

Challenges facing New Zealand science

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Everybody at this meeting understands that New Zealand's economic, social, and environmental development is very much dependent on an effective agricultural system producing products that the world wants, at a price that makes New Zealand wealthier and in a way that ensures our environment is protected. Each of those three elements requires a considerable investment in obtaining new knowledge through the processes of research. Unfortunately the New Zealand research system has not developed at the pace of those of our comparator nations.

As a whole, we spend only 1.2% of GDP on research, about half of that from the public sector, and half from the private sector, whereas comparator nations spend somewhere between two and three times that amount. Of particular concern is our low expenditure from the private sector. If we just compare ourselves to Denmark, a nation of similar size and with a strong agricultural sector, in 1980 we and the Danes invested very similar amounts in research, science and technology. However, between 1980 and 2010, if we were to have spent at the same rate as the Danes, we would have invested an additional NZ\$35 billion in science to what we have and at least 50% of that would have come from the private sector.

I have no doubt that it is this cumulative under-investment in knowledge that explains why our productivity relative to that of Denmark has declined so far. Successive governments have until recently not given much more than lip-service to the role of science in enhancing New Zealand's productivity potential. However, in the last couple of years we have seen a considerable shift in focus. For the first time we are seeing research being considered to be a proper investment rather than a cost to society, and slowly but progressively the various elements of the New Zealand science system are being analysed, and as our economic situation allows, the issue is being confronted.

Partly through the role of the Prime Minister's Chief Science Advisor, we are seeing a positioning of science at the highest level of policy formation, recognising that science has a much broader part to play than simply in the narrow sense of how we spend Vote RS&T.

The Minister of Science has issued a list of strategic priorities for the sector which represent a very progressive and forward-looking view of what science can contribute to New Zealand. The agency functions are being addressed, with the merger of the Foundation and the Ministry, to create a more effective policy-driven unit for science, and in time this will lead to more effective arrangements for the science system.

The Crown research institutes (CRIs) have been reviewed to remove the perverse incentives that led to them being in competition with the private sector rather than working to support the growth of New Zealand industry. We have seen a re-consideration of the role of science in our international partnerships.

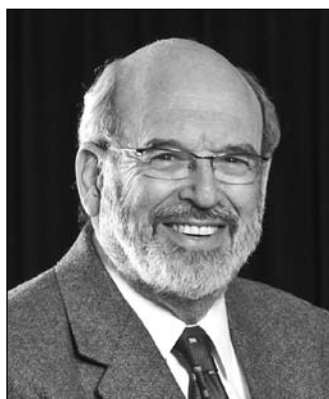
As you will soon see, there will be attention to improving the transfer of knowledge from the public to the private sector and the development of strategies to increase New Zealand's private sector investment in RS&T. There is much more to do – the competitive funding system has multiple problems, there is a need for better science infrastructure, and there is the need to recruit and retain more talent, and these issues are all well understood and becoming points of focus.

Challenges for the food industry

The food industry faces a number of significant challenges. Firstly, the nature of our markets continues to change; increasingly our markets will be in Asia rather than in Europe and I believe with that change will come a change in emphasis on what the markets wish to purchase.

At the same time, the world population will increase from 6.5 to 9.5 billion people over the next 30 years or so. Issues of resources utilisation will change consumer attitudes to food, which has become based on high-energy consumption, releases of large amounts of greenhouse gases, and often has large virtual water footprints.

The world is becoming increasingly concerned about issues of food security, and indeed we are seeing nations – particularly



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in Asia – ensuring their long-term food security by gaining reliable and sustained access to crops – particularly in Africa and maybe in New Zealand.

From New Zealand's perspective, the issue is a particularly complex one. We actually produce only enough food to feed arguably 20 million people. That is a large city – but not the largest – in China. We could not feed the whole of Mexico City to an acceptable standard. So, in terms of volume of global food production, our production is not particularly significant. Yes, we are a large cross-boundary trader of milk-related products but we only produce 2% of the world's supply.

