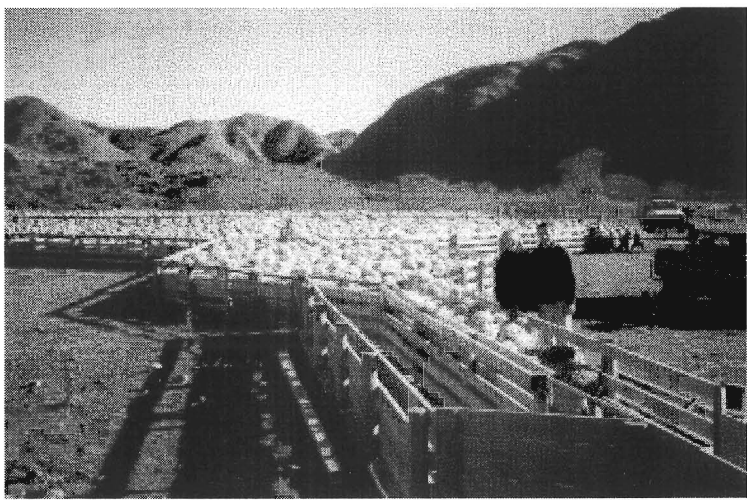
Genetic engineering technologies on the farm

– what are the issues for New Zealand beef and sheep farmers?



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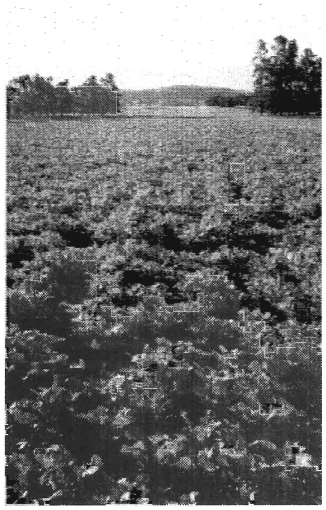
Marlborough
November 1999

Prepared as part of the Kellogg Rural Leadership Programme

Do New Zealand sheep and beef farmers stand to boost profitability and viability of their businesses through embracing the use of genetically engineered resources?

"Farmers are frustrated at the lack of good information coming forward" in regards to genetic engineering.[1]
Alistair Polson, Chairman of New Zealand Federated Farmers.



This paper aims to lay out the issues for farmers concerning the introduction of genetically engineered seeds and animals into the farm system. This **informal paper** is designed to be a 'starting point' for sheep and beef farmers who are interested in finding out what benefits and risks the technology of genetic engineering may hold for their businesses.

It takes a stock-take of consumer attitude to genetic engineering and outlines the questions farmers need to answer before using genetically modified resources on their farm.
Farmers need to consider how using genetically engineered products will effect -

a) the marketability of their products
b) the position of their products in world markets (e.g. commodity, niche)
c) the diversity of income sources from their land
d) farm production costs, including legal and compliance costs
e) farm sustainability and ecology of the area
f) genetic ownership structures and farmer autonomy
g) farmer health, lifestyle and rural culture

This paper cannot answer all the questions raised but it does attempt to provide farmers with some **predictions** for the future and some **recommendations** on how to approach the issues associated with agricultural genetic engineering. Farmers do have the ability to have some control over the direction of their industry; through their choice of what they grow and how, through the producer boards research and development priorities and through their lobbying power (e.g. Federated Farmers).

Distribution and use of this paper among the rural community is encouraged.
Beef and sheep farmers could use the attached bibliography to investigate the issues further.

[1] Otago-Southland Farmer, October 8th, 1999, page 20.

Contents

(1) Farmers at a cross-road

Right now in New Zealand, there is a need to take up opportunities to improve farm business profitability. The average sheep and beef farm in New Zealand runs 3,600 stock units. The business sells about 1400 lambs and 13,000 kg of wool per year but farm profit before tax, drawings and capital purchases averages **only $30,000**.[2]

There is a desire among farmers to stay on the land and to carry on with the traditions of farming sheep and cattle. However, the margin between profitability and 'poverty' is getting closer.

Should beef and sheep farmers embrace genetic engineering as a means of improving viability? What economic and social benefits would farmers stand to gain from using genetically modified resources on their farms?

Will genetically modified products allow farmers to cut costs on animal health, sprays and fertiliser? Would genetically modified resources improve the farm's sustainability (i.e. the ability of the resources such as soil to be maintained and/or improved)? Will markets pay more for meat from genetically modified animals? What opportunities are there for farmers to produce high-value niche products, such as pharmaceuticals and designer foods?

Would the widespread use of genetically modified resources in the market (such as seed, ram and bull genetics) increase or decrease the purchase costs of seed and stud stock in general? Will farmer's autonomy be improved or restricted? Will farms be healthier and happier places to live on and will rural communities be strengthened?

(2) What I recommend

There is no doubt that the biotechnology of genetic modification could bring huge changes to sheep and beef farms. It has the potential to **speed up** genetic advancement, **alter the type** of products farmers' produce and be a **catalyst for change** in the ownership and distribution of animal and plant genetics.

Manage it carefully

However, for economic and social benefits to flow to farmers, the use of genetically engineered resources will have to be managed very carefully by industry stakeholders. Using genetically modified organisms to decrease production costs, without altering the product to benefit consumers, is not likely to win support from consumers. This is because they are taking all the risks without any of the benefits. Consumers that are prepared to take risks are those who can't afford to pay high prices

Must bring benefits to consumers

The short-term trend is that food products (especially commodity products) developed using genetic modification, will be less sought after by consumers than GE-free products. Discounted prices will be the result. Over the next 5 to 15 years consumer attitude towards genetically engineered products may become more accepting. Some may remember when the first cars were introduced, people were instructed to run ahead with red-flags to warn pedestrians of the dangers!

Consumer acceptance will only occur if the **understanding** of the science among the public is improved, the products developed are demonstrated to bring considerable **benefits** to consumers in terms of food quality and safety, and consumers feel satisfied about the **level of risk** associated with the products.

Farmers that use genetically modified resources to simply produce more of the same product e.g. beef or wool, without adding any significant advantages to the consumer, may only serve to discount the product, keeping it locked into the generally fickle commodity trade. In some cases, there is the potential to lose the market altogether.

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[2] Annual Review of the New Zealand Sheep and Beef Industry, Meat and Wool Economic Service, 1998-1999.

As a result of these conclusions, farmers should tread warily in considering using genetic engineering technologies in their businesses.

(3) What is genetic engineering?

Genetic engineering or genetic modification first took place in 1973. It is one small part of biotechnology and involves using a range of techniques to alter the genetic structure of an organism. The result is an organism with a new genetic makeup and potentially, new characteristics.

