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A Rising Tide of Anti-Animal Consumerism? Issues and Opportunities

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Summary

The livestock revolution that has occurred over the last few decades has seen a phenomenal increase in demand for livestock products in much of the developing world. This has largely been matched with growth in supplies, driven by government policies, and increased animal numbers and productivity. But this growth has been accompanied by a number of side-effects which in many cases impose negative externalities on society and suggest that current trends in animal product consumption are unsustainable. As a result there is emerging an anti-animal sentiment among some consumer groups. These people are concerned about livestock issues such as human health effects, biodiversity losses, deforestation, emissions to the air and water, diversion of grains from human to animal consumption, and animal welfare. Each of these will be discussed and it will be suggested that pastoral producers in New Zealand have the opportunity to respond in ways that may increase their market share through appropriate recognition of consumer concerns.

Key words: livestock revolution, diet transformation, externalities, opportunities.

"When changes (in externalities) take place or new ones are recognised, the system of property rights is no longer efficient and efficacious. A new system of property rights is needed to reflect societal values..." R.W.M. Johnson 1992

1. Introduction: The Livestock Revolution

Recent decades have seen rapid growth in both demand for and supply of livestock products (LPs), the so-called livestock revolution (Delgado et al. 1999). It has provided opportunities for rural poor in the developing world to engage in animal raising and to lift themselves out of poverty. The growth in demand for LPs has most noticeably occurred in the industrialising developing countries in Asia and South America, such as China and Brazil, where increased LP consumption substitutes for consumption of traditional foods such as cereal and root crops. Since 1982, the share of total calories consumed from LPs has risen in developing countries, but actually fallen slightly in the developed world. In China and Brazil, for example, the share of calories sourced from LPs increasing strongly through time in both countries. Annual consumption per person of meats is higher in the developed world (with the exception of Japan) than in developing countries, although by 2007 South American consumption per person had almost reached European levels. A similar situation exists for per person milk consumption, except that South American consumption, while greater than that in Japan, remains below that in other developed countries. Growth in total consumption of meat and milk since 1992 has been much higher in developing than developed countries. An exception is meat consumption in India where cultural and religious factors limit the consumption of meats. Between 1992 and 2007, total

consumption of meats and milk in developing countries increased by 79% and 74% respectively, compared with just 12% and 14% in the developed world.

Major drivers of these trends in the developing world are well known, primarily income growth and increased urbanisation of the population. Changing preferences towards LPs as incomes increase is reflected in expenditure elasticities of demand (Searle 2003) with those for meats and milk being substantially higher in low- and middle-income countries compared with high income countries. So not only do developing countries display higher growth in per capita incomes than developed regions, they also have higher food expenditure elasticities for LPs. Both these factors combine to contribute to the observed rapid rates of growth of animal products consumption. LP consumption per person is often higher in urban that rural areas due to several factors such as higher incomes, presence of supermarkets, better developed cool chains for handling LPs, and greater consumer exposure to media advertising of LP products (Rae 1998). These drivers, along with population growth, largely explain changes in total LP consumption.

On the supply side, growth in production of LPs in the developing world has been about as rapid as growth in consumption and in most cases has been outstripping growth in the human population. Production growth in the developed world, except for non-ruminant meat, has been stagnant apart from non-ruminant meat, and developing countries now produce more meat and milk than does the developed world. The developing regions increased production of ruminant meat, non-ruminant meat and milk between 1992 and 2008 by 72%, 103% and 89%. Among these regions, production growth was more rapid in those regions where consumption was increasing the most, with fastest production growth occurring in China. Drivers of this supply growth include growth in the number of animals farmed and increases in yields per animal and overall productivity. These trends have, in turn, been driven in part by market signals and profit expectations, greater availability and lower costs of purchased feedstuffs, and the development and adoption of new animal production technologies. Governments have also driven livestock production in many cases, through directives, policy pronouncements and other non-market incentives. For several developing countries such as China and those of South Asia and Latin America, total factor productivity growth in livestock production has been healthy, at rates of between 2% to 5% per year , but faster for non-ruminants than for ruminants (Ludena et al. 2007; Rae et al. 2006).

