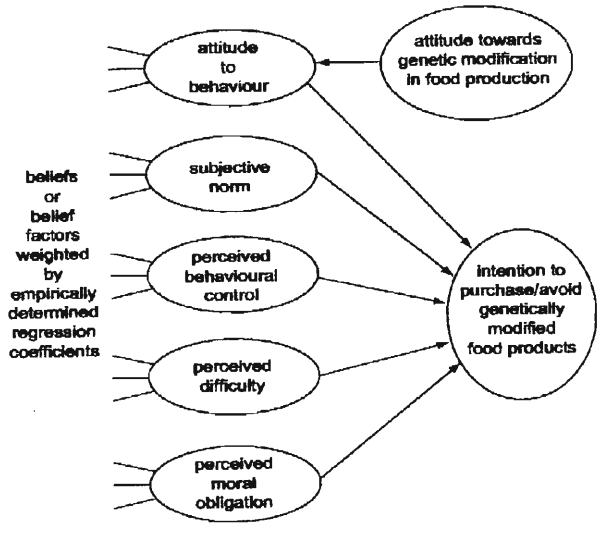
Figure 1. The attitude model



Source: Bredahl, Grunert & Frewer (1998)

The attitude model (fig1) predicts an individual's attitude toward the use of GE, in this case food production. This attitude is determined both by the attitude the person has toward the process of applying GE in food production and the attitude toward the resulting products.

Figure 2. The purchase intention model



Source: Bredahl, Grunert & Frewer (1998)

The purchase intention model (fig2) suggests an individuals intention to purchase or avoid GE food products, determined by the attitude that the person has towards purchasing a product by subjective norm, perceived control over the decision, the perceived difficulty of avoiding the product and by the moral obligation to avoid the product.

Information → Attitude → Behavior

An Overly Simplistic Model of Human Response (Caron Chess, Rutgers University)

Public fears regarding Biotechnology which includes GE, invokes perceptions of Risk. Given the complexity of Biotech and genetic techniques, frequently raises questions from consumers.
The public forms their opinion based on perception of the technology after considering public dialogue. It is important that all information presented to the public is unbiased, balanced and educational.

Obtaining reliable facts is difficult. The media prefers (to publish) news worthy headlines bearing news articles, not complex explanations. This has been replaced by '*factoid*' information.

The fact that most of the information we read has been filtered through a third party – some times in an attempt to remain unbiased; sometimes selecting pieces of information to suit their own opinions.

Imagery is everything. We define the technology by the extreme cases and then exaggerate these with frightening images.

> **'Factoid'** - *A piece of unverified or inaccurate information that is presented in the media as factual, often as part of a publicity effort, and then becomes accepted as fact because of frequent repetition.*
> **'Factoid'**- *an assumption or speculation, that is reported and repeated so often, that it becomes accepted as fact; a simulated or imagined fact.*
> http://www.dictionary.com

It is a requisite to ensure that any information, which is read, is substantiated by researched evidence or in regard to WEB based material related back to users and refers to easily verified fact.

There is also a requirement of the public to listen. Too often sectors of the public whether they are on the positive or negative side of the GE debate become dominant and fail to listen. Habit 5 of Steven Covey, (7 habits of highly effective people) is 'Seek first to understand before being understood'.
The underlying principals of this is that:

a) Diagnosis must precede prescription
b) Understanding comes through listening.

There is a sector of consumers who are less trusting of self interest groups such as Biotechnology companies and advocacy groups such as consumers and environmental organisations. This evidence is backed up by surveys (*Hoban 1996*).
There appears to be cynicism of large businesses, which have a vested interest and are perceived to have a monopoly over the distribution of information, and policy and regulation
Survey results (*Hoban 1999; Hoban and Katie 1998*) indicate that the public is seeking unbiased information in its interest to understanding Biotechnology and future results.

Trust is very easy to lose and very hard to build.

A study by *Slovic 1993* illustrates that depending on how statements are phrased has a major impact on whether trust is increased or decreased.
Events that are trust decreasing have a significant negative impact on consumer trust and trust increasing events only minimally increase trust.

