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Presidential Address 1999
Perspectives and role of Animal Production/Science in the New Millennium

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Last year, as my first function as president of NZSAP, I was privileged to attend the AAAP meeting held in conjunction with the 8th World Congress on Animal Production in Seoul Korea. The theme of this congress was "Sustainability of animal production in the 21st century and the quality of human life". Information presented showed that the world population will increase to and plateau at 9.5-10 billion by the year 2050, an increase of 60-70% over the present population. I had known that the world population is experiencing a period of exponential growth but I had not fully comprehended the impact and immediacy of the problem. I, like so many others, have largely ignored such information as being too far away in both time and location to be of great concern . However, in 6 months time we enter the new millennium and 2050 does not now seem so far off. Whether we like it or not, we cannot remain blissfully ignorant of the world situation. Modern technologies ensure within hours we know about any major event that happens in any part of the world.

Evidence presented at the congress showed that most growth in the world's population is occurring in the less-developed countries, placing burdens on their food production. Additionally, in developing countries, as their wealth increases, peoples' diet changes from predominantly plant-based foods to a higher intake of animal protein . The combination of these factors means there is a need for increased food production from animals either by running more of them, increasing the output/animal run, or both.

The opportunity to attend this Congress and listen to speakers from all over the world put forward different views and perspectives made me think about the role New Zealand and NZ's animal production industry should be playing in meeting the challenge of providing food for the world's population.

TABLE 1 Changes in world human and livestock populations.

	World Human population	World Animal popul. [millions]				
	[billions]	cattle	sheep	goat	pig	poultry
1937	2.15	628	636	182	260	2055
1948	2.35					
1960	3.09	941	994	348	406	3900
1977	4.33					
1997	5.77	1324	1073	696	939	13400
2020*	7.9	1195	1000	750	1411	20660
2050*	9.5-10					

*FAO estimates

Animal science and production is ultimately about food production with a major objective being to improve outputs from livestock and increase efficiencies in land use and livestock managed within production systems. In the world environment , much emphasis is placed on sustainable ways and means of expanding food production to meet the needs of the growing world population. Animal scientists, in diverse ways, are working to solve these problems. However, there are concerns and questions about some of the methods used to achieve these ends. Some of these are:

1. The increasing use of grains to feed animals often at the expense of people. [At the congress I was reminded that 25% of the world's land surface is used for grazing livestock, 20% of the world's arable land area is used to grow cereals for use as animal feeds and that 25% of the worlds cereal production in 1998 is used for feeding livestock, an increase of over 100% since 1980];
2. Foods and by-products of processing industries from undeveloped countries that are exported to developed countries to feed their livestock;
3. Increased use of intensive feed-lot systems in developed countries with concerns about animal welfare and water and atmospheric pollution;
4. Whether biotechnology should be used to improve production yields of animals and crops. For example, the debate about BST to increase, at minor cost, milk production of dairy cattle.

New Zealand is involved in the world's food supply chain but is a small producer of total animal product relative to countries like India, China, USA and Russia. What makes New Zealand significant on the world animal production scene is the proportion of our product placed on the export market. This is shown in Table 2.

TABLE 2 NZ Primary production relative to world production

		NZ production as a	
product		% of world production	% exported
Wool *		1.0	90
Meat and fish	- lamb	95	
	- mutton	0.5	55
	- beef	78	
Dairy		2	95
Kiwifruit		35	90
Apples		2	60

source - NZM&WBES * includes synthetic fibres

New Zealand's major contributions to the worlds food supply chain are meat, milk and fibre products from grazing ruminant animals. Our most important resource is the ability to grow pasture at a cheap cost and through use of appropriate labour-saving and production technologies, to manage large numbers of animals per man. New Zealand is primarily a commodity producer with a small internal consumption of product making it dependent on the world market for export returns. This means that NZ is a price taker rather than being a price maker. To maintain our standard of living we are dependent upon selling our products to the rich end of the world market.

In my student days, I was taught some economic theory and one of them was the concept of comparative advantage. This concept espoused the idea that it is better and more efficient to use available resources to produce goods and services that can be produced more cheaply than others

and sell or exchange surplus production for other products able to be purchased cheaper elsewhere than if they were produced on the home market. Efficiency of production is based on the marginal cost of production, where production should expand no further than the point where the cost of producing an extra unit of the good or service equals the return. For example, in the production of animal feeds, as less and less suitable land is used for cereal production, the cost of production can exceed the price that the feed grain can be purchased on the international market.

