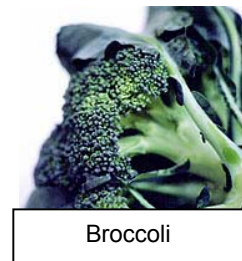


18. Health Enhancing Products from New Zealand plants

Our development of health enhancing products have three important factors:

1. New Zealand's reputation continues to grow internationally as a source of clean and green raw materials, including customised high-tech ingredients that are sold to nutritional manufacturers around the world.
2. There is increasing demand for food and food products that enhance human health and wellness on a global scale as public health legislation shifts to the individual taking more health responsibility and health foods considered the most important instrument.
3. The trends towards health-related products, convenience products and value-added products represent a significant growth potential for new and novel fruit varieties meeting these demands. Fresh fruit and vegetables have been relatively "under-consumed" compared with snack foods.



Broccoli

The high-value foods of the future will bring together not only new raw materials, but also information. Foods are already tailored for a number of specific market sectors, but advances in understanding the human genome will allow individuals to get print-outs of their genetic status and therefore offer potential for health and disease management and performance enhancement. Consumers will need to know the scientifically validated advantages of certain foods.

Seven areas are expected to determine how we can get better health from food: (i) food safety, (ii) chemical-free products and food preservatives, (iii) fruit and vegetable crops with health claims, (iv) plant extracts for better health, (v) consumer perception of food health and education, (vi) nutrigenomics, (vi) functional food efficacy and health claim testing.

Role of Science: three examples of major initiatives for New Zealand scientists:

1. Improving our understanding of healthy eating: *The New Zealand Food Composition Database*, is a partnership between Crop & Food Research and the Ministry of Health. It is a core information asset aimed to improve the health of all New Zealanders through an understanding of healthy eating and spanning the disciplines of clinical nutrition, nutrient delivery, phytochemicals such as antioxidants, gut health, bioactive compounds, new functional food ingredients, and processing and postharvest seafood research.
2. *Vital Vegetables®* programme is a NZ\$22 million, five year programme of the New Zealand and Australian vegetable industries. VegFed has joined with Ausveg, Horticulture Australia Ltd, Crop & Food Research and Australia's Department of Primary industries (Victoria) to undertake work in five areas: (i) Vegetables with enhanced health-functional phytochemicals, (ii) phytochemicals known to promote good health and to measure some of the ensuing health benefits, (iii) freshness technologies, (iv) processed products, (v) Information.
3. Nutrigenomics uses information about human genes to assess the effects of nutrients on health, performance and disease management, opens opportunities for new high-value foods. The Foundation for Research, Science and Technology is funding a \$19.2 million research programme being undertaken by a new collaborative partnership, called the *New Zealand Nutrigenomics Centre of Excellence*, involving the University of Auckland and the three crown research institutes, Crop & Food Research, AgResearch and HortResearch. It is the first nutrigenomics centre in New Zealand and joins centres recently set up in Europe and the USA and it has its own website: www.nutrigenomics.org.nz. The research work is expected to revolutionise the ability of the food industry to customise food for an individual's genetic needs

Examples of foods and plants with special health properties include: arnica, avocado, bee products, broccoli, skincare products from New Zealand plants, ginseng, licorice, manuka and kanuka, yakon and konjak.

1. Introduction

Health as a driver of food consumption

Concern for one's health has become a strong driver of food consumption in the markets of moderate- and high-income consumers. Health costs are causing a mini-boom in preventative medicine: increasingly important is obesity, alzheimers, arthritis, back pain, diabetes, heart disease, and gut disease. Taking care of one's health may be rewarded by reduced insurance premiums; personal wellness can be achieved through a combination of diet, exercise, and lifestyle e.g. obesity has the same predicted risks as smoking in terms of life longevity.

Public health legislation in some countries is shifting to the individual taking more health responsibility, with health foods considered the most important instrument¹.

There is an expectation that an increased choice of foods will be available. Restaurant meals with nutritional information, suitability for genetic types, and taste definitions will become normal and people will customise their meal choice to suit needs/desires.