The genes dictates what proteins are produced

All living things are made up of cells. Inside each cells are genes (on strands of DNA). A gene is a unit of hereditary material that, by itself, or with other genes, carries the information necessary to produce the protein(s) that determine a characteristic of an organism. For example a gene may dictate birth weight of a calf.
Genetic engineering developments have meant that scientists can isolate individual genes, and then put them into the DNA of another organism. Unlike conventional breeding processes, the cells can be from a completely different species. This creation of a new organism by moving a gene or genes from another species produces a 'transgenic' organism.

When plants or animals are crossed in conventional breeding, the offspring receives half its genetic material from each parent. Breeders have traditionally relied on random natural mutations to give new characteristics to a variety. Genetic engineering gives agricultural scientists a whole new set of building bricks to chose from when breeding new varieties and more control over the characteristics of a plant or animal.

Four key steps up the ladder

On a practical level, it is helpful to divide gene technology into four stages.

a) At the first stage, scientists are working to understand the **cell** at a molecular level. Understanding the biochemical pathways help us learn more about the organism in general.

b) The next stage is to find genes that could be useful. This can be done by identifying and locating the **genetic marker** for a gene, e.g. genetic marker for baldness.

c) The third stage is known as **transformation**, where a gene from one organism is copied into an organism of the same species. The 'flavour savour' tomatoes are an example of this.

d) The fourth stage is when a gene from one species is copied into another species. This transgenic engineering is the technique that attracts the most media publicity.

How genes are transferred

Genes are transferred from one organism to another by a whole range of methods. There is potential to use embryo transfer and cloning in partnership with genetic modification.

A bit of history

Genetic engineering has been used commercially for more than 15 years to produce insulin for treating diabetics.[3] Wide spread commercial planting of GM soya beans, corn and cotton began in 1996 in the United States. In New Zealand, field trials of genetically engineering crops have been carried out since 1988.[4] Chymosin, used in cheese making in New Zealand, is made from transgenic bacteria. Traditionally it came from cattle, calves and pigs stomachs.

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[3] Ministry of Health and MAF Kit of genetically modified food.
[4] "Frenzy over foods", Crop and Food media release, 24 September 1999.

(4) What are the general opportunities for sheep and beef farmers?

There are enormous advantages for agriculture from simply understanding more about the genetic make-up of an animal, without going as far as 'transformation' or transgenic engineering. However, altering genetics does create a whole new realm of possibilities for agricultural production. Farm businesses could diversify their income sources by growing avocados in North Otago for example. Sheep farmers could reduce costs by running sheep resistant to flystrike or parasite attack. Nematode parasites of sheep and cattle are estimated to cost New Zealand farmers $270 million each year.[5] Pastures resistant to the establishment of the fungus causing facial eczema could greatly boost farm profitability.

In general, genetic modification technologies should allow farmers to **diversify** the products grown on the farm or to produce a **higher yield** of the same product. It may allow farmers to produce a product with a particular **attribute** that consumers demand e.g. highly tender beef or beef with exact iron and vitamin levels for human nutrition. From a scientific point of view, genetic modification technologies can greatly speed up breeding advancements.

Ryegrass, clover, lucerne, sheep and cattle genetics

Sheep and beef farmers have the most to gain from altering the cattle, sheep, clover and ryegrass genes. Trials in New Zealand are currently underway on a transgenic clover resistant to insect and virus pests. Monsanto's short-term aim is to use the Roundup Ready gene (currently in Canola) in forage brassica crops (e.g. turnips and rape). This would allow farmers to spray Roundup to control weeds, without destroying the forage crop. Double-cropping genetically engineered lucerne may also become an option. When lucerne is dormant in winter, a winter-active forage variety could be under-planted. In spring, when the lucerne starts growing, the winter crop could be sprayed out with Roundup[6] . Meat New Zealand is funding two research projects looking at footrot resistance genes and genes for sheep loin size and growth.

Keith Steele, CEO of AgResearch, believes gene sciences can help New Zealand "fine-tune agricultural products to meet the demands of the international markets". He believes a doubling of export incomes within the next 20 years could result from the creation of new industries and keeping our existing industries "at the leading edge".[7] AgResearch stands to grow their business if farmer demand for genetic engineered resources becomes widespread.

AgResearch carried out a one year project looking at the biological feasibility of breeding a wool-less sheep. The aim is to produce a sheep primarily for meat, which won't need shearing. The project concluded that using standard breeding would be a better option than using genetic engineering as the gene for wool growth is available in sheep already and traditional techniques are cheaper at present. The project did not investigate the consumer acceptance of a possible product.[8]

The exact dollar benefits unclear

Obviously, the degree of production benefits is entirely dependent on the success of the particular genetic modification. Quantification at this stage is difficult as only a few genetically modified animals have been developed or even tested. However, there are transgenic sheep in both Australia and New Zealand.

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[5] AgScience, February, 1997, page 6.
[6] Murray Willocks, Monsanto, interview with Jo Grigg, 5th November 1999.
[7] AgResearch Science magazine, No 17, May 1999, pg 2.
[8] Dr Andy Bray, Leader of the Fibre and Skin Group, AgResearch, interview with Jo Grigg, November, 1999.

(5) The major players in genetic engineering

New Zealand has the expertise

The New Zealand sheep and beef industries are in a position to develop genetic engineering technologies if the industry requires. At a crown level, biotechnology expertise can be found in the Molecular Biology Unit at Otago University, AgResearch, Hort Research, the Universities and Crop and Food Research. The sheep mapping genome programme is carried out by the Molecular Biology Unit. New Zealand's strength at this stage is the large and good quality base of sheep and beef phenotypes (characteristics) to draw from.

Ten companies own virtually 100% of the transgenic seed market

At an international level, there has been a profusion of biotech companies recently. The USA has 1300 and Europe has 700.[9] While New Zealand has considerable expertise in the area of the sheep genome and potential to be a major player in this area, the cow genome is being widely studied overseas as well as in New Zealand.

In regards to plant varieties, ten conglomerates own 40% of the world seed market.[10] The top five companies (Asta Zeneces, DuPont, Monsanto, Norvatis and Aventis) account for 60% of the global pesticide market, 23% of the commercial seed market and virtually 100% of transgenic seed market. [11] Sales of genetically modified seeds grew 20 fold from 1995 to 1998.

(6) Who's in charge? - regulations for controlling genetic engineering technologies

ANZFA to protect consumer

The New Zealand government regulates risks associated with genetic technologies through the Australia New Zealand Food Authority (ANZFA) and the Environmental Risk Management Authority (ERMA). ANZFA is designed to protect the consumer. It is a government agency that develops food standards and assesses new genetically modified food on a case by case basis.