If we think about food and the food industry, there are really three kinds of food product. Firstly, there are bulk commodity ingredients in foods. We cannot get rich or sustain any prosperity by simply being an exporter of commodity foods.

Secondly, there are foods which have a premium value because the consumer values them more. New Zealand lamb has a high market value because it is seen as a luxury food. So are prime beef cuts, so is venison, and so are green-lip mussels. However, the nature of consumerism will change – the challenge of carbon footprints, the challenge of water footprints, and the shift from Europe to Asia will all influence how and what consumers will buy and what premium we can put on such foods.

Thirdly there is the issue of food related to quality of life. A classic example of course is infant formula. Infant formula has not commodified over its long period of production because it has been designed and is marketed on the basis of it being better than cow's milk in supporting the growth of children. Increasingly food is being sold on the basis of what it does for the quality of life. However, we need to be careful. What qualities of life are they that food will maintain a premium for? In Asia it is largely around cognitive function and metabolic disease.

One of the problems we face is that the food industry is full of unsubstantiated claims about the health benefits of foods. Increasingly, regulatory authorities are worried about such claims and we are seeing the regulators getting much more interested in such claims. Nutraceuticals and foods for health will be the largest opportunity for value-added products, but they will not do so on the basis of unsubstantiated claims. They will only do so on the basis of properly evidence-based research. Where such evidence can be obtained, the potential for very high value-added premiums is very large.

Strategies for the future

So what is to be the strategy for the New Zealand food industry? We cannot bring much more land, if any, into food production, we have to protect the environment, and we have to ensure that farmers and growers achieve profits as well as the down-stream manufacturing companies and marketing companies. We need to start thinking ahead – what will we be selling in 10 or 20 years' time?

My bias is that one area that we need to give more emphasis to is food for health, supported by robust claims and supported by scientific research, because I believe that this is the major area in which large and larger premiums can be maintained and sustained. This is an area where we have a competitive advantage in that there is already a lot of interaction between our agricultural and medical research communities.

What kind of research strategies do we need? Remember that we need research strategies that bring profit to the farmer and the grower as well as to those beyond the farm gate or beyond the paddock.

The first thing we need is better research infrastructure. The research infrastructure of New Zealand has been particularly weak in some areas of the biological domain. The PGP (Primary Growth Partnership) programme and the associated food innovation network are addressing some of the down-stream food science issues. However, there are still big up-stream issues.

We need to better understand how to match soil, forage, animal and climate; we know very little about the soil microbiome and its relationship to crop production or greenhouse gas emissions; we understand very little about key cycles – for example, just recently it was reported that trees channel soil methane and emit it; and we have been slow to exploit the molecular capacities in terms of animal and plant genomics and particularly animal and plant epigenomics. Epigenetics is uncovering layers of complexity about gene environment interactions and we need to exploit such opportunities.

Given the extent to which we use livestock as the basis of furthering our food supply, our animal science capacities have become surprisingly weak. We have not started to apply the modern technique of non-invasive metabolic imaging, and so forth, to advance the industry.

When it comes to post-farm gate, I am not in a position to say much about food science, although there have been welcome new initiatives in the food production space. I am very concerned about the low number of agricultural and food science graduates within New Zealand. However, what is clear to me is that we do not yet have the infrastructure in terms of doing proper nutritional research to validate food-for-health claims. We have limited capacity in human metabolomics, and we have minimal capacity in clinical nutritional research facilities, including state-of-the-art sensory capacities using techniques such as functional magnetic resonance imaging (fMRI). We need to take advantage of our ethnic mix to help design foods for a broader range of markets. These are the mainstays of modern nutritional research.