Consumer Issues

- Aging Population
- Self treatment for prevention and disease management
- Mixed feelings on GM
- Increasing awareness of research
- Concerned about quality/safety of products
- Must taste good
- Credible information often lacking
- Popularity of food segments differs globally

In Summary

- Functional food market large and growing
- Consumers have growing awareness of nutritional health
- Consumers have safety and quality concerns
- Regulations will probably continue to evolve
- Nutrigenomics likely to have strong focus in the future

2. Better health from food

In this section we cite seven areas that will determine how we can get better health from food.

1. Food safety

- Consumers want to know that their food is safe, and proof of claims is becoming a key requirement, especially in the health benefit area.
- Certification and tracking of food production for safety reasons is increasing.
- There is a growing desire for "safe" and "natural" foods. Growth in the organic food sector is a consequence of this desire.

¹ Rabobank 1999

2. Chemical-free products and food preservatives

- Key driver is consumer demand for novel healthy products and manufacturer need for longer shelf-life without chemical preservatives
- Focus on health benefits and 'natural' products

3. Fruit crops with health claims

- Key drivers are; consumers wanting an evidence-based health benefit, producers and retailers wanting to differentiate and add value and Governments want to increase fruit and vegetable consumption and improve health of citizens.
- Integrated approach is powerful involving genomics, screening, validation and knowledge of fruit and vegetable handling and processing systems

4. Plant extracts for better health

- World-wide interest and investment to find bioactive compounds from botanicals
- Wide range of plant material being mined and multiple options for applications
- Strong growth predicted and strong investment in both pathways: nutraceutical and pharmaceutical
- Food processing know how for bio availability and bioactivity
- Integrated capability from discovery to food ingredient formulation

5. Consumer perception of food health and education

“Some will want longevity, vitality and virility; others will be motivated to avoid the long list of chronic and acute diseases that plague modern mankind. There will be those that demand the latest scientific data, and those who yearn to return to the folkloric roots of traditional medicine.”²

“Nearly two-thirds of grocery shoppers report that their purchase decisions are driven by their desire to either reduce the risk of, or manage, a specific health condition.”³

6. Nutrigenomics

“As pharmacogenomics (the use of genetic information to predict the safety, toxicity, and efficacy of drugs in patients) leads to “personalized medicine”, the application of similar tools and methods to examine individual responses to macro/micronutrients will lead to nutrigenomics”⁴

- Nutrigenomics, especially the development of customised foods based on genetic information, is an expanding area
- Few specialist companies focused on this market opportunity but many research groups interested
- Predicted to be strong growth area in future driven by consumer demand for food for individual needs

² Nutrition Business Journal, Aug/Sept 2002.

³ Dolan K, Ponnampalom E. *Let Food Be Thy Medicine*, Agricultural Engineering Newsletter, Michigan State University, Sept/Oct 2001.

⁴ Burril S. *Biotech 2000 Life Sciences- Changes and challenges* The Biotechnology Industry Annual Report.

- General consensus this will be an important area in the future. Expected outcomes include individualised diets for those at risk and significant healthcare savings.

7. Functional food efficacy and health claim testing

- Growing consumer demand for evidence-based claims
- Regulatory agencies expected to enforce stricter rules in this area in future - currently much freedom with functional foods

About Functional Foods

- The term 'functional foods' generally implies foods with health benefits above that supplied by common nutrients.
- There is no universal definition, but a common definition is :
"Foods similar in appearance to conventional foods, consumed as part of a normal diet but with demonstrated physiological benefits and/or reduced risk beyond basic nutritional functions"
- Alternative terms: are Nutraceuticals and Designer Foods.

Market Segments for 'functional foods' include:

- Gut health
- Bone/Joint health
- Heart health
- Sports and recovery
- In the future: hormonal, body fat, vision, emotions (stress, tiredness), cancer, gender and age specific needs.

3. Role of Science

3.1 Information is a vital ingredient with Future Foods

The high-value foods of the future will bring together not only new raw materials, but also information. Consumers will need to know the scientifically validated advantages of certain foods.

Greater knowledge of the effects of food on human metabolism is opening up new opportunities for improving health and demand will grow for diets that combat particular diseases, maintain health and mental acuity for longer, or maximise performance, for example, for elite sports people.

Foods are already tailored for specific market sectors - the young, the old, and lactating mothers - and in time this will come down to the individual level. Advances in understanding the human genome will allow individuals to get print-outs of their genetic status and therefore offer potential for health and disease management and performance enhancement.