ERMA to protect environment

ERMA is different from ANZFA in that it is an independent crown agency. It is charged with protecting the environment and communities from 'adverse effects of a new organism (including genetically modified organisms). It approves all R&D, field-testing and releases of 'living organisms' that can be propagated e.g. genetically modified potatoes. Jon Hickford, Senior bio-chemistry lecturer at Lincoln University, believes farmers can place trust in ERMA's regulations as "they are excellent in world terms".[12] The cost of this assessment process is very expensive however.

Farmer's voice represented by Federated Farmers (FF)

Each new organism has to meet the standard set by the Hazardous Substances and New Organisms Act. As applications are notified in the main metropolitan newspapers (not regional) and farmers have other time commitments, it is unlikely that many farmers are involved in the consultation process. The trend is for farmer organisations such as Federated Farmers to respond to applications on behalf of groups of farmers. Alistair Polson, Chairman of FF, says that FF make submissions to ERMA for each new application and seek advice from the main industry concerned.

The company trialing the new organism is responsible for enforcing the conditions for trials. When farmers are assessing the risks associated with genetically modified trials in their district, they need to consider the effectiveness of having a commercial organisation enforcing trial conditions.

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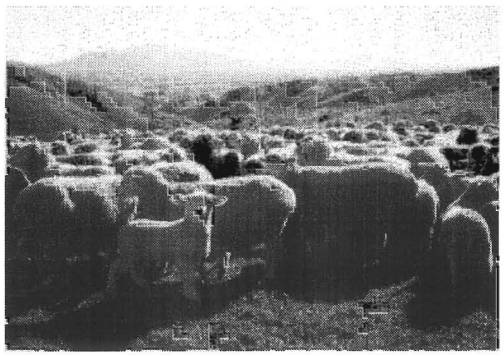
[9] "Rural News", October 4th, 1999, page 42.

[10] The Australian Magazine, July 3-4, 1999, page 30.

[11] Rural Advancement Foundation International website, 3rd September, 1999.

[12] Jon Hickford, Lincoln University, interview with Jo Grigg, November 1999.

(7) If farmers were to produce genetically modified products, would they have a market for these products?



Monsanto has admitted that their biggest public relations mistake was introducing genetically modified organisms that had strictly farmer rather than consumer benefits.[13] Consumers have been quick to pick up that while the farmers and seed and pesticide companies may reap the benefits, the consumer may be taking all the risks.

Reading and tracking consumer attitude to genetically modified organisms is vital to farmers considering using genetically modified resources. The agricultural industry as a whole needs to tread carefully to ensure that products have a guaranteed higher-return market before money is spent on their development and production.

It's all very well to have on-farm benefits, but will the consumer want genetically modified beef or lamb? Farmers need to be sure of this before levy-funds and taxes are invested into the research and development.

PPCS meat processor 'wary'

Currently consumer acceptance of genetically modified food in 'developed country' markets is very low. When Stewart Barnett, CEO PPCS, was asked if his company would attempt to sell genetically modified meat he said "New Zealand would be dead if we tried". Even if farmers produced a meat product that had outstanding quality attributes that appealed to consumers, PPCS would not be prepared to try and market it. While he agreed that "consumers may come to it over time", his advise to farmers considering using genetically engineered resources at this stage was "don't".[14]

There is ample evidence of consumer distrust in genetic modification. While 'media hype' is often blamed for negative consumer reaction, consumer opinion is a reality and must be respected. The inability of the consumer to 'mother-on' to genetic engineered crops has spread to investors. The Deutse Bank released a report for investors advising them to steer clear of companies involved with the sale of genetically modified seeds.[15]

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[13] "The New Zealand Farmer", September 9th, 1999, Peter Kerr.
[14] Stewart Barnett, PPCS, interview with Jo Grigg, Marlborough, September 1999.
[15] "GM industry faces collapse, says bank", Daily Mail, August 25, 1999.

Reaction to things 'unnatural'

In the late 1980's, 1500 people were permanently disabled and 37 died after they consumed the dietary supplement tryptophan which had been genetically engineered. The BSE crisis in the UK, which revealed the limitations in Britain's scientific management, added to consumer scepticism of things 'unnatural'. Closer to home, the DDT residue issue, the illegal introduction of RCD and the raising of herbicide residue thresholds in some genetically modified foods has increased New Zealand consumer scepticism of 'agricultural technology'.

Consumers cautious

The British supermarket chains Marks and Spencer and Sainsbury's now have a GE-free food policy for their labels, in response to consumer pressure. The European Union remains the major market for NZ lamb with the UK accounting for 27% of total exports and the rest of the European Union a further 29%. The United States is the major destination for NZ beef and veal, accounting for 64% of total beef exports.[16] "Chefs in America" (which represents 10,000 hotel and restaurant chefs) has urged the USA Federal Department of Agriculture to adopt stronger regulations, particularly in labelling and pre-market testing, for all genetically engineered foods".[17] In 1999 Unilever and Nestle said they would not use genetically modified ingredients in their European products. The large Japanese brewer Krin and Sapparo use GE-free maize to brew their beers.[18]

In 1999, corn farmers in the USA have had some difficulty getting markets for their genetically modified crops. Crops genetically altered to resist pests or herbicides debuted three years ago in the United States and, since then, their use has skyrocketed. The increase in GM crops is strongly due to the US government spending over $15 billion in agricultural biotechnology, as a means to support US agriculture. Grain industry sources estimate that 35 percent of the U.S. corn crop is derived from genetically modified seeds. However National USA Corn Growers Association president-elect Lynn Jensen commented that supermarkets are now 'backing away' from the products.

Lies, dam lies and statistics

Survey statistics on consumer support of genetic engineering vary widely, depending on how the questions are worded. The Eurobarometer survey in 1997 suggested that 64% of New Zealanders support genetic engineering of crop plants if used to improve resistance to pests and diseases. 75% approved of the technology to produce medicines and vaccines.[19] The Eurobarometer biotechnology survey was run in all 15 countries of the EU plus Canada, New Zealand and Japan, It is able to make international comparisons using the same survey. Margin of error at the 95% confidence level for a 50% answer to a question is ±4-5%.[20]

There has been increased criticism of the emotive response to the genetic engineering debate. While it is sensible to see genetic engineering as a tool, with varied results being the outcome, consumers prefer black and white answers rather than shades of grey. As consumers will tend to be cautious, so should the sheep and beef industry.