Research funding

So what are the impediments beyond funding to us moving ahead? The first, no doubt, has been our very small and highly contestable research attitude. We have been fighting each other and competing, rather than collaborating against the rest of the world. The funding mechanism has driven that – but the Centres of Research Excellence represent one successful attempt to reduce it, and the CRI reforms under way will represent another major step. We have not done well in attracting major international research companies to focus effort in New Zealand – because we have not done well in exposing them to, and thinking about, what we offer.

I am concerned about the fact that New Zealand companies only spend a total of 0.4% GDP on research. In contrast, in all our comparator countries the investment by the private sector in research ranges between 1% and 3% GDP.

So let us explore the low public- and private-sector spends a little further. At the heart do we have a really deep cultural issue? Have we been seduced by the national myths – number 8 fencing wire, punching above our weight? We think we are innovative, although the report of the OECD and the recent report from the New Zealand Institute show that we are not particularly. We live on a past glory that probably was never there. Could it be that we are a very young country which has not yet learnt to value intellectualism? Singapore gives the lie to that as an excuse. Is it that strong egalitarianism inhibits expenditure on research, which is envisaged as elitist? Is it that our current spending pattern was established in the postwar period of protectionism and farming for Britain at a time when commodity was king, and we built up an almost untouchable pattern of high social spending so that finding that extra 0.5% GDP for investment by the Crown in R&D has not been achieved?

Strategic investment is hard when electoral cycles are short, but I sense that we are starting to have that dialogue in a constructive way. It cannot afford to be partisan. Science must operate on a much longer time base than electoral cycles.

The issues of why the private sector does not invest in research have been a particular focus of mine. I worry that the public sector investment is so low and the private sector does not see value in a parallel investment. Could the chronically low public sector investment be causing the private sector not to see RS&T as exploitable because there has been insufficient flow of ideas? I worry that the public sector investment has been too end-user focused and has therefore displaced private sector investment – indeed, several food companies have told me that has been the case.

If our real strength is in the export of ideas in the form of value-added products and services, our businesses need to work better with the public sector to form liaisons and international partnerships to take ideas to scale, to find capital. The food industry has only thrived because of science and technology making us so efficient. That is selling ideas. If we make widgets, we do not often sell them well to the world. We are in the age of parallel discovery – just making the best does not sell. The market goes to those who can take it to scale and to big markets – just look at the battles with cellphone technology. That is why we need cleverer partnerships at the pre-commercial stage with those with money and market access.

Given the quality of science and engineering education in New Zealand, we clearly have a large unexploited potential for

knowledge-based industry growth, but there is an issue of the availability of investment capital and the commitment of the New Zealand shareholder to more speculative investments or those with a longer-term return.

Changing attitudes

I worry that we do not have enough scientists involved in the senior management of companies and particularly in board rooms, to encourage companies to see the value of research. I worry most of all that our companies focus on short-term returns – the next pay-out cycle – rather than recognising the importance of investing over a number of years.

Government can make only so much change, but the fundamental change is going to have to be in persistently working on the removal of institutionalised, cultural attitudes within academia, CRIs, and the private sector. We have institutionalised behaviours that limit our ability to move ahead. Institutional competition overweighs the national interest, time and time again.

Conclusions

This Government has made enormous strides in trying to change the positioning of science within New Zealand. The CRI Task-force is an outstanding example. The Government has created a situation where the CRIs can contribute so much better than they have in the past. However, for this reform to be successful, the scientists and the CRIs, the managers, the Boards and the companies and academics that they interact with, will have to develop very new behaviours.

New Zealand is a small country. Actually, we don't punch above our weight – indeed our productivity is lousy. Despite the national myth, we are not as innovative as we pretend to be. However, at the end of the day, prosperity depends on new knowledge – new knowledge which is used to advance our place in the world by adding value to those things we can produce, namely food and minerals. The real challenge is to use research and technology to make real increases in value. This is much more than potentially unstable market gains from the high-paying consumers in advanced Western markets. It is also about those aspects of food where a premium can be sustained predictably into the long-term.