There has also been rapid growth in “landless” industrial production systems, relative to growth in mixed farming and pastoral systems. Such industrial systems, that emphasise grains and crop proteins in feedmixes as opposed to pasture, forage and household wastes in other production systems, account for 74% of all poultry production and 40% of pork, over half of which takes place in the developed world. This trend is also evident for traditionally-grazed beef and sheep production: by 2030 60% of these animals in developed countries are projected to be raised in “landless” systems (FAO 2000).

Are the above trends likely to continue into the future? The answer is yes. Past drivers of demand are expected to continue their influence. By 2050, around seven out of every 10 people are expected to be living in urban locations; population growth will continue but at a somewhat slower rate; and incomes are expected to recover from the global recession in the medium term. Price developments will also influence future demand, and it appears that

those of livestock products may remain higher than in the recent past but will show increased volatility (FAO 2009). The latest OECD-FAO Agricultural Outlook (OECD/FAO 2010) expects consumption growth in developing countries to continue to outstrip that in OECD countries. For the former group, consumption is projected to increase through to 2019 (compared with 2007-09) by 38% for poultry, 33% for pigmeat, 23% for beef and 31% for sheepmeat. Similar growth rates are projected for dairy products in the developing world – WMP and butter (38% growth to 2019), cheese (33%) and 23% for SMP. Keyzer et al. (2005) suggest that consumption growth could be even faster than projections made by some international organisations. Their reason is that most projections are made using fixed income elasticities, but in many developing countries a significant part of the population has not yet entered, or has only just entered, the income group where a significant portion of income growth is spent on meat.

Regarding animal numbers, Bruinsma (2003) projects global animal numbers to increase by 30% - 50% by 2030 relative to 2000 with intensive pig and poultry production showing the largest increases. These projections show relatively large increases in developing countries (especially near large cities) but production may decline in some developed countries as their governments respond to public concerns over livestock production impacts.

2. Some Consequences of the Livestock Revolution

The livestock revolution has allowed transformation of diets and significant nutritional and health benefits in many parts of the world, especially in developing countries. This revolution has also provided the opportunity for rural smallholders to adopt animal raising as part of their farm systems and therefore to raise household incomes. But rapid growth in livestock production and consumption has produced negative consequences in terms of human and animal health effects, biodiversity losses, deforestation, emissions to the air and water, diversion of grains from human to animal consumption, animal welfare issues, and intensification. Such consequences are summarised below, with much of this material coming from various publications of the Food and Agricultural Organisation that has for some time been active in researching and formulating policy advice in this area. Further details can be found in de Haan et al. (1997), Steinfeld et al. (2006), FAO (2009) and Steinfeld et al. (2010).

2.1 Greenhouse gases

Livestock production contributes to greenhouse gas (GHG) emissions through CO_2 from production operations (e.g. fuel consumption used for fertiliser and feed-crop production), desertification and deforestation, methane emissions from ruminants and N_2O emissions from agricultural soils used for feedcrops, burning of feedcrop residues and manure management.

The CO_2 emissions attributable to livestock from production, desertification and deforestation contribute a net annual loss of 1.3 billion metric tonnes to the atmosphere (Asner and Archer 2010) although Steinfeld et al. (2006) suggest this estimate could be as high as 2.7 billion tonnes. Nearly all of this is from deforestation, mainly for pasture land in the humid tropics, but recently some deforestation has been for cropping to provide feeds for livestock production. However estimates of CO_2 losses due to land use change are

difficult to quantify and have a considerable degree of uncertainty. Moreton et. Al (2006) estimate that 17% of Amazon deforestation between 2001 and 2004 was driven by cropland expansion primarily for soybean production. Further conversion of forests to pastures has been projected (Foley et. al 2005) with the continued global expansion of grazing systems.

Turning to methane, livestock farming was responsible for over one third of global methane emissions in 2005 and for two thirds of total agricultural methane emissions. Such livestock emissions arise from enteric fermentation and manure management. Ruminant animals such as cattle, buffalo, sheep and goats account for the majority of these emissions which are influenced by the quantity, quality and type of feedstuffs used. Generally, lower feed quality or higher feed intake lead to higher methane emissions. Methane is also produced during the anaerobic decomposition of livestock manure, the amount emitted being dependent on the type of manure treatment or storage facility, the ambient climate and the composition (animal type and feed regimes) of the manure.