Another aspect of this debate that causes uncertainty is that it is human nature to remember bad news and forget the good.
"Whenever I talk at public meetings, there is always somebody who calls out "what about thalidomide?" Yes, thalidomide failed its users in a tragic way. But what about penicillin, tetracycline, insulin, aspirin, the eradication of smallpox and a thousand other success stories? Science does not claim certainty – that is the realm of the fundamentalist. Science accepts that errors can be made. It provides probabilities to define the limits of our certainty and attempts to minimise these margins of error with good research published in peer-reviewed journals.
Worse, sometimes the bad news is simply untrue. Once spawned from rumour or biased reporting, a scare story simply won't go away." *Dr David Saul, School of Biological Sciences, University of Auckland.*

Falsehood flies and the truth comes limping after; so that when men come to be undeceived it is too late: the jest is over and the tale has had its effect. - Jonathan Swift

A DSIR survey (Couchman and Fink-Jensen 1990), as covered in a paper by Joanna Gamble identifies that three quarters of the public surveyed had heard of G.E., few felt that they could explain it to others. Genetic manipulation in human cells is the least acceptable. Manipulation in plant cells is the most acceptable.
Three quarters of the public were aware that GMO's could be used to produce food and medicines and typically no more that 50% were concerned regarding eating G.E. product.
These facts are interesting because a report done by (*Macer, Bezar, Richards-Harman, Kamada and Macer 1997*) indicate that New Zealand had a less favorable attitude towards G.E. than Japan, Canada or the E.U. average. New Zealand was more in line with the German, Greek and Austrian way of thinking.
This is also in line with the outcomes of the (*Bredahl 1999*) report mentioned earlier.

Another survey done, by (*MacPherson Kearns and Sharland 2000*) from Massey University, surveying consumers' response to various forms of labeling.
While it is apparent it did not have any affect on choice, behavior or sensitivity to genetic modification, it illustrated that the public knowledge had improved over the 3 year period following the Macer's et als study (1997).

So the fact that is consumer awareness has increased. Evidence also suggests that acceptance of G.E. food remains low.

Is this because of the sceptical view of G.E. in food production, which researchers have not been effective in explaining the benefits or safety of G.E. products, or that consumers have not had the opportunity to purchase G.E. food because few products are marked and labeled. These results are also similar to the *Lone Bredahl* report, surveying consumers in Denmark, Germany, Italy and UK.

So this brings us to another area. If the public bases their perceptions on food safety issues, it needs to be noted that less than 10% of G.E. that goes on in the world, revolves around food and crops. The majority of work is based around routine laboratory and diagnostic work. This has been carried out for many years.
This is why we see environmental lobby groups now challenging field releases and crop modification, rather than condemning the whole technology.
The discussion needs to be put in perspective.

> *"The one who listens does the most work, not the one who speaks"*
>
> -Steven R. Covey

Regulations are developed to provide public safety and also to ensure that the environment is protected.
An issue with regulation is the cost of compliance and control. Just because the cost of compliance is increased does not necessarily increase the margin of safety.
For example while it costs as much as NZ$100,000 to obtain approval for a field trial in New Zealand it costs as little as US$15.00 in the United States.
To increase the level of trust in the regulatory system you can make the regulations stricter or make the public more trusting of the regulatory system through information and education.

Those that feel the current regulations are ineffective may seek to reduce public comfort even further in the hope regulations will get tighter, thereby increasing compliance costs, driving scientists overseas thus stifling development
A move towards a knowledge economy will be hindered if regulations are promulgated in New Zealand to satisfy activists' demands which add little to safety or environmental protection.

The Environmental Risk Management Authority (ERMA) has the role of making decisions on all applications of GE, under Part V of the Hazardous Substances and New Organisms Act. (HSNO)
The overall mission of the authority is to:

Ensure that the risks associated with the introduction of hazardous substances and new organisms are cost-effectively managed, so as to protect the environment and human health and safety, while taking into account costs and benefits for the whole New Zealand community.

This mission will be achieved principally, through, actions by the Authority, and ERMA New Zealand to:

- Make cost effective and effective decisions on applications under the HSNO Act, which take appropriate account of benefits and costs as well as risks, to New Zealand, promote compliance with the act and the Authority's decision.
- Promote public understanding and knowledge of the risks associated with new organisms and hazardous substances and how to manage them, and
- Enhance the HSNO Act as an effective legislative framework for risk management.

As well as this mission the Government has also issued a statement on its six key goals as a guide to the state sector. The goal of most relevance to ERMA is:

- Protect and enhance the environment
- Treasure and nurture our environment with protection for ecosystems so that New Zealand maintains a clean, green environment and rebuilds our reputation as a world leader in environmental issues.

These are strong regulatory guidelines. Together with recommendations made by the Royal Commission on Genetic Modification, New Zealand has one of the strongest regulatory systems in the world.

