Global aspects of the debate on biotechnology[1]

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To simplify matters, the debate on biotechnology is about whether this science is, in the balance, positive or negative for human health and the environment.

It is unfortunate that the term "biotechnology" has come to be synonymous with "genetic engineering" or "GMO's". Biotechnology is a very broad term used to describe all aspects of new technologies applied to living things. This includes advances in human and veterinary medicine, pest control, crop production and nutrition. Unlike some other aspects of biotechnology, genetic modification is a form of biological rather than chemical intervention. In this submission I will restrict myself to the area of biotechnology that involves DNA transfer from one species to another, thus resulting in genetically modified organisms.

It amazes me that in a few short years the molecular biologists that were hailed as crusaders in a new genetic revolution are now reviled and characterised as mad scientists in the grip of greedy corporations bent on destroying the environment. At the WTO conference in Seattle last year we were warned that "entire countries will be held in biological bondage. Genetic engineering will become a biological weapon used for agro-terrorism." The public is given a fearful impression with images of Frankenstein foods, killer tomatoes, and terminator seeds. Is it any co-incidence that all three of these images are taken directly from scary Hollywood movies? I believe that the campaign of fear now waged against genetic modification is based largely on fantasy and a complete lack of respect for science and logic. In the balance it is clear that the real benefits of genetic modification far outweigh the hypothetical and sometimes contrived risks claimed by its detractors.

Let me begin by pointing out that nearly any science or technology can be used for destructive purposes. We already have the ability to annihilate ourselves with physics, in the form of nuclear weapons, with chemistry, in the form of chemical weapons, and with biology, in the form of deadly microbes. I suppose it might be possible to increase the effectiveness of biological weapons with genetic modification, but as far as I am aware there is no need to do so. The ones we have already are more than capable of wiping us out.

I would submit that the programme of genetic research and development now underway in labs and field stations around the world is entirely about benefiting society and the environment. Its purpose is to improve nutrition, to reduce the use of synthetic chemicals, to increase the productivity of our farmlands and forests, and to improve human health. Those who have adopted a zero-tolerance attitude towards genetic modification threaten to deny these many benefits by playing on fear of the unknown and fear of change.

Many in the anti-biotech movement focus on the issue of corporate control. This is an entirely different subject than the science of genetic modification itself. Corporate control in the form of monopoly can occur in any sector. But, for example, just because Microsoft is alleged to have a monopoly over computer operating systems doesn't mean we should all throw our computers in the garbage or demand that computers be banned. The technology itself must be analysed and judged separately from the institutional framework that is used to deliver that technology. And, unless we wish to dismantle all the laws relating to intellectual property there will continue to be proprietary rights in new developments, thus requiring an element of control. This is generally accepted as beneficial in that it encourages innovation and competition.

The so-called "precautionary principle" is constantly invoked as an argument for banning genetic modification. Whatever the precautionary principle means, it is not that we should stop learning and applying that knowledge in the real world. We will never know everything and it is impossible to create a world with zero risk. The real question, as so ably put by Indur M. Goklany in "Applying the Precautionary Principle to Genetically Modified Crops", is whether the risks of banning genetic modification are greater or less than the risks of pursuing it. Of course, if we pursue genetic modification, or any other new technology, it must be done with great care and caution. This results in the adoption of a precautionary "approach" or a precautionary "attitude" rather than treating it as a "principle". The daily example of crossing the street is sufficient to explain the difference between the two interpretations. If we would only cross the street when we had a 100 per cent certainty that nothing would go wrong during the crossing we would never leave the curb. But that doesn't mean we should cross without pausing and looking both ways before venturing into the roadway.

Concerns have been raised that GMOs will cause genes to be transferred from our food into our bodies, thus "polluting" our genetic make-up. There is no logical reason why genes from genetically modified organisms should effect our genes any more than those from the trillions of bacteria and the plates full of food that pass through our system every day.

Having commented on these general concerns about GMOs, let me turn to the many benefits that will be available from a responsibly managed programme of genetic modification.

From an environmental perspective there are three main areas of positive impact on ecosystems. First, genetically modified crops will generally result in a reduc-

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tion in the use of chemical pesticides. This will result in a dramatic reduction to the impact on non-target species. For example, when chemical or biological sprays are used to combat pests of the butterfly family (Lepidoptera), all species of butterfly and moth are killed. By contrast, when Bt cotton or Bt corn are grown, only those butterflies or moths that try to feed on the crop are severely impacted. Reducing chemical sprays also results in a cost saving to the farmer.