In 2005, around a quarter of livestock methane emissions took place in the developed countries of the OECD, which meant that the major sources of these emissions were developing countries. Between 1990 and 2005, total emissions from livestock declined in the OECD partly as a result of policy changes and productivity growth, and also in the non-EU members of the CIS as they transitioned to market economies. Among the high-income countries, livestock methane emissions increased somewhat in North America and Australasia as animal numbers increased. The Environmental Protection Agency (EPA, 2006) projects an increase in methane emissions from livestock farming in all regions between 2005 and 2020, summing to a 20% increase over that period. Developing countries of China, Africa, Latin America and South and South-East Asia together will account for over 90 per cent of the projected global increase in methane emissions from livestock.

Combining the CO_2, N_2O and methane emissions from the entire livestock food chain, livestock contributes around 7 billion tonnes CO_2-eq annually of which around one-half are from methane. The majority of these emissions are from extensive livestock systems, even after accounting for feed production for intensive systems. This is largely because the majority of deforestation is for extensive grazing, and for methane-emitting cattle and sheep. Livestock account for around 9% of total anthropogenic CO_2 emissions, 37% of methane and 65% of N_2O emissions. These total livestock emissions sum to around 80% of all emissions from agriculture and 18% of global anthropogenic GHG emissions (Steinfeld et al. 2006).

2.2 Nitrogen emissions

Nitrogen is a vital input to agricultural production processes via animal feedstuffs and fertilisers or through nitrogen fixation by plants. Nitrogen is also a found in marketable outputs such as crops, live animals, milk and meat. But excess nitrogen may move into surface and ground waters or be released as ammonia and nitrous oxide to the air. The adverse impact on natural systems can cause substantial human health and economic costs. Livestock emissions of NH_3 to the atmosphere result from fertiliser use, manure spreading, grazing, animal houses and manure storage. In many regions of the world, emissions of

NH_3 from intensive animal production systems account for over 80% of total NH_3 emissions to the atmosphere.

The OECD nitrogen balance database (OECD, 2001) measures the difference between nutrient levels entering the soil and nutrient uptake by crops and is a comprehensive source of national nitrogen data but only for OECD countries. In the case of New Zealand, livestock manure accounted for 65% of the total nitrogen input in 2004, while the nitrogen input from inorganic fertilisers increased by 86% from 2000 to 2004, reflecting in part the increased application of these fertilisers to grazed pastures. The nitrogen balance (inputs less outputs) for New Zealand increased from 37 kg N/ha in 2000 to 47 kg N/ha in 2004. Such data are not comprehensively available for developing countries. However, the past and projected growth of (especially intensive) livestock systems in parts of Asia and Latin America suggest high and growing N surpluses. Poor manure management in some of these regions suggests future livestock growth will continue to contribute to water and air pollution, that in turn impacts on human health, climate change and acidification.

2.3 Water

Plant-based foods use around $0.5m^3$ of freshwater for every 1,000 kcal., compared with 4 m^3/1,000 kcal for animal-based foods (Falkenmark and Rockstrom 2004) and livestock account for about 10% of global water flows (Deutsch et. Al 2010). Therefore the projected continuing substitution of animal foods for some crop foods in consumption will have an important impact on global water scarcity. Feed crops use both irrigation water and rainwater in rainfed croplands and grazing land, and maintaining the flow of water to produce animal feed is a major water challenge in livestock production. This challenge will intensify as grazing and/or feed production extends to drier regions requiring irrigation. The structural shift to intensive livestock production will also add to this challenge. For example grazed beef production systems consume 12,000 – 30,000 litres of water per kg meat, compared with 53,000 litres per kg meat in intensive production systems. (Deutsch et al. 2010)

2.4 Human health

Animal-sourced foods are a good source of high quality and readily digestible protein, along with energy and micronutrients, in the human diet. Thus they are able to address multiple macro and micronutrient deficiencies in diets. Such foods are of particular importance for women of reproductive age and for young children. Since the livestock revolution has impacted on food consumption patterns mainly in urban and peri-urban areas, and in countries of Asia and South America, there remain large numbers in other developing countries whose diets are deficient due to a lack of animal product consumption. These include the rural poor, communities where animal raising has been inhibited for various reasons, or where lack of grazing lands has driven traditional pastoralists to settled areas. Diets that are low in the quality protein and micronutrients that can be provide by animal products are associated with problems such as reduced work capacity, poor growth and nutritional anaemia (Neumann et al. 2010).