These possibilities offer new challenges and opportunities to the food industry. New partnerships will emerge, bringing together expertise in food, human genome information and information delivery. Large overseas food companies are already forming joint ventures with companies accessing genome information. Future shoppers may well use their own decision

support system linked to a personal communication device before making food buying decisions.

3.2 Technology / research needs

- Sustained research into proving the health promoting benefits of ingredients (scientific evidence)
- Discovery of compounds delivered through food ingredients which are capable of blocking genes known to cause various cancers
- Area of carbohydrate metabolism, particularly in relation to weight gain/loss
- 'Hedonistic' value of food ingredients – 'quality' and 'delicious' are not the same
- Moisture management within foods, particularly composite foods
- Replacements for commodity ingredients when there is a short supply

3.3. Examples of major initiatives

1. *Improving our understanding of healthy eating*

Improving the health of all New Zealanders through an understanding of healthy eating is the aim of a strengthened partnership between Crop & Food Research and the Ministry of Health.

Working across disciplines is an important part of the science process. Important to food-health are the disciplines that span clinical nutrition, nutrient delivery, phytochemicals such as antioxidants, gut health, bioactive compounds, new functional food ingredients, and processing and postharvest seafood research. The New Zealand Food Composition Database, a core information asset is an important source of knowledge in this research.

Providing New Zealanders with easy-to-use information to enhance their understanding of healthy eating and making appropriate food choices is critical to a healthy future. It is also important for Public Health Intelligence to have detailed information to use in its epidemiological analyses.

Crop & Food Research and the Ministry of Health are joint owners of the New Zealand Food Composition Database which has information on more than 2700 foods and up to 100 core nutrients. Several products including subset databases, recipe and diet analyses and food tables are currently available. Nutrition scientists expect to develop new products that promote easy access and better understanding of eating for good health.

2. *Vital Vegetables® programme*

The NZ\$22 million, five year Vital Vegetables® programme is the initiative of the New Zealand and Australian vegetable industries. VegFed has joined with Ausveg, Horticulture Australia Ltd, Crop & Food Research and Australia's Department of Primary industries (Victoria) to undertake the work. The project is also supported by the New Zealand government's Foundation for Research, Science & Technology (FRST).

Vital Vegetables® is a large and comprehensive programme divided into five areas. These are:

1. Vegetables with enhanced health-functional phytochemicals – to identify and measure
2. phytochemicals known to promote good health and to measure some of the ensuing health benefits.

3. Freshness technologies – to understand retention of freshness, flavour and vital components after harvest to ensure consumers benefit.
4. processed products – to find ways of retaining phytochemicals during different methods of processing, and to explore non-digestible parts of vegetables for components with wider health benefits.
5. Information – in reader-friendly forms for interested groups.

Broccoli with more punch against cancer is to be the first vegetable produced in the new, trans-Tasman Vital Vegetable® programme, says Crop & Food Research's Dr Ross Lill.

Crop & Food Research and Australia's Department of Primary Industries (Victoria) are working together to find broccoli types with the optimum content of cancer fighting components.

Dr Lill says scientists are certain that the glucosinates, vitamins and antioxidants in broccoli improve the body's defences against cancer. *"However, the quantities and the qualities of these phytochemicals vary between broccoli cultivars and depend on how the cultivar is grown and handled after harvest. We are developing broccoli that we know will be good for the health of those who eat it."*

3. Research into Nutraceuticals

Research into nutrigenomics opens opportunities for new high-value foods
Research which could revolutionize the ability of the food industry to customize food for an individual's genetic needs has recently won \$19.2 million of new funding from the government's Foundation for Research, Science and Technology.

The new funding is for the emerging discipline of nutritional genomics (or nutrigenomics), which uses information about human genes to assess the effects of nutrients on health, performance and disease management.

The research is being undertaken by a new collaborative partnership, called the New Zealand Nutrigenomics Centre of Excellence, involving the University of Auckland and the three crown research institutes, Crop & Food Research, AgResearch and HortResearch.

It is the first nutrigenomics centre in New Zealand and joins centres recently set up in Europe and the USA and it has its own website: www.nutrigenomics.org.nz.

The science programme leader, Professor Lynnette Ferguson from the University of Auckland, is enthusiastic about the potential of diet to make a real difference to genetically-linked diseases.