GM debate linked to anti-multinational company feelings

Multinational companies are the prime leaders of genetic modification technologies. This has caused some consumers to link their anti-multinational feelings ('profiteering' and 'exploitation') with the GMO debate. The New Zealand publication "Tiki the Penguin's Guide to Genetic Engineering", put out by the GE-free Project, states "I'm frightened about GE in the hands of companies that do it". "Some nasty organisations don't care who gets trampled on in the process".[21]

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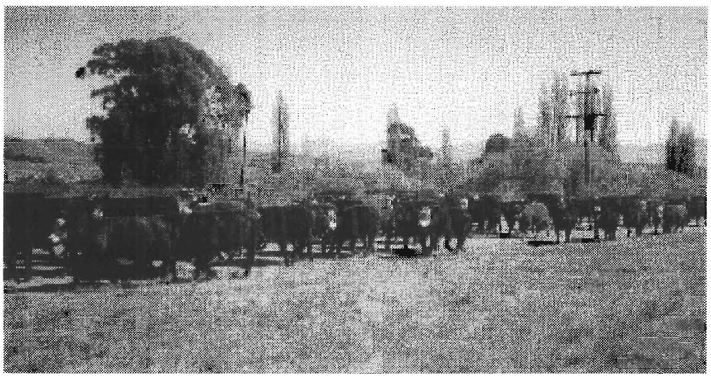
[16] Meat and Wool Economic Service Annual Report, 1999, pg 24.
[17] International Consumers Institute website, 9/13/99
[18] RAFI, September, 1999.
[19] Crop and Food Media release, 9/24/1999.
[20] "Genetic engineering: what do the public think?", Crop and Food Media Release, 24 September, 1999.
[21] "Tiki the Penguin's Guide to Genetic Engineering", GE-free Project 1999.

The Foundation of Economic Trends and the US-based National Family Farm Coalition are taking a lawsuit against Monsanto, DuPont and Novartis saying they are "exploiting bio-engineering technologies to gain a stranglehold on agricultural markets".[22] The removal of the 'Terminator' gene (that makes a seed sterile) from the market place, was an attempt to diffuse the perception of control over seeds by large private companies.

It is not suprising that it is the larger companies that are involved in genetic engineering technologies as the development and compliance costs require significant investment. The New Zealand farmer needs to ensure that the control of the patents is managed in a way that competition between the multi-national companies can exist.

[22] Financial Times, Jean Eaglesham, September 1999.

(8) Where could genetic engineering technologies position our meat and wool products on the world markets?



Potential to discount farmers commodity products

New Zealand beef, mutton, pelts, wool and hides are mainly sold as commodity products. In other words, the product value is determined by competition from other meats or synthetics and supply and demand.

Meat from genetically modified beef could be exactly the same in nutritional composition and structure to non-genetically modified beef. However, the requirement for labelling of genetically modified food ('is' or 'may contain') immediately advertises a 'difference' to the consumer. Current consumer trends suggest that having a product labelled 'genetically modified' downgrades the value of the product, especially if it is a commodity product.

Need to monitor what our competitors are doing

As a consequence, it would be unwise for sheep and beef farmers to support research and development that produced genetically modified food that had no or minimal added advantage to the consumer. In fact it would be strongly recommended that there are advantages to being GE-free with commodity products if it helps move the product away from the commodity market to the 'speciality' market. The actions of New Zealand's competitors in this area are paramount to the direction New Zealand should take.

Surveys in Europe by the TIME magazine in Jan 1999 asked consumers, "If food were labelled as genetically engineered, would you buy it for yourself or for your family?". 28% said yes and 58% said no.[23] Surveys in Canada, Australia, USA and European Union show that the public preferred genetically modified foods to be labelled. Labelling should occur in New Zealand by 2001.

(9) Is the GE-free option a good one for sheep and beef farmers?

It is unlikely that New Zealand will adopt a total GE-free policy, as pressure from commercial interests on a centre-right party is too strong. Perhaps this environment may change with a Labour government with an Alliance coalition partner. Labour has stated they will favour the development of organic production in New Zealand, drawing criticism from those who see it as an unnatural interference in the marketplace.

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[23] Time Magazine, January 1999, page 4.

Trade agreements challenged

Following in the 'nuclear-free' footsteps and going GE-free will be difficult from a trade point of view and will require re-negotiation of several bilateral agreements. New Zealand has an agreement with Australia that we should have similar food standards and that New Zealand has to accept any food from Australia that meets Australian labelling requirements.[24] Australia is currently growing genetically modified crops.

Since 1994 New Zealand has been signatory to a number of agreements administered by the World Trade Organisation agreeing that trade barriers have to be 'scientifically justifiable'. American Ambassador Josiah Beeman stated that a labelling regime 'could lead to difficulties in the bilateral trading relationship between the USA and NZ'. [25] However, it is most probable that the USA will not have grounds to threaten trade with New Zealand because of labelling. Codex Alimentarius Commission (agency of the United Nations World Health Organisation and Food and Agriculture Organisation) is in favour of labelling.
However, the USA would see a totally GE-free stance as offensive. New Zealand importing and exporting businesses would be affected by GE-free regulations.

Boost clean, green image but may need GE in future to help improve environment

A GE-free stance will immediately boost our clean, green image which will attract more buyers to our products. Currently New Zealand trades heavily on this attribute. Recently, Europe wanted GE-free canola and Australia was able to supply it as it was the only country that could guarantee it was not genetically modified. This contract was worth $A26 million.
However, the continuing reliance of the bulk of New Zealand farmers on pesticides and insecticides, and with a gradual consumer acceptance of biotechnology, our 'natural' image may begin to diminish, even if we were GE-free.

Going GE free has market potential but would require an international marketing effort from a whole range of industries. To avoid hostility from countries producing GM goods, a GM-free New Zealand would be best to market itself as 'natural'.

Organics and genetic modification – can they be reconciled?

Murray Willocks, Business Manager of Monsanto New Zealand, was quoted in Straight Furrow as saying that "if New Zealand stays away from genetically-modified crops then farmers will have to farm organically" as they won't be able to compete in the non-organic market.[26] He denies this statement, saying that the future will involve several farming systems (organic, conventional and genetically modified).
He warns farmers that "organic production may run the risk of becoming too big if New Zealand aimed towards being predominately organic". "Price premiums would be lost with competition from large organic areas of India and Pakistan."
He also believes that genetically modified organic systems should be possible.[27] From a market point of view, it is strongly in the interests of organic farmers to be GE-free. Consumer shyness of GM-foods is attracting more of them towards organic food. At this stage, whether organic growers use genetically engineered resources is dependant more on consumers' concept of 'natural food' than scientific argument.
At this stage, the organic industry is strongly against genetically engineered organic systems although they do not have to be mutually exclusive. However if GE technologies could be shown to be safe and highly beneficial to the environment, ethical pressure may come on organic farmers to use this technology.