In contrast to under-consumption, excessive consumption of animal products, especially those high in saturated fat, is a different but also a serious problem. Such over-consumption can have negative health consequences, such as obesity, cardiovascular disease, type 3

diabetes and various types of cancer and significant growth in health care costs. The increasing consumption of animal products, often in association with lifestyle changes, decreased physical activity and inclusion of more fast foods in the diets of especially urban populations, is not just a feature of developed countries but is also emerging amongst higher income urban populations in developing countries. While consumers in Europe and the USA for example have raised fears over the link between animal products (especially red meats) and such diseases, the evidence can be inconsistent. It appears that the health risks associated with meat are related to their saturated fat and cholesterol content rather than to the type of meat. Hence the choice between lean and non-lean meat may be more important that that between red and white meats.

Animals can also pose serious threats to human health through the transmission of illnesses, food safety hazards and antibiotic resistance due to excessive antibiotics use in livestock husbandry (Bonfoh et al. 2010). There are many examples including swine fever, avian influenza, BSE, brucellosis, anthrax, SARS, as well as the health hazards of drinking water contaminated through animal production, and E. coli and campylobacter contamination of livestock products. Respiratory problems can arise due to poor air quality in animal houses. These problems have been exacerbated by the intensification of livestock raising, indoor production systems and the shift in animal production closer to areas of high population density. They also reflect the poor capacities and infrastructures to control such diseases and outbreaks especially in developing regions of the world. These not only give rise to human health and economic costs, but also disrupt product markets and trade in animal products.

2.5 Biodiversity

Livestock production threatens natural biodiversity in several ways. The rapid growth of demand for meat and milk has encouraged production systems that are dominated by a handful of breeds, and that favour high-output international breeds over local breeds. Consequently there has been a loss of animal genetic diversity and a significant number of domestic animal breeds are classified as being at risk of disappearing. Intensive livestock systems, because they typically rely on a narrow range of feed crops and those produced on deforested land or former rangelands can be a major cause of ecosystem degradation and biodiversity loss. The same can be said of extensive systems that graze pastures developed following deforestation, or pastures that rely on a small number of introduced plant species at the expense of local plant material. Overfishing to provide fishmeal as animal feed, along with water pollution from livestock, reduces biodiversity in aquatic ecosystems. Livestock emit greenhouse gases that contribute to climate change which in turn impacts on ecosystems and species. Diseases can be spread from farmed animals to wildlife, and landscapes are simplified through livestock intensification.

2.6 Feed production

The trend away from smallholder and backyard animal raising, that uses a wide range of household wastes and forages as feedstuffs, to large scale and commercial systems that rely on cereals and processed concentrates for their livestock, continues to encourage greater use of grains and oilcrops as animal feeds. As livestock production has grown, it has come to depend more and more on concentrate feeds and less on locally-available traditional feedstuffs. This has raised the concern that food crops are increasingly being

diverted from human to animal consumption, and that feeding of crops to livestock rather than directly to humans is inefficient. The latter refers to feed-product conversion ratios, which can vary hugely depending on the feed type, animal species, and the production and feeding. For protein, it has been estimated (Aiking et al. 2006) that on average 6kg of plant protein are required to produce 1 kg of animal protein. This situation is what Frances Moor Lappe referred to as a "protein factory in reverse" (Lappe 1971). For grains, recent data for these feed: meat ratios are of the order of 2:1 for poultry and around 5-10:1 for feedlot beef with the ratio for pork somewhere in between. In some ruminant farm systems however animals consume much of their feed as forage, grass and hay, materials that would not be available as human food should animal production decline.