"We know that a small number of genes may play a disproportionate role in disease development, and that they may be particularly responsive to manipulation by diet ... "If we can understand the interactions between diet and genes, this will not only help manage disease, but could help us optimise physical and mental performance, slow the effects of aging and reduce health care costs."

Dr Julian Heyes of Crop & Food Research says nutrigenomics has the potential to create new market opportunities for customised food products which are enhanced with specific nutrients.

"New Zealand's advantage in this area of research is our access to raw food ingredients which are either unique to this country, or we have a competitive advantage in producing them. This includes such things as novel fruit varieties, protected arable cultivars, dairy and deer products and seafood... It also creates the opportunity for the development of food products customised for the health needs of an individual. Such developments would increase the value of all parts of the chain from consumer products right down to growers of agricultural and horticultural crops."

AgResearch and HortResearch both have a background in animal and plant genomics and bioinformatics, which uses computer models to solve information problems in the biological sciences.

"One of the major outcomes from this programme will be a tool to link studies of the human genome with the action of defined foods on the way an individual's genetic make-up is expressed," Dr Warren McNabb of AgResearch says.

Dr Jimmy Suttie, Science Leader of Food Science within AgResearch, points out "Nutrigenomics gives a way of aligning future focussed discovery health science with the food and production sectors, to reach for a long term vision for healthier added value foods. The challenge will be to take the food production industries as a whole on the journey with this team."

"Eventually we expect that people with known genetic predispositions to diseases would be able to take a food-based approach to staying well. This would have huge benefit to health in New Zealand."

Professor Ferguson says future application of nutrigenomics could benefit cardiovascular disease patients.

"It's a disease where several genes are known to be associated with increased risk and studies are beginning to show that the kinds of foods eaten, together with other environmental factors, alter the susceptibility of people to the disease.

"The implication for the food industry is that certain groups of people may be more likely than others to respond to changes in the amount or type of fat intake.

"If a scientifically validated genetic test were available for the genes involved, a doctor or nutrition expert could then use the information to recommend increasing or decreasing a specific food in the diet."

Strategic advice on the programme will be provided by a science advisory group, made up of both science and industry representatives, and include independent advisors on regulatory and ethical issues.

4. Examples of foods and plants with special health properties

4.1. Arnica

Three New Zealand pharmaceutical companies that use arnica are keen to source local supplies and have been working alongside Crop & Food Research and existing and intending growers.

Producing Arnica flowers as a medicinal crop is an exciting new prospect for Otago and Southland growers. The environmental research has shown that flowers are only produced

where there is sufficient winter chilling and little or no flowering occurred in North Island trials. Analyses of the sesquiterpene lactone concentrations has shown that the flower quality is high and suitable for international markets. Selecting elite plants from the original introductions is expected to produce even better flowering lines of Arnica in the future.

One company, Weleda New Zealand, wants up to 1000 kg per year of the dried plant grown with full organic certification or possibly in transition towards certification.

Another company, Phytomed Medicinal Herbs, who also worked with Crop & Food Research and is keen to help foster growth in medicinal herbs. *“Phytomed works with extracts of 200 medicinal species. At least 60 of these, such as black cohosh root, ginseng, lemon balm and Echinacea, are sourced locally. We’d like more, particularly produce that is certified organic.”* Phytomed offer contracts to growers for organically certified product.

4.2. Avocado

Avocado also has other health-giving qualities that could make it a true wonder oil. Avocado oil contains 120-250 milligrammes per gramme (mg/g) of the powerful anti-oxidant alpha-tocopherol (vitamin E), compared with 100-140 mg/g in olive oil.

It also contains beta-sitosterol, which inhibits intestinal cholesterol absorption. Beta-sitosterol levels in NZ cold-pressed avocado oil are approximately 450mg/100g, also higher than in olive oil (approximately 250mg/100g). Margarine spreads with added plant sterols have recently gained international acceptance despite their premium prices.

Bright green avocado oil also contains pigments such as carotenes, xanthophylls and significant amounts of chlorophyll which also act as antioxidants. The most important of these is lutein. Recent studies have shown that consuming lutein or zeaxanthin, which the body cannot produce itself, slows the progression of macular degeneration, the most common cause of eyesight problems in older people. HortResearch has found that avocado oil contains approximately twice the amount of lutein in olive oil.

A HortResearch team led by Dr Allan Woolf is working with Massey University and Olivado to identify the oil’s components and help ensure its health benefits are maximised in the cold-pressing extraction process.