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[24] MAF/Ministry of Health Information Sheet.
[25] "The shifting sands of the genetic engineering debate", Jonathan Hill, August 1999.
[26] "Straight Furrow", Tuesday, May 4th 1999.
[27] Murray Willocks, Monsanto, interview with Jo Grigg, November 1999.

(10) What's the potential for farmers to produce higher-value specialist products?

New Zealand farmers are good at producing meat and wool. However, the rewards for doing so are often minimal in terms of return on investment. By using genetically engineered sheep and beef cattle to produce either new products or similar products with particular attributes, farming may become more profitable.

Genetic engineering to reposition farm products in the high value markets

Rather than producing more of the same, genetic engineering may help farmers produce 'natural' or 'designer agro-product's' for the food, pharmaceutical or cosmetic industries. Beef could become more of a 'health' product, supplying high levels of iron, vitamins and minerals while being exceptionally low in fat. These sorts of products are known as 'neuriceuticals'.

Of all the uses of genetic engineering, the production of specialist products is probably the best bet for increasing returns from growing sheep and beef cattle. This is because the production of specialist products that have a certain appeal to consumer need is likely to have greater market appeal. This is especially true for pharmaceutical health products, as consumers are prepared to take the risk of using GM products if the risk of poor health is minimised. Rt Hon John Luxton believes farmers could be selling their products in the chemist, not just the supermarket.

Farmers may be restricted in taking part in this new industry

The use of transgenic animals for novel biomedical applications has progressed to the commercialisation stage in New Zealand.[28] For example, the Scottish Company PPL Therapeutics rear two flocks of 5000 genetically engineered sheep near Tokoroa. The sheep produce milk that can be used in the treatment of cystic fibrosis.[29]

However the bulk of this 'genetic' knowledge is and will be vested in private companies or crown research institutes and protected by patents. For farmers to become involved in running a specialist flock, the cost of set-up and intellectual property may mean farmers need to enter joint agreements with a biotechnology business partner. There is a danger that owners of the new genetics will see greater benefits in leasing or buying land, running their own flocks and employing farmers merely as 'shepherds' to manage the flock. Benefits to farmers will be minimal where a company holds the intellectual know-how and the farmer is only the 'vehicle'.

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[28] "Genetic modification of livestock for the production of therapeutics and designer foods", Phil L'Huillier, AgResearch paper, pg 1.

[29] The Press, 25 March, 1999.

For farmers to get a share of the profits from gene ownership they will need to either enter business contracts with biotech companies, sell their farming skills to biotech companies, have dividends paid to them through owning a share of a patent or have shares in biotech companies.

Farmers will require capital and scale

For farmers to get the benefits of increased market returns from sheep and beef farming for themselves, they would have to invest a large amount in the technology right from the initial R&D stage. Only farms with considerable capital or scale may be able to afford the genetics, to reap the benefits directly. They would also need to be more involved with marketing the product along the food chain. This also requires considerable capital.

It is likely that a few farmers may benefit considerably but not all farmers will have the opportunity. The natures of these niche markets rely on restricted entry into supplying the market. This point is often overlooked in the genetic engineering debate, to the peril of the average New Zealand farmer.

Benefits open to all New Zealand farmers

If a large amount of specialist product was required on a world-scale, a larger percentage of New Zealand farmers may be able to get into growing higher-value products. The genetics would be more affordable and accessible. The returns to the biotech company that developed the organism would be through mass use of the organism in farming systems, rather than use by a select few. However, as soon as too many farmers were producing the product, the market value may decline.

New Zealand farmers must keep the advantage

Crop and Food CEO Michael Dunbier believes that New Zealand farmers can "get out of the basic foodstuffs market and further away from commodity trading" through using genetic engineering.[30] As long as the genetics are affordable for New Zealand farmers, yet restricted to New Zealand farmers for their use, a competitive advantage over overseas producers is achievable. As research and development by producer boards is aimed to benefit all New Zealand levy payers, this type of product may be better suited to be developed by producer-owned organisations.

Genetics 'owned' by farmers as a group

For New Zealand farmers to have ownership of intellectual property for the new products at a group level, farmer-owned organisations such as producer boards will need to 'own' the patents. This will involve considerable investment of levies. Monsanto spends US$1 billion a year on research and development compared to the $10 million spent by Meat New Zealand. To ensure a return on the research and development costs, it is likely that the patents will in time become commercialised. Commercialisation may involve some ownership by overseas interests and use of the patents by competitors to the New Zealand industry.

Cost of research high so need to pool resources across industries

New Zealand spends only 1.1% of GDP on research and development compared with 2.1% for other OECD countries. Investment in scientific research through the Public Good Science fund represents only 5.1 days of the social welfare budget.[31] As genetic engineering research is expensive, long-term research, there is likely to be less money in the pool for other research. This siphoning–off may have negative effects on non-GE research and development. Bryan Guy, President of the Grasslands Association, raised this concern.[32]

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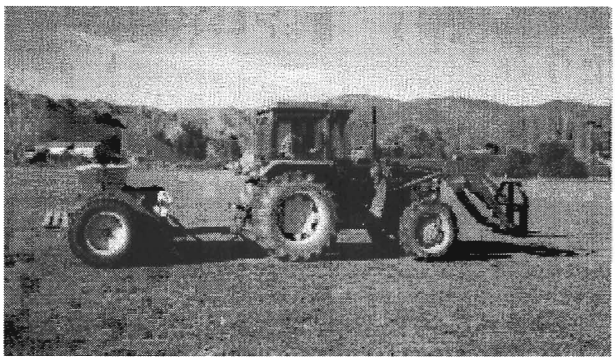
[30] Crop and Food website, 1999.
[31] AgResearch Science Magazine, no 17, May 1999, pg 7.
[32] Straight Furrow, Oct 5, 1999, pg 3.

As New Zealand has such a small GDP it makes sense that resources and expertise across industries are pooled. Discoveries in human reproduction, lactation and muscle genetic diseases are expected to make a significant contribution to the milk and meat industry.[33] It's estimated that gene technologies (including genetic engineering) could bring $6 billion to the economy in 2010. For farmers, the benefits will mainly come from improved production efficiency rather than returns from ownership of genes.

Although the Rt Hon John Luxton MP believes that success in agriculture will increasingly depend on the amount of knowledge the farmers have and how they use it, it is unlikely that farmer-owned organisations and farm businesses will make large amounts of money through ownership of genetically modified organism patents. They will basically be the purchaser of them.

[33] Foresight Vision for 2010, Website, 9/15/1999.

(11) How will using genetically modified resources impact on farm gross margins?