Why am I an animal production person talking about cereal grains and economics. Most of the intensification of animal production world wide that has occurred in the last 20 - 30 years has been based on the use of concentrate feeds. Table 1 showed the growth in world livestock numbers since 1940 has been largely in pigs and poultry and both these species require a cereal based diet. As developing countries attempt to increase their animal feed production , less and less suitable land is being used. For example, in Indonesia, a country I worked in for a couple of years, poultry production has been expanding to provide more animal protein for their rapidly growing population. To feed the broiler chickens they have expanded their cereal and soybean production, and in an attempt to be self sufficient, are over cropping dryland soils and fragile land recently cleared from rain forest. The marginal cost of production is high - much higher than the world price. If the concept of comparative advantage worked in practise, Indonesia would find it cheaper to import cereals and soybeans from South or North America where the marginal cost of production is low.

Why does the concept not work particularly well? In the real world most of the technologies and resources for intensive food production are captured by a few developed countries. Most of the worlds oversupply of animal food products occurs in western countries based on use of cheap feeds either home grown or imported and where political considerations interfere with the free movement of food and other goods. The hunger problems that exist in the world are not due to an inability to grow enough food but to the inability to equitably share and distribute these food resources.

Further complicating the situation are changes that occur as a result of economic development. As a country's wealth increases, it becomes less agrarian, consumes more animal protein and its birth rate declines. [The relationship is not a negative one between animal protein intake and birth rate but rather, in undeveloped countries, the need to have large families to work the fields and to act as a form of superannuation for parents in their old age.] For example, in Japan over the last 50 years we have seen a remarkable change from a peasant-based agrarian economy to one of the world's richest nations. Their per capita rice consumption has declined by 37% while their red meat and milk consumption has increased by 220 and 123% respectively. Currently the average Japanese person has an animal protein intake of 55 g/h/d. In contrast, Korea between 1960 and 1998 increased its per capita animal protein intake from 6g/d to 25g/d, and Indonesia currently has a crude protein intake of 20g/d with only 5g/d coming from animal protein. In comparison, the USA, NZ and Bangladesh have a per capita animal protein intake of 71, 69 and 8 g/d respectively.

What role has animal production and science in food production? Without a doubt, the population of the world today could not be fed using the technologies and methods of the 1940-50s.

Animal production and science has had a major part to play in achieving these developments. Improved knowledge and its application has seen animal performance increase significantly. Review of papers published in proceedings of this society by eminent past and present members in the early 1960s showed most work involved macro-scale production science aimed at developing improved farm systems, explaining the feeds and feeding of sheep and cattle and encouraging farmers to use objective measures of performance to select for better genetic ability in livestock. Other more detailed science involved improving diluents for AI in cattle, understanding the causes of facial excema and categorising the causes of white muscle disease. Nowadays the development and use of new technologies have enabled farmers to reach levels of production never thought possible even 10 years ago. For example, in sheep production, ultrasound pregnancy scanning has allowed farmers to separate out ewes in mid winter based on whether they are carrying 1, 2 or more lambs and to feed them through mid and late pregnancy and lactation to their actual feed requirement. This has resulted in significant lifts in output both in numbers and weights of lambs sold. Further, sophisticated techniques are now available to identify and measure sub-clinical effects of conditions that previously were not even suspected of having a major involvement in animal production. There has been some great scientific work done in understanding the mechanisms of mineral metabolism, intestinal parasites, immunology, control of reproduction, artificial insemination, lactational physiology to mention just a few. The use and implementation of this technology has allowed NZ Farmers today to handle more livestock/man and achieve higher levels of production than was the case 10 years ago.

That animal science has been important in these developments is not in dispute. However, what we face now is a more serious consequence of this success. Science and animal science has become more remote from its stakeholders and from the wider community. The populace at large, has becomes suspicious of science and scientists. Twenty years ago, the average man in the street may not have understood the detail of what was involved in an animal science experiment but they could follow the concept and see down-stream benefits of the work and why it should be done. In fact, many farmers were ahead of scientists in trialing and implementing new ideas and technologies on their farm. Today, however, science has become more complex and specialised and the rate of development has outstripped the ability of the informed man in the street to comprehend the sense and sensibility of the research and the benefits that may accrue from such work. Part of the problem is ours as we have not done a good enough job in explaining the rationale of the work. There is much good work sitting gathering dust on shelves because no one has had the time, inclination, or perhaps, ability, to go the next step and develop systems for its use and introduction.