- Avocado has a high concentration of the phytosterol, β -sitosterol, a natural component that is claimed to have significant health benefits.
- β -sitosterol levels in avocado are higher than in olive oil and is up to 25 times more than found in oranges.
- Beta-sitosterol is an effective option in the treatment of benign prostatic hypertrophy, lowering cholesterol, increasing immunity and reducing inflammation, and increasing urinary flow parameters.
- Beta-sitosterol has been known to reduce cholesterol levels over the last three decades. Its close chemical resemblance to cholesterol enables it to block the absorption of cholesterol by competitive inhibition. Although beta-sitosterol is not well absorbed by the body (5-10%), when consumed with cholesterol it effectively blocks cholesterol's absorption, resulting in lower serum cholesterol levels. Beta-sitosterol has also been shown to improve lipoprotein (HDL, LDL) profiles.
- Beta-sitosterol acts against cancer. It is found to reduce the growth of human prostate and colon cancer cells. It also acts against lymphocytic leukemia.

- Beta-sitosterol may give a boost to competitive athletes who often suffer from immune suppression and reduced inflammatory response during their intense training periods and competitions.
- Beta-sitosterol has been shown to normalize blood sugar and insulin levels in Type II diabetics by stimulating the release of insulin in the presence of non-stimulatory glucose concentrations, and inhibiting glucose-6-phosphatase.
- Beta-sitosterol has the ability to relieve inflammation, heal ulcers, enhance uterine tone and alleviate cramps. It also has anti-viral, anti-bacterial and anti-fungal agents.
- Other health benefits may include reducing potential damage caused galactosamine, a powerful liver toxin; decrease in recurrent coronary events and mortality in such patients when up to 1.5 avocados are included in a high carbohydrate diet over time.
- New research from UCLA indicates that avocados are the highest fruit source of lutein among the 20 most frequently consumed fruits. In addition avocados have nearly twice as much vitamin E as previously reported, making avocados the highest fruit source of this powerful antioxidant.
- Vitamin E is known to slow the aging process and protect against heart disease and common forms of cancer by neutralizing free radicals, which may cause cellular damage.

4.3. Bee Products

New Zealand has a well-established industry of products obtained from bees. Bee venom, pollen and native tree honey are recognised for their health giving properties. Pollen is considered one of nature's sustained energy release supplements, and bee venom with its plentiful amino acids has extraordinary health properties. Native tree honeys are delectable and healthy. Flavours are distinctive, and some of the New Zealand specialities include manuka honey, pohutakawa honey, and soap created with manuka honey, which has natural antibacterial and cleansing properties. *(Source; Bee Natural)*

4.4. Skincare products from NZ plants

In keeping with New Zealand's clean green image, the country has many beauty products made from natural ingredients. The following companies are amongst the leaders in skincare ranges made from environmentally sustainable products.

1. Living Nature

The company's products are manufactured in Kerikeri (Northland) using a number of native New Zealand ingredients such as manuka oil and flax gel.

Largest New Zealand skincare and makeup brand, owned by New Zealanders, Employs more than 80 staff and a turnover in the region of NZ\$20 million. Living Nature's key markets are in Korea (largest export market); UK, Australia, Malaysia, the Netherlands, Russia, USA and Germany.

Ingredients built on unique formulations using knowledge and science built up from founding director Suzanne Hall's (NZCS (chem.); MABThNZ) observation and testing of New Zealand plants was the base for Living Nature, a successful company started in 1987. Living Nature now produces nearly 300 natural skincare and makeup products and sold selling globally and produced in its factory at Kerikeri, Northland.

Based around New Zealand's unique plant ingredients such as manuka oil, flax gels (Maori: harakeke); New Zealand kelp; totara extracts. Also include essential oils, flower extracts

(such as pansy, calendula); evening primrose; carrot oil; jojoba; nut oils, cocoa butters, evening primrose; aloe vera; rose hips and many more. Living Nature products also use unique New Zealand clay (halloysite) found only in Matauri Bay, Northland.