Ultimately, for genetically modified seeds or breeding stock to be used by farmers, it needs to bring them some benefits. Indirect benefits could be gained through increased prices for the product or farmers getting a higher share of the final market return. Direct benefits could be through savings on inputs or through increased production, e.g. parasite resistant sheep which reduce the need for a pre-tupping anthelmintic, or a clover that delivers the right nutrient balance to maximise animal growth. Endophyte-free ryegrass that can resist attack from the Argentine Stem Weevil could markedly improve lamb growth rates and animal health.

Huge potential to increase on-farm production

Currently at AgResearch there is a programme to improve white clover performance to boost animal production. The aim is to "remove constraints to white clover growth, quality and reproduction" through making the clover resistant to virus diseases and insect pests e.g. grass grub, clover root weevil. New Zealand field trials have shown that mosaic virus reduces white clover production by up to 40 percent.[34] Clover production is key to achieving high lamb growth rates and high ewe condition on most New Zealand sheep farms. The outcome of this genetic modification technology should be increased production efficiency compared to our competitors.

However, farmers will need to consider how long the increased returns through increased production can be sustained. Past experience has shown that increasing yields can merely put downward pressure on the price e.g. wheat yields have increased in Canterbury but the price has trended downwards.

Purchase price of seeds and stud stock may increase

The growth of genetic engineering technologies will act as a catalyst for the patenting of both existing genes and new organisms. There is money to be made in genes, the 'bargaining cards' for agribusiness's in the future. The on-farm input costs may increase as more organisms in the farm system will be patented and privatised. GM seed and animal genetics are likely to be more expensive than their non-GM counterparts as companies seek to secure a return on their research, development and testing investment.

Already sheep genes (non-genetically modified) are currently owned and marketed commercially in New Zealand (e.g. the Inverdale ewe fertility gene which is available from AgResearch). This trend will continue. There is nothing new in the fact that farmers will have to pay for the privilege of using genetics that hold a particular commercial advantage. What is

[34] AgResearch Science Magazine, no 17, May 1999, pg 12.

new, is the number of resources on the farm that will have a 'patency' cost added to the cost of the resource and the trend towards a few companies having a monopoly over farm inputs.

As biotechnology companies consolidate, a lack of competition may result, increasing the purchase price. Patents are guarded strongly. Monsanto has taken hundreds of North American farmers to court when they discovered farmers were growing their patented plants without having paid a licence fee. This included farmers whose non-GM crops were evidently contaminated by Round Up-Ready Canola seed from nearby plantings.[35]

On the other hand, the expected benefits to farmers should balance the extra cost of the genetics. Market forces should determine that the genetics are priced at a level where farmers can see a net return from using these genetics. Price will be strongly dictated by how long the company has the sole right to the patent.

Farmers in developing countries further restricted

Those farmers that do not purchase the new genetics may be left behind in terms of efficiency, becoming less viable over time. This is also true for farmers in developing countries who can not afford the new genetics. Their inability to compete further hamstrings their farming profitability and the ability of their country to develop into a stable, financially independent state. New Zealand farmers and society must consider this issue.

Companies sell a 'genetics and pesticide package'

The amalgamation of biotech and chemical companies has seen a trend towards a supplier owning both the germ plasam and the inputs required to grow the crop. Companies require farmers to buy their brand of inputs to use on the GM crop (e.g. sprays, fertiliser) and restrict farmers from keeping and selling the seed. In the USA, growers of Monsanto Roundup Ready Canola are instructed to use Monsanto Roundup (rather than a competitors brand) to spray their crops. The cost of using the genetics is on a per hectare basis and the spray cost is added separately. Companies are quick to see the benefits from being involved in the supply of genetics and the production of the crop.

(12) Will compliance costs increase?

Costs of keeping food sources separate

Murray Willocks of Monsanto argues that compliance costs in agriculture have increased over time and that the use of GMO's will not substantially increase costs for farmers.[36] It is true that with the move towards identification and tracing of individual cattle and sheep flocks, on-farm compliance and management costs are likely to increase. However, there is a high probability that some non-GM and GM products will have to be kept separate up to point of sale to the consumer. This 'Identity Preservation' demand by consumers is likely to bring considerable costs and logistical problems to the meat and wool industry.
Stock will have to be tracked from farm to farm and during processing. New Zealand is in the process of establishing a proven system to track meat but blended products will cause a problem. What happens to the offal's and manufacturing products such as mince that come from a variety of animals? If there is an accidental blend of GM-free with GM, who will pay for this mistake? The jury is still out as to whether meat from animals fed genetically modified grains has to be identified although it is likely it will have to be.

Farmers will spend more time in the office

Audit trail and quality assurance costs are becoming more of a reality in agribusiness but the introduction of GMO's (when the consumer requires labelling) will increase demands on farmers time. Farmers will spend more time at the desk or computer leaving paper trails.

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[35] "GM Food – should we worry?", Nicola Legat, North and South Magazine, August 1999, pg 41.
[36] Murray Willocks, Monsanto, interview with Jo Grigg, November 1999.

Farmers will have to manage their farm systems so that GM-free stock do not graze GM pastures. Finding GM-free grazing for stock may prove difficult. Protocols for growing GMO's (such as buffer zones, breeding practises) will have to be developed. The Government (through MAF) will probably fund these.

Costs of labelling

With the introduction of genetically modified organisms, systems will have to be in place to identify and label all foods in the food chain. The debate is on in New Zealand in regards to who will pay for this. It is likely that a combination of the government, the food sellers and food producers will pay for the enforcement of food standards. The consumer is unlikely to have huge price hikes as it is easier and less costly for a supermarket to pass on the extra costs to the growers.

Neighbourly relations - liabilities for farmers

On their web-site, the European Landowners Association (ELO) warns landowners about the considerable potential liabilities associated with growing genetically modified crops. These include product liability claims (if the crop detrimentally effects the neighbours) and the effects on land values in the area. The ELO urges all landowners to show due caution and advises them -

1) To take specialist legal advice before growing genetically modified organisms.
2) To consult experts on possible consequences on property values and the environment.
3) To consult all interested third parties, including financial backers.
4) To forbid tenants in tenancy agreements from growing GMO's without the landlord's explicit consent.

In the European Union, legislation on the liability associated with the use of GMO's is unclear. The European Commission has been promising its White Paper on environmental liability for eighteen months, but it is not now expected to appear until 2000.[37] New Zealand farmers would be wise to take out liability insurance if they considered growing GMO's although evidence suggests that the cost of this insurance could be very high.

Liability passed to company directors

'Friends of the Earth' drafted a Genetically Modified Food and Producer Liability Bill, which was introduced to the United Kingdom House of Commons by the Labour Member of Parliament Alan Simpson in June 1999.[38] This Bill would ensure that liability for any untoward health or environmental problem falls on the company directors that introduced the GMO, rather than the farmer. This sort of bill would help ensure that the GMO's are well tested by the companies before release.