In 2007, a total of 746 million tonnes of cereals were fed to livestock, representing 35% of the global harvest. This compares with a total of 966 million tonnes consumed as human food. Another 350 million tonnes of protein-rich feedstuffs were used, primarily oilcakes and brans. Comparing 2007 with 1987, use of grains as feeds increased by 17%, but that of oilcakes more than doubled, increasing by 109% These trends of course have implications for deforestation, land use and associated environmental concerns. There has also been been growth recently in demand for fish-based animal feeds, with about one-third of wild-caught fish globally being used for this purpose. Therefore the diversion of fish from human to animal feed is also an emerging area of concern. Compared with oilcrop-based feeds, the demand for feedgrains has been rather stagnant for the last couple of decades due to gains in feed efficiency and reforms to feedstuffs subsidy programmes. As a result, the share of global cereals production used for animal feeds has fluctuated around about 37%. Over this period therefore, production of cereals has managed to keep pace with the growing demand for animal feeds. But unless such efficiency gains can continue into the future, it seems probable that land areas devoted to feed crop production will increase further. Even if feed efficiency gains can continue to be achieved within any given production system, structural change may well see overall feed:meat ratios increase in the developing world. This is due to the replacement of smallholder household production systems (that use little purchased feed) by large-scale commercial operations that are based in commercial feedstuffs, such as occurring in China. Keyzer et al. (2005) argue that for this reason the feed demand projections of several international organisations are likely to be underestimated.

2.7 Animal welfare

Animal welfare concerns and public outcries over the treatment of farmed animals arose along with the emergence of intensive production systems that strove for reduced production costs (Harrison 1964). Since then, it has become clear that systems that provide high standards of animal welfare also result in higher production costs than conventional systems. This is primarily due to higher labour, feed and capital costs and lower productivity due for example to reduced stock densities and longer time periods to produce outputs. A number of national and international standards and regulations exist to encourage the implementation of good animal welfare standards. To date, these predominate in developed countries and in intensive pig and poultry systems but public concerns are still demonstrated. The shift to large-scale intensive production systems in developing countries, in response to demand growth for pig and poultry products, indicates that attention will need to be given to welfare issues in these countries also. Animal welfare is being linked to international trade and market access. Some producers, especially those

in countries that for various reasons find addressing animal welfare concerns to be very costly or simply infeasible given current infrastructure and know-how, fear that animal welfare will become another non-tariff barrier, reducing their access to export markets.

3. A Consumer Backlash?

The growth in animal production and associated changes in feeding practices and farming systems are raising concerns over the sustainability of livestock production into the future. These concerns revolve around animal and human health issues, the diversion of much of the world's grain production from human food to animal feed and the environmental impacts of livestock production. From a consumption perspective, these same concerns are encouraging questions to be asked over the high levels of meat and milk consumption in developed countries and in many regions the increasing share of human protein intakes that derive from animal products. Can or should the consumption of animal products be reduced, especially in industrial countries? Might animal-sourced protein in human diets be replaced to some extent by protein from crops?

Information on how consumption of foods and other products impacts on the environment, in addition to the production impacts, would be informative in allowing consumers to address the consequences of their buying habits and perhaps encourage a degree of behavioural change. Such information has recently been published by the United Nations Environment Programme (UNEP 2010). Material Flow Analysis is used to measure domestic material consumption in 28 European countries. In terms of kg of materials use per capita, construction minerals represent the largest flows followed by fossil fuels (coal, natural gas and oil) and agricultural crops. The situation changes once environmental consequences are factored into the measurements. This involves Environmentally-weighted Material Consumption (EMC) methodology. When material flows are assessed on their contributions to global warming, fossils fuels are ranked first followed by animal products (including fish). The EMC analysis was repeated by incorporating the sum of various environmental impact categories in addition to global warming such as acidification and land use, using equal weights for all impact categories. Animal products and fish then became the most important consumption contributor to environmental impacts, followed closely by fossil fuels. Agricultural crops were in third place. While this study only considered consumption behaviour in Europe, the results starkly indicated the impact of high levels of animal consumption on the environment. Continued income and population growth in the developing world are likely to drive similar outcomes, and even higher impacts will result globally unless consumption and production patterns can be changed.

Concerns over the ethics and consequences of increasing the role of animals in human diets has been expressed for some time. Lappe (1971) raised these concerns, as more recently did Singer and Mason (2006a and 2006b). These authors address both the inefficiency of processing quantities of crops through animals to produce less protein or energy than was in the original feed, and ethical issues over the consumption of food produced through inhumane practices. Singer and Mason believe consumers have the moral obligation to refuse to support farming methods that are cruel to animals and bad for us. Sutton (2008) writing on a BBC website discusses the nitrate problems associated with livestock production and declares "The Nr challenge for developed countries is clear: eat less meat...This is a message that needs to be shouted much more loudly". On the same website,

the Director-General of the International Livestock Research Institute (Seres 2009) notes that livestock provide protein, nourishment and a livelihood to over a billion people in Asia, Africa and Latin America, and calls for science to address the environmental issues that are a concern to many. He also notes that reduced meat consumption in wealthy societies may be reasonable given its benefits regarding human health and the environment, and hints at possible new markets for local livestock products that are not produced under large scale, factory conditions.