Additionally, there are some research findings which are now blocked for general use by 'owners' of the information concerned for their own commercial advantage.

What has created this alienation of science from the man in the street? Science has become remote, distant and poorly communicated and areas of science appear to be tampering with the very core of man's identity.

The purpose of science is to understand and study effects of natural processes and to be able to study these in depth in both a qualitative and quantitative way. The main investigative approach used is the reductionism system which breaks down the process into components for separate study. This approach resulted in the development of different branches of animal science such as anatomy, physiology, biochemistry, genetics, nutrition etc. and has led to tremendous advances in the study of biological mechanisms and ways in which they can be manipulated and enhanced.

The aim of most of the work has been to improve the overall efficiency and output of animals and their welfare and management. Nowadays, the use of sophisticated equipment, e.g., GLC, HPLC, NIR, CAT scans etc., allow scientists to measure smaller and smaller changes and to investigate interactions or effects that were impossible even 10 years ago. The end result is more and more is known about less and less. The reductionism system has now developed to the stage where effects of change are being measured on the cell and on cell components rather than on the animal as a whole. In fact, the current furore about molecular genetics and the ability to modify the genetic structure of an organism is just an extension of this approach.

The discovery that DNA of the plant and animal is the same and that sections of DNA from one can be inserted into the other, have opened new and different ways and means of better understanding genetic control mechanisms affecting animal output. The ability to cut and paste segments of DNA has rescinded the belief that the gene is the basic building block of any organism and that there are laws controlling the exchange of genetic material from one generation to the next. This is rather scary and brings up the bogey of genetic engineering and man playing God.

Biotechnologists and molecular geneticists would argue that the ability to exchange one gene for another, irrespective of where it comes from [i.e., the same or different species] is a progressive way for improving, for example, disease resistance in animals such as footrot or facial excema. The belief that once the gene has been inserted [like a leggo block], it will behave 'normally' and be transferred from that generation to the next in the normal sexual reproductive way, leads to the possibility that once we can control the gene we can control function, behaviour and qualitative and quantitative characteristics. We are not working with nature as was the case with traditional breeding methods, rather we are making nature do what we want. This places the "owner" of the gene in a position of power and control. With this possibility for control, it is not surprising that businesses are contracting science providers to explore ways and means of manipulating production and performance. As you know, there is a big debate worldwide about the role of biotechnology and in particular, the use of genetically modified foods. Biotechnology applied to pharmaceuticals and human and veterinary medicine is deemed acceptable because controls are imposed on who can prescribe the remedy. However, biotechnology related to food production raises concerns about food safety because of the lack of control on how, when and where it is used. The debate going on now about foods modified using genetic engineering, such as modified Canola and the Crop and Food's improved potatoes using pieces of DNA from an animal species, are two cases in point. The major concern is whether the downstream effects have been fully evaluated and whether there are harmful effects still to be discovered. I think this concern is understandable and that scientists have not done a very good job at explaining and allaying the fears of the man in the street. However, it seems to me, the main concern is not about the use of this technology but about its ownership and control. In terms of food production, the capture of new and improved techniques is in the hands of a few players. These players tend to be multi-national companies mostly based in USA or Europe with economic leverage greater than that of many nations [including NZ].

There was an interesting article on the 'Ethics of genetic modification', by Dr Barbara Nicholas of the Christchurch School of Medicine, printed in 'The Press' on June 14 1999. She outlined in this article much more succinctly and clearly than I, the concerns many people have about genetically modified foods and the role of biotechnology in science. She stated '.. governments are discovering that their commitments to free trade are leaving them without the means to regulate the foods that those companies choose to produce by whatever biotechnological means' and ..... 'GM food is the tool that is being used by big business interests and associated political forces, to develop an extensive level of control over food and agricultural industries, and associated trade. the concern of these big businesses is not to enhance our choice of food, to feed the hungry, or to minimise or overcome poverty. Nor are they concerned to protect the small farmer or sustain traditional communities and genetic diversity. The technology would be used in quite different ways if that were their agenda. Their concern is profit."

The problem with multi-national ownership of modern food production technologies is that it is based and predominantly used in a few 'rich' nations to promote higher levels of performance, thereby exacerbating further over-supply of production in those countries and ultimately at the expense and disadvantage of less developed countries.