[37] European Landowners Association website, September 1999.
[38] Friends of the Earth website, September 1999.

(13) How will using genetically modified products affect the overall sustainability of the farm?

Farmer's asset base and future production potential is tied up with the sustainability of the land they own. Key sustainability issues for New Zealand sheep and beef farms are improving soil fertility while maintaining water and soil quality, preventing damage from erosion and pests, controlling parasites in stock, preserving native biodiversity and remaining financially viable. Genetic engineering technologies have the potential to both improve and decrease sustainability, depending on their application.

However, there is no way that the risks to the environment from the introduction of GMO's can be thoroughly assessed. The real test will only be when they are released into the ecosystem and by this stage, it is often too late to withdrawal the organism (especially in the case of plants). Farmers must agree that they are prepared to take a degree of risk, the same as with any new on-farm technology.

Can farmers feel confident in the trial and risk assessment processes?

When ERMA assess an application for the introduction of a new genetically modified organism, the company introducing the new GMO has to provide the information. Society members also get a chance to express their opinion.
There is a great deal of confusion over the degree of testing GMO's go through. Scientific test results are not the most glamorous of reading and often a positive yes or no answer is not possible. In this respect the risks are hard to calculate and farmers are faced with having to place trust in a government system that relies on company-generated information to make a decision.

ANZFA bases safety on the concept of 'substantial equivalence', where genetically modified food is compared with already existing non-GM counterparts. However, the New Zealand Health Department admits that as animal diets are made up of many complicated foods, it is difficult to assess the effects of new varieties on animal health and, down the food chain, effects on human health. Currently, there are several genetically modified foods on the market in New Zealand and they will not have to be labelled until July 2001.

It is true that GMO's require more testing than conventional foods. For example, the new conventionally bred golden kiwifruit (Hort 16a) required less 'official' testing than a GM kiwifruit would require.

What is risk?

Farmers should be aware that it is in people's nature to be more nervous about 'new' risks than familiar risks (e.g. the microwave was once seen as a big risk). There is also a strong feeling in society that things 'natural' are good and all things 'unnatural' are bad. Often this conclusion is not logical.

Farmers should seek out the most reliable information. The Eurobarometer tells us that New Zealanders place most trust in scientists in universities and CRI's (54%), followed by consumer organisations (23%) to provide accurate information on genetic engineering. International organisations (62%) were the most trusted to regulate genetic engineering while Parliament achieved only 14%.[39]

Some risk of unwanted new organisms being created through 'crossing' in the environment

Most crops engineered for herbicide tolerance, insect resistance or virus resistance pose various environmental risks. Researches have already demonstrated that gene pollution can occur with genes for herbicide tolerance moving from cultivated Canola to close relatives in nearby fields, such as wild mustard. This can also occur in conventional farming. Canada has forbidden the growing of transgenic oats because the herbicide resistant gene could become established in the weedy relatives of oats.[40]

The use of the antibiotic resistance gene as a marker

The gene for antibiotic resistance is often inserted in the new organisms (along with the preferred new gene) as a marker gene. Farmers should discourage this practise as it not only puts consumers off genetically modified food in general but also increases the chance of humans and animals becoming resistance to specific antibiotics.[41] A report by the United Kingdom Ministry of Agriculture states that genetically engineered corn, which contains antibiotic resistance genes, could render useless eight powerful antibiotics used by doctors to fight fatal diseases.[42]

Opportunity to improve ecology but some 'first-generation' GMO's shown to decrease sustainability

Genetically modified crops that are insect resistant almost all contain a gene from the bacterium Bacillus thuringiensis (Bt). Bt causes a plant to produce endotoxin (insect repellent). However, crops that continuously produce Bt endotoxin quickly speed up the process of the spread of resistance to the Bt endotoxin in pests feeding on crops. Scientists in North Carolina have found Bt resistance genes in a wild population of a moth pest that feeds on GM Bt corn.[43] Bt crops violate the basic and widely accepted principle of 'integrated pest management' (IPM) which is that reliance on any single pest management technology tends to trigger shifts in pest species. Farmer's range of integrated pest management techniques will become limited.

Bt sprays are also commonly used by organic farmers as a non-chemical alternative. In this case, it seems that the GMO has the potential to decrease the long term sustainability of both conventional and organic farming systems.

On the other hand, a genetically modified possum that can decrease possum numbers would have huge pay-offs for farmers in regards to the ability to control TB, protect forestry and bush and reduce pasture loss to pests. Animal Welfare has the potential to be improved with the use of genetic modification to prevent flystrike or facial eczema. This in turn may improve our image in the market.

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[39] "Genetic engineering: what do the public think?" Howard Bezar, Crop and Food media release, 24 September 1999.

[40] The Australian Magazine – Food and Wine Issue, July 3, 1999, pg 4.

[41] Peter Wills in "GM food – should we worry", Nicola Legat, North and South Magazine, August 1999, pg 42.

[42] Internet?

[43] Why we need genetic labelling of GE food", Jean Halloran and Michael Hansen, Consumers Policy Institute, Consumers International, April 1998.

How will it effect diversity?

Though genetic engineering has the potential to greatly increase diversity, its commercial focus is causing the inverse to happen. This is because one variety is increasingly grown over large areas. This will reduce diversity and may reduce the potential for humans to improve human and environmental health in the long term. Having a huge area planted in a single homogeneous crop variety (i.e. genetically the same) makes the system vulnerable to new insect pests or pathogens. Farmers should consider the implications of this 'erosion of diversity' from both a commercial and personal ethical point of view.

Dr Jon Hickford, Senior Lecturer in Bio-chemistry at Lincoln University believes that genetic engineering could have "enormous advantages" but the risks must be quantified.[44] For farmers, environmental risks are closely tied to economic profitability so these must be carefully considered. Higher yielding forage crops that are free of harmful chemicals or are drought tolerant could bring immediate benefits to farmers and consumers but the flow-on effects of using these crops should be considered for the various New Zealand environments over different climatic periods.
In short, farmers have to decide whether the potential risks are outweighed by the potential benefits. Many of the options for combating farming problems, such as low fertility, flystrike and parasites, are becoming increasingly unsustainable and generating health risks of their own. A cautious approach to genetic engineering may bring considerable benefits with an acceptable degree of risk.

What side of the fence are they on?