Second, and perhaps the most important environmental benefit of genetic modification, is the ability to increase the productivity of food crops. Along with other advances in technology, chemicals, and genetics, GMOs will often result in increased yields due to pest resistance, drought resistance, more efficient metabolism, and other genetic traits. It is a fact of arithmetic that the higher the yield of food per unit of land, the less land must be cleared to grow our food. Intensive agricultural production, much of which can be achieved through genetic modification, is a powerful tool to reduce the loss of the world's natural ecosystems. The less land that is required to grow our food, the more that can be retained as forest and wilderness, where biodiversity can flourish. There is no doubt that when natural ecosystems such as forest are converted to agriculture there is a huge loss in biodiversity. Genetic modification could mitigate or even help reverse the continued loss of forest, particularly in the tropical developing countries where this trend is most severe.

Third, the development of herbicide tolerant varieties of food crops allows the adoption of low and zero tillage systems. This results in a considerable reduction in soil erosion, both conserving native soils and reducing the amount of chemical fertiliser inputs.

During a recent visit to Southeast Asia I took part in a seminar on biotechnology in Jakarta, Indonesia. There I met five farmers from South Sulawesi who had just completed a trial of Bt cotton on their farms. They reported that yields had risen from the normal 600 kilos per hectare to an average of 2500 kilos per hectare, a four times increase in yield. At the same time they had reduced pesticide applications from eight sprayings to one spraying, and the single spraying was for a secondary insect pest, not the bollworm that the cotton was now protected against. And yet, environmental NGOs, supported by the Indonesian Minister of the Environment, are trying hard to thwart the efforts of these farmers. Indonesia imports over $1 billion in cotton each year, mainly from Australia. Bt cotton could help Indonesia to be more self-sufficient in cotton production. It could also improve the lot of farmers, reduce chemical use, and result in reduced clearance of natural forestland for agriculture.

There is a tendency to treat medicine and nutrition as separate subjects when in fact food is simply our most important medicine. This is brought home by considering one of the recent advances in genetic modification, the golden rice. Whereas normal rice contains no carotene, by splicing a gene from daffodils into rice plants, it has been possible to produce rice that contains carotene, the precursor of vitamin A. Vitamin A is necessary for eyesight and every year about 500,000 people, mainly children in India and Africa, go blind due to vitamin A deficiency. The golden rice has the potential to eliminate this human tragedy when it is introduced in a few years. At a recent conference on biotechnology in Bangkok, a Greenpeace spokesperson claimed that there was "zero benefit from GMOs". Let someone come forward and state that 500,000 children saved form blindness is a "zero benefit".

Genetic modification promises to bring a wide range of advances in human health and nutrition. As summarised by Professor Philip Stott of the University of London these include:

- Foods with increased digestibility, less saturated fats, cholesterol-reducing properties, and the potential for heart and cancer health benefits.
- High-performance cooking oils that will maintain texture at raised temperatures, reduce processing needs, and create healthier products from peanuts, soybeans, and sunflowers.
- Edible crops that carry vaccines against diseases such as cholera, hepatitis and malaria.
- Crops with reduced allergenicity, e.g. peanuts.
- Crops with better storage and transport characteristics through delayed ripening and fungus/pest protection. These include bananas, pineapples, raspberries, strawberries, and tomatoes.
- New subsistence crops that will extend agriculture into marginal areas such as saline soils, soils poor in nutrients, and drought-affected regions.

How can a policy of zero-tolerance for genetic modification be justified in the face of these overwhelming benefits? The bankruptcy of the anti-biotech movement position is illustrated by the example of the so-called "Terminator seeds". When Monsanto proposed to produce a genetically modified soybean variety that produced no viable seeds, environmental groups vilified the company for condemning farmers to dependence on corporate seeds. Yet, the same environmental groups raise fears that viable seed from genetically modified plants might be harmful to the environment if they spread into the wild. So its damned if you do and damned if you don't. These groups have made it clear that they are against all genetic modification, and they will invent any argument to support that position, regardless of logical inconsistency or demonstrated fact.