As science has become more reductionist, there is an increasing need to have parallel with this approach, a more holistic attitude to production systems aimed specifically at explaining the role and place of new technologies and how they can be implemented. NZSAP can have a major role in promoting this through selection of conference themes and running integrative workshops. I like the workshop idea where stakeholders [i.e., farmers], scientists and science providers work together with new technology to explore ways and means of its implementation. This requires papers of a different sort than those which are mostly published at present. We will need to be up-front in encouraging more papers aimed at integrated use of new technology, rather than receiving reports of scientific work

done. Production scientists who are broad rather than deep should be encouraged to participate and present papers. We need to provide more sessions aimed at explaining the use of new technology and controls that are in place for ensuring food and product safety. We have an education job to re-establish and convince our stakeholders that the cellular level work being done using the more fundamental reductionist approach has the purpose of assisting them in the future, but there are uncertainties in the time scale. Additionally we need to make farmers in particular aware that the day of a generalised recipe answer is over, and that use of technologies will vary with specific circumstances from farm to farm.

The original objective, of this society, of providing fora where scientists could share and discuss results has a wider role today of putting animal science in a context so that the informed man in the street can understand what is being done, and why. I think that we will have to take initiatives and ask that authors, in addition to presenting their results, are required to write a popular article placing their work in a broader context for the lay person. This would have the added benefit of linking more closely with the media and journalists and give them ready print material to publicise and promote our work to the public.

I started out this address talking about the world population and the need to increase animal production to feed the burgeoning numbers. The world is shrinking. Speed of communication and travel are such that we are rapidly evolving into a single global community and as such we have responsibilities for other people and their welfare. I have been asking myself what role can or should NZSAP play in providing food for these people. It would not be sensible nor economically responsible for NZ to intensify its monogastric animal industry. Our comparative advantage in livestock production is tied up with grazing ruminant animals.

Twenty five percent of the land area of the world is used for grazing animals and much of this is rangeland in Asia, the Middle East, Africa and South America. Much of this land is currently severely overgrazed near settlements and poorly used in more remote areas. Most areas are capable of more intensive use using ruminant animals. I believe NZSAP and NZ's animal production industry can assist these countries to use these areas more appropriately and efficiently.

There have been many visits from delegations of bureaucrats, scientists and others to NZ to study our animal production and grazing systems. Most of them have an interesting time, are impressed with the way systems operate, and go home imbued with the idea of implementing a cloned version of the NZ system. Most of these ventures are doomed to disaster without the willing and active support of people on the ground who have to do the work. Rather than delegations of this sort with a top down approach, it would be better to have selected persons work with and alongside indigenous people to incrementally change their systems.

There seems to be two main possibilities. Firstly we lobby Government for more support for specific scholarships for students from these locations to study in NZ aspects of applied animal production. At the conclusion of their study they would return with skills and knowledge of the system and of ways for implementing change for the benefit of farmers and industry in their home environment. Perhaps, some of the Society's funds could be put aside to provide a scholarship for this purpose. Secondly, NZSAP could use the talents of its members and become a contractor for the provision of consultant services for animal production development aid projects in selected countries.

Rather simple innovations such as use of surplus feed to make into supplements, the role of legumes in pastures to provide a source of nitrogen, introduction of systems to prevent overgrazing and, more knowledge of the specific production requirements of animals and the matching of these to the feed supply have been shown to be needed. The great innovative and problem-solving skills of New Zealanders with the 'can-do' attitude and the use of appropriate technology can materially assist.

If such a venture was supported, we would need to develop a commercial arm of the Society which would sell our potential to assist. This would have to be done in competition with other NZ consultancy enterprises and in the face of bigger economies who are more interested in selling their technology than in alleviating hunger.

In conclusion, we have a big job in front of us to re-educate our community at large to understand that, although modern science is more complex, the integrity of those involved is no different today than in the days when measurements were on a macro scale and results could be seen and touched..

Science, including animal science cannot be ostrich-like and put its head in the sand. We must urgently confront this issue. To fail to do so will imperil the on-going work of providing the means to feed the burgeoning world population. What the man in the street needs to understand, is that in order to provide food to feed our grandchildren and their children, there is a need to develop new techniques and methods. As I said earlier in this address, the world of today could not feed its current population using the technology of the 1950s. The world of 2020-2050 will similarly need to enhance and develop new and better techniques and strategies than we now have in place.