Farmers must be aware the statistics can be manipulated to suit an argument. They must be careful to work-out what biases the speaker or publication may have. "Only $1 million is spent in the US each year studying the environmental impact of GM crops" quotes the Australian Food and Wine Magazine in 1999. However the article doesn't say if this is government or company spending or both. Murray Willocks of Monsanto claims that farmers have the potential to improve the yield of forage crops by 20-40% if a variety with the 'Roundup-Ready' gene was used. However, this production gain is yet to be tested in reality. It was arrived at by extrapolation (seeing what non-genetically modified pastures are yielding and then predicting what the genetically-engineered pastures will do).[45]

New Zealand farmers have had to shoulder huge costs for organisms that have been unwillingly introduced to the environment, for example Nasalla tussock released with some Argentinean lucerne seed in Marlborough. On the other hand, the introduction of RCD shows that some farmers are prepared to take risks if their current sustainability and profitability are being compromised.

For an ecological point of view, it would be best for farmers to lean towards taking a cautionary approach to the introduction of GMO's. Extensive, long-term trials of the new organism under conditions that most strongly mimic natural conditions should be encouraged.

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[44] The Press, 28 March, 1999.
[45] Interview with Jo Grigg, 5th November 1999.

(14) What type of business do farmers want to have?

Farmers as part of a New Zealand economy and rural community

Sheep and beef farmers need to consider the effect using GMO's on their farm may have on related industries. Federated Farmers, in their policy statement, support the right of farmers to use any technology they want, providing appropriate controls exist.[46] There is a real challenge in managing technology choice so that farmers producing for different market segments are not compromised. Increasingly, agribusiness industries in New Zealand will have to work together.

Effect on related industries

Aratiki honey director Russell Berry says that if NZ allows GE nectar or pollen producing crops to be grown, "the beekeeping industry may soon be in a steep decline".[47] He believes that the GE-free honey status will give New Zealand a market edge over US and Canadian honey. However, the same market edge for beekeepers may be a market disadvantage for sheep and beef farmers.

Obligations under the Treaty of Waitangi

A Maori spokesperson from the Nga Kaihautu Maori Advisory Committee argued against inserting a human gene into a cow genes to produce a type of milk which may help cure multiple sclerosis, objecting from a cultural point of view. He told ERMA that it was "culturally offensive and abhorrent".[48]

These sort of issues will be difficult to resolve. What is certain however is that increasingly, sheep and beef farmers will have to answer to the wider community for their decisions.

Does it fit with the farmer's view of themselves?

The family sheep and beef farm is not just an agribusiness, it is also usually a 'lifestyle' choice, a way of life and source of cultural identity for farmers. In this respect, a farmer's perception of the 'rightness' or 'wrongness' of their farm management is important. Farmers will have to consider for themselves if they have any ethical, religious or emotive issues with the concept of genetic engineering or its outcomes. Farmers need to consider whether the use of GMO's will make farms healthier and happier places. Will rural communities be strengthened by the use of these technologies? It will take honest, frank dialogue on an industry level to find the answers to these questions.

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[46] Federated Farmers Gene Technology Policy, July 1998.

[47] "GE nectar threat for beekeepers" Straight Furrow, August 24, 1999.

[48] "Genetics Row sure to be election issue", The Press, 3/28/1999.

14) Conclusion - Sorting the wool from the dags

There are plenty of arguments and fact and fiction surrounding this debate. What is certain is that sheep and beef farming has changed over the years and will continue to change rapidly with advancements in gene technology.

Farmers should keep these points in mind –

- Genetic engineering technologies could help farmers reduce input costs, diversify their products, improve product quality and improve viability.
- Genetic engineering technologies could increase on-farm compliance and input costs, limit marketability of farm products and decrease farm viability.

In other words, benefits to farmers all depends on the **outcome** of the technology.

What should farmers do?

Farmers need to be involved in weighing up the cost/benefits of each new GMO being assessed by ERMA. Farm discussion groups may be a good medium for this. To help this process, there must be independent 'easy-to-read' information, targeted especially for sheep and beef farmers.

- If New Zealand products on the commodity markets were genetically modified, without substantially improving product quality for the consumer, it is likely that their value would decrease in the short to medium term.

What should farmers do?

Farmers need to ensure that GM technologies are strongly focused towards bringing benefits to the consumer of the end-product, as well as to farmers (i.e. improved food quality, increased food safety).

Farmers should see the gene technology industry as a 'service industry', which they can have influence over as a 'consumer'.

Farmers should stay in close contact with your local meat processor and wool buyer to monitor consumer attitude to genetic modification and market trends.

- A few farmers could improve profitability by being involved with companies in producing specialist products for the health, cosmetic or pharmaceutical trade.
- Flocks to produce specialist medical products will be primarily owned and operated by biotech companies, with the farmer providing 'flock management' skills.
- The bulk of farmers will be restricted from entering specialist pharmaceutical markets through the cost of intellectual property and genetics.

What should farmers do?

Farmers need to be proactive in learning more about biotechnology so they can be ready to identify commercial opportunities and take them up.

Farmers may need to form joint ventures to raise capital, so they can purchase the specialist animal or forage genetics to produce niche market goods themselves.

- Farmers need to be aware that government regulators will not necessarily be able to withdraw a GMO once it has been released. In this case, the problem would lie with the landuser, the farmer.

What should farmers do?

Farmers need to be sure in their own mind that testing of GMO's is satisfactory and the risk is minimal.

Farmers need to have liability insurance for worst case scenarios.

- Transformation and transgenic gene technology is only one biotechnology tool for farmers. There are considerable benefits to be made through gene identification and conventional breeding.
- GE will speed up the patenting of animal and plant varieties.

What should farmers do?

Farmers should be proactive in learning about new genetic solutions as they become available.

Farmers need to lobby for more spending on agricultural research. They should attend producer board meetings to debate research priorities and be leading the debate rather than letting things happen around them.

- GE will increase the need for robust meat and wool traceability systems from farm to market.

What should farmers do?

Farmers should move towards animal identification and quality assurance schemes for your farm.

Farmers should ensure they have the systems in place to separate GM and non-GM products coming from their farm.

Farmers should be in contact with their wool or meat buyer to ensure their farm systems comply with buyers' policies on GM-foods. I.e. Under new labelling requirements, the inclusion of GM resources in animal feed (e.g. crop stubble) may need to be declared to the consumer. In turn, this may affect the farmer's ability to sell the product or be accredited under a particular quality assurance scheme.

Farmers are encouraged to use the bibliography below to seek more information.

The information contained in this paper is from a variety of sources. While endeavouring to be as accurate as possible, the author acknowledges no responsibility for damages suffered as a result of the reader's reliance on this information. The author can be contacted at tempello@voyager.co.nz

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Federated Farmers (04) 473 7269

Independent Biotechnology Advisory Council (http://www.ibac.org.nz)

ERMA (04) 473 8426

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Also see Foresight Gene Technologies Discussion Paper, http://www.hrc.govt.nz/biotech.html

AgResearch (07) 834 6600

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