Genetic modification has a special promise for New Zealand as it applies to tree species and the future of forests and the forest industry. It is not widely realised that New Zealand is somewhat unique in the world with regard to its forests. Whereas many native tree species produce wood that is highly desirable for many purposes, the trees themselves are so slow-growing that they are not suitable for commercial forestry. This is the main reason that by the 1940s, about 80 per cent of the original forest cover had been lost to deforestation. It was simply more economical to convert the land to farming and grazing than to grow new stands of native trees. By contrast, in North America and Europe there are numer-

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The New Zealand forest industry - genetics-based biotechnology and international competitiveness[1]

Forest products are competitively traded internationally and New Zealand forest product companies mainly earn their living by marketing products internationally. To stay in business and expand, the New Zealand forest industry must stay internationally competitive. Companies must have the option of using genetics-based biotechnology applications to improve competitiveness and keep up with or ahead of competitors.

The New Zealand forestry industry, which is plantation or "tree-farm" based, is already arguably New Zealand's most sustainable industry. Biotechnology has potential applications within plantation forestry that would improve that sustainability. It could also deliver productivity and environmental performance benefits for the processing sector as well. Companies should have the option of enhancing what is already a sustainable industry through access to biotechnology. We believe the risk to New Zealand from forest industry applications of biotechnology can be effectively managed through a regulatory system that relies on comprehensive risk assessment of specific applications.

World demand for forest and paper products continues to increase. At the same time, the area of the

1 Adapted from the New Zealand Forest Industries Council submission to the Royal Commission on Genetic Modification

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ous native trees that are well suited to commercial forestry, thus resulting in a managed forest that is more similar to the native forest than the situation in New Zealand. It was only the introduction of Radiata pine from California that finally made it possible to have a domestic forest industry that was sustainable. Radiata pine, along with a few other introduced tree species, has become a major contributor to New Zealand's economy. Genetic modification may play a key role in the future of New Zealand's forests both native and plantation.

One of the main differences between trees and annual farm crops is the much longer breeding cycle in trees. It is sometimes ten years or more from when a tree is planted before it produces viable seed. This results in a much slower breeding programme, taking longer to breed desirable characteristics than with crops that produce seed annually. Genetic modification allows us to "short-circuit" this long breeding cycle and to develop trees with desirable traits much more rapidly. There are a number of key modifications that could greatly benefit the native rainforest, the plantation forest, and the environment.

Through the use of the so-called "terminator gene", it may be possible to produce plantation trees that are sterile. This could reduce or even eliminate the incidence of self-seeding and encroachment of non-native plantation tree species into native forest. This, in turn would be of great assistance in preserving and protecting native forest from being taken over by exotic tree species.

Through the use of genetic modification it might be possible to increase the growth rates of some native tree species, thus making them suitable for commercial growing. This would allow the establishment of managed native forest and the possibility of expanding the area of land planted with native trees rather than exotics. It is particularly unfortunate that the government of New Zealand has seen fit to ban forest management in native forests. Only through successful management will it be possible to justify a large increase in native forest cover.

Genetic modification may allow for faster growth rates in plantation tree species such as Radiata pine. This would not only make the industry more profitable but it would result in a more rapid uptake of carbon from the atmosphere. An increase in carbon uptake, coupled with great use of wood as a substitute for non-renewable fuels and materials, could result in significant reductions in greenhouse gas emissions. Indeed, the most powerful tool at our disposal to reduce CO2 emissions is to grow more wood and use it sustainably to offset emissions from the burning of fossil fuel and the production of steel, concrete and plastic.

In terms of New Zealand's environment, the more profitable it is to grow trees the better. Genetic modification could bring about tree varieties that grow faster, are resistant to insects and disease, and have better wood quality. This will lead to further reforestation of the land that has been historically deforested for grazing. More trees and forests results in more carbon sequestration, better protection of soils, cleaner air and water, and less ruminants producing greenhouse gas and increasing the threat of climate change.

The bottom line in the debate over genetic modification has to do with the inevitable and natural quest for knowledge and new ways of doing things. While it may seem daunting that we have discovered the secrets of deep space and atomic particles, this trend towards awareness of our environment seems bound to continue. Of course we must curb ourselves when discoveries prove to be destructive or detrimental. But there is no definitive evidence that proposed genetic modification programmes are either destructive or detrimental. All the evidence points to the potential for improvements in both human and environmental health.

I call upon the Royal Commission to consider the subject of genetic modification in a truly global perspective, to reject unfounded allegations and to accept demonstrated benefits. It is not without precedent that civilisation has been thrown into dark ages and anti-intellectual periods due to the superstitions and myths of cliques with no science. I ask you to listen to reason and truth and to assert the right and benefit of scientists to continue to explore nature and to help provide the means for our survival and good fortune.