The Royal Commission identified that New Zealand should keep it's options open, and it would be unwise to turn our backs on the potential advantages on offer, but should proceed carefully, minimizing and managing risks. At the same time continuation of the development of conventional farming, organics and integrated pest management should be facilitated.

The Royal Commission on Genetic Modification report was thorough and has made some sound recommendations for the future.

It is the regulations, framework and the enforcement of them that holds the key to acceptable use of biotechnology.
The Royal Commission identified that rigorous assessment by ERMA will be required before approval is accepted.

A sound regulatory system that is successfully communicated to the public over time will increase levels of public support.

> *"The significant problems we face cannot be solved at the same level of thinking we were at when we created them."*
>
> - Albert Einstein

Conclusion

Given the biodiversity of New Zealand and both the contribution to and the reliance on, the primary industry to the New Zealand economy, New Zealand cannot ignore biotechnology, both in terms of its use and its concerns.

Biotechnology will be the next modern revolution, and will become an increasing part of our food industry.
The challenge is to develop environmentally sound technologies and systems that will ensure a nutritious, safe, economical, food supply, whilst acknowledging public concerns.
Public acceptance of the quality and rigorous application of all safety assurance procedures is therefore vital.

New Zealand has traded on the image of clean and green and there is no doubt that image is an important branding tool for both international trade and cultural self- image. With the agricultural sector providing 66% of New Zealand's export earnings, and striving to compete globally this image should not be taken lightly.

As a result of exposure given to biotechnology, mainly in the area of crops, the public is seeking unbiased information about an often-misunderstood technology.
Genetic Engineering (GE) in particular has been treated as an outcome instead of a set of very precise and powerful tools.
Biotechnology uses techniques, which provide much more understanding of and control over living processes. It is a means to an end.

It is an uncontested fact that GE can produce dangerous food, and cause problems.
It is the ability to transfer genes from one species to another that is so appealing, creating huge potential for living organisms.
It is also the same ability that provides future potential that creates the greatest fears. Interfering with nature and evolution, some would say.
With progress there goes risk. It must be noted that all risk is relative.

As with previous eras, consumer and industry concern was raised over technologies such as artificial breeding, pasturisation and hybridization. The public will ultimately formulate opinions based on current and ensuing public dialogue as they did then.
All concerns need to be considered, listened to and discussed.

Surveys have identified various levels of acceptance of the GE technology, from acceptance on a case-by-case basis to total rejection.
Attitudes vary depending on values. The levels of social and higher-level involvement tend to lead to deeply embedded life values. These values tend to be held toward nature and attitude toward technology. (Ostrom and Brock 1968: Thomsom, Borgida and Levine 1995)
So therefore a persons intention to purchase or avoid GE food or products may be determined by the attitude toward the product, the perceived control over the decision to purchase, the perceived difficulty of avoiding the product and by their moral obligation to avoid the product.

To improve public trust, biotechnology organisations and regulatory bodies must display trustworthiness. If the public were confident it would not be exploited, it would be more likely to trust and in turn, support biotechnology.
However interestingly the public expects to be exploited.

The public mindset is that biotechnology organisations have a vested interest to misrepresent the safety and efficiency of biotechnology by overstating benefits and understating risks (see Hunt and Frewer 2001: Dholakia and Sternthal 1997: Eagly, Wood and Chaiken 1978).

Trust is very easy to loose and very hard to build.
Depending on how statements are phrased has a large on whether trust is increased or decreased (Slovic 1993).

The public needs to question all information relating to GE. Obtaining reliable facts is often difficult. Information tends to be filtered through a third party some times; there is a tendency to select pieces of information that suit personal views or values.
It should be a requisite to ensure information that is read is substantiated by researched evidence.
The public also has a responsibility to listen. 'Seek first to understand before being understood', habit 5 of Steven Covey's 7 habits of highly effective people.

Likewise those organisation involved with biotechnology strategies need to produce factual and trusting information, identifying both the positive and negative impacts of the technology with well researched evidence.

Oganisations also need to use the public submission system. As identified in research public acceptance has increased over time, as more contact with trusted information and products themselves increased.

The media tend to publish news worthy headlines and not complex information. This is called 'factoid' information.

New Zealand has one of the best regulatory systems in the world in terms of ensuring public safety, and that the environment is protected.
New Zealand, through commissioning the Royal Commission report on Genetic Modification, has given itself the opportunity to pursue a biotechnology strategy, enabling it to remain competitive as a global exporting nation. The Royal Commission Report also identified and made recommendations to Government, to allow, through rigorous assessment criteria that biotechnology strategies are able to work in co-existence with existing farming practices.