Awards include:

- Trade New Zealand Exporter of the Year 2003 (New Zealand)
- “Here’s Health” Best Bodycare and Beauty Award 2003, UK
- “Here’s Health” Award for Excellence 2004, UK

2. Evolu Botanical Skincare of New Zealand.

Evolu has created a unique range of beauty products combining New Zealand’s botanical ingredients with natural spring water. Kati Kasza, founder:”... New Zealand's environment has provided me with wonderful resources to create a well balanced skincare range. Pure essential oils, plant and marine extracts are blended with New Zealand pure spring water....”

3. Linden Leaves

Christchurch based Linden Leaves is also an award winning company with an extensive range of ‘inspired New Zealand body care” products exported to several countries. Linden Leaves aims to create products that wherever possible we use natural ingredients and are sourced from renewable resources. '

4.5. Ginseng

Deep shade (80%+) is needed to optimize the growth of the valuable medicinal herbs ginseng and goldenseal. Such shade levels can be supplied artificially or by mature forestry plantations. The quality of these crops produced in New Zealand has been excellent but they both require a 4-6 year cropping cycle to build up their root mass. Development of pesticide free production systems will give New Zealand growers an internationally competitive advantage.

4.6. Licorice

Trials have shown licorice root can be produced throughout New Zealand. A three to four-year growth cycle is needed to build up the glycyrrhizin concentrations but most of the root mass is in the top 300mm of soil suggesting that mechanical harvesting is feasible. The hot water extract of licorice has a long history of use as a medicine, in beverages, and as a sweet confectionery and it offers many opportunities to use its functional properties.

4.7. Manuka and Kanuka

While New Zealand’s natural product companies rely on state-of-the-art technology and scientific research, the industry is an old one with the indigenous Maori people long adept at utilising native trees and plants for health-giving properties. Today Maori are starting to turn this knowledge and affinity with the land into profitable export ventures.

One example is Tairawhiti Pharmaceuticals. The company has been exporting New Zealand East Cape Manuka and Kanuka Oil to Europe for nearly 10 years. The Manuka Tree (*Leptospermum Scoparium*) has long been valued for its healing properties by the Maori people and Tairawhiti’s website (www.manuka-oil.com) gives information on both the way in which Maori used the Manuka plant and the properties of Manuka Oil, which it says have been proven by modern scientific research.

Geographical clusters of natural product companies have developed in New Zealand – mainly in the East Coast, Canterbury/West Coast and Nelson regions – and companies throughout the country are in the process of forming an industry group to help accelerate the growth and development of the sector.

Natural products are poised to play an increasingly important role in New Zealand's export profile – fuelled by a growing international demand for self-medication and natural remedies. Enjoying a plethora of natural advantages and displaying a commitment to innovative, quality products underpinned by scientific research, the prospects look very bright for this emerging export industry.

Crop & Food Research have a growing number of research partnerships with iwi and one that is underway is a partnership with Horouta Manuka (East Cape) investigating manuka cultivar breeding to optimise flowering, honey quality and yield. Part-funded by MAF's Sustainable Farming Fund, it brings together a number of iwi landowners who want to improve the returns from their land. Another project with Horouta Manuka, under the Maori Collectives programme, involves investigating the bioactivity of manuka honey and hive management. Both programmes are led by scientist Dr Meto Leach.

4.8. Yacon and Konjak

Konjac and yacon are two new promising crops for northern New Zealand. Konjac is grown in Japan for the corms which can reach a size of 10 kg after a number of years. The corms contain glucomannan which is a valuable food additive to lower cholesterol, lessen carbohydrate absorption for diabetics and as a fat replacement in prepared foods. Our research has shown konjac can be grown successfully in the Waikato but production methods are still being developed as it needs some shade to grow well. New functional food products will be developed with konjac flour.

Yacon, from South America, produces tuberous roots which have a market in Japan as a fresh vegetable but they are also a good source of fructooligosaccharides (FOS) and fructose-based syrups. Production systems are being developed based on potato production methods and limited commercial production has begun. Additional lines of yacon will be imported from South America to develop a more uniform root vegetable and food products developed utilising the prebiotic properties of yacon FOS.

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This case study is one of a 21-part case study series aimed at demonstrating the value of science and innovation in New Zealand's leading edge bio-science industries... and their significance to New Zealand.

Martech Consulting Group is a strategic consultancy based in New Zealand. The growingfutures case study series was in part based upon Martech's extensive work with sector representative groups, science providers and organisations that interact with science providers to achieve consensus on co-ordinated actions, improve governance, develop sector-based strategies and improve innovation processes.

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