The Environmental and Risk Management Authority (ERMA), has the role under the Hazardous Substances and New Organisms Act (HSNO) to rigorously assess and to approve any new GE strategy. There is a large amount of responsibility around ERMA's role in approval of applications, so as to ensure that New Zealand's competitive advantantage is maintained, current farming practices can work in co-existence and the environment and human health and safety are protected.

ERMA needs to earn the right from the public to be trusted and not assume that it has public trust as of right.
ERMA needs to be independent, transparent and well funded.

New Zealand is in a unique position, not only to be world leaders as competitive global export marketers, but also as leaders of implementation of effective biotechnology strategy.
The key element to the successful implementation of this strategy is maintaining the core values as outlined earlier.
These core values, combined with attitude and a willingness to listen before being listened to, give individual perception of 'paradise'.

References

Anderson Dan R. PhD CPCU Journal Biotechnology Risk Management: The case of Genetically Modified Organisms

Bartol Frank F, Zorn Carolyn E., Mulvaney, Donald R, Wower Jacek, Animal Biotechnology and Industry: Challenges and Opportunities in the Real World*Department of Animal and Dairy Sciences
Auburn University

Bredahl Lone, 2000. Determinants of consumer attitudes and purchase intentions with regard to genetically modified foods. Working paper 69. The Aarhus School of Business.http://www.map.hha.dk/WPpdf/wp69.pdf

Busquin P, (2001) EU research Commission Press Release: GMOs: are there any risks? Launch of a European Round Table on GMO Safety. Brussels, 8 October 2001

Chess Caron, - The Public and Agricultural Biotechnology: Key Questions. Rutgers University, New Brunswick, N.J

Convention on Biodiversity. Cartenga Protocol on Biosafety. FAQ.
http://www.biodiv.org/biosafety/faqs.asp

Council For Biotechnology Information - Benefits of Plant Biotechnology.
http://www.whybiotech.com.

Crop and Food Research. Public Issues.
http://www.crop.cri.nz/psp/articles/docs/gm_crops/qgene16.htm

Environmental Risk Management Authority (ERMA). About us. Purpose, Mission and Goals.
http://www.ermanz.govt.nz/about/erma-purpose.htm

Faust Marjorie A., Ph.D., Associate Professor of Animal Science, Iowa State University. Straight talk about Biotech crops for the livestock and meat industries.

Food and Ethics Council – Novel Foods: Beyond Nuffield.

Gamble Joanna. Public perceptions of Genetic Modification

Independent Biotechnology Advisory Council: The Biotechnology Question. An introduction to the technology that is changing our lives.

Industry Canada. Earnscliffe Research and Communications, Public Opinion Research into Biotechnology Issues. \January 2000. http://www.strategis.ic.gc.ca

James Harvey S, Jr. - Department of Agricultural Economics University of Missouri Working Paper No AEWP 2002-01

Ministry of Agriculture and Forestry: In Brief. http://www.maf.govt.nz/mafnet/rural-nz/agriculture-forestry-horticulture-in-brief/in-brief.pdf

Ministry of Research, Science and Technology: Science and Technology Interest, Understanding and Attitudes in the New Zealand Community.
http://www.morst.govt.nz/publications/interest/section6.htm

New Zealand Dairy Board. Biotechnology: Why We're Investing In Research. Publication.

Nill Kimball. Technical Director, American Soybean Association. The contribution of agricultural crop biotechnology to American farming.

Potential Economic Impact of Biotechnology:
http://www.lifesciencenz.com/repository/speeches_submissions/economic_impact_biotech

Royal Agriculture Society of England – The challenge of genetic change in animal production. September 27 2002. http://www.bsas.uk.

Royal Commission on Genetic Modification Report.
http://www.gmcommission.govt.nz/

Saul Dr David: School of Biological Sciences University of Auckland.
GE Food Crops A' Natural' Fallacy.
d.saul@auckland.ac.nz

Small B. H., Wilson J.A., Pederson J.A. and Parmenter T.G. Agresearch, Ruakura Research Centre. Genetic Engineering and the Public: Attitudes, Beliefs, Ethics and Cows.

The Life Sciences Network. - http://lifesciencesnetwork.com

Vaughan S.R.: Ministry of the Environment. Genetic Modification An Overview and Background.