Garnett (2009) expresses doubt that technology alone will be sufficient to reduce livestock GHG emissions, since reductions per animal may be cancelled out by future growth in animal numbers. She suggests that it is also necessary to consider reducing consumption of livestock products especially in rich societies as part of the overall strategy to reduce GHGs and refers to a considerable body of research that shows that a varied diet of plant foods is able to provide the full range of nutrients required to maintain a healthy diet, and references other studies that demonstrate that certain vegetarian diets offer similar nutrition to those inclusive of animal products but with lower GHG emissions (for example Carlson-Kanyama 1998). Garnett projects livestock consumption to 2050 on the assumption that per capita consumption levels in developed countries decrease to those of the developing world in 2050. Results suggest substantial reductions in per capita consumption of meats and milk in rich countries but still a substantial increase in global consumption and GHG emissions from livestock production.

Goodland (1997) promotes eating "lower down the food chain" and proposes a set of taxes to ensure consumers eating higher up the food chain pay the full environmental and social costs of their diets Such taxes would be relatively high on meats with high feed:meat conversion ratios such as beef. Gerbens-Leenes and Nonhebel (2002) are concerned about the land use requirements of changing food consumption patterns and rising claims on agricultural land worldwide. They present data on land area required to produce a kg of various food types, and animal products are among the highest – beef (20.9m^2 of land), butter (13.8), cheese (10.20), pork (8.9) and chicken (7.3). These compare with a range between 0.3 m^2 and 1.4 m^2 for fruits, vegetables and cereals. A conclusion of their analyses is that if consumption patterns in developing countries continue to shift towards those in western countries (as they are), and if no reductions in consumption of animal products are achieved in rich countries, per capita land requirements will rise substantially.

4. Opportunities

So is there a rising tide of anti-animal consumerism? Clearly some consumers are acting this way but we are unsure as to the strength of the tide. But there is certainly plenty of information in the public domain to encourage consumers to think about the issues and to raise the prospect of an anti-animal backlash affecting the purchasing patterns of some consumers at least in the developed world. Might this be viewed as a threat or an opportunity by major producing countries of animal products such as NZ? It may be a threat should consumer trends be ignored but should provide profitable niche market opportunities for those who are willing to change production and marketing methods. Does the NZ animal products industry see scope to further build on such niche opportunities, or to build a future based largely on commodity supplies to developing countries (or

segments of developed regions) where consumers are less concerned about the environmental or animal welfare issues?

As consumers have been turning increasingly to animal sources for protein food the share of animal- sourced protein in total protein intake has been rising, and quite sharply in regions such as Asia and South America. For the world as a whole, animal sources now provide 39% of the total protein food supply compared with 34% in 1970. But in Asia, these shares were 17% in 1970 but had reached 32% by 2007. Even in Europe, where consumption of animal products has been much higher than in the developing world, animal-sources provided a greater share (57%) of total protein intake in 2007 than in 1970 (when it was 51%). If vegetable sources of protein can substitute to some extent for that from animals in human foods, opportunities may exist to reduce animal production and reduce the negative externalities arising from animal production. Aiking et al. (2006) describe a research programme whose central hypothesis is that a shift from meat protein to plant protein is environmentally more sustainable than present trends. This programme evaluates the environmental, technological and societal feasibility of developing protein-rich products based on plant proteins, called Novel Protein Foods (NPFs), to substitute for animal products in consumption. Comparing pork with a pea-based NPF in a value chain analysis, they found that the latter outperformed pork over a number of indicators (land area, energy, water use, nutrition depletion and emission indicators) by factors of 4 - 200 times. However based on consumer choice experiments, they concluded that consumers facing a choice between currently-available meat substitutes and meat would prefer the latter and that ecological or moral benefits of NPFs are insufficient to change consumers' minds. Results such as these will be used in future to further develop NPFs within this programme.

There would seem to be ample opportunity to develop branded animal products that could appeal to segments of consumers who are concerned about current trends in animal production and processing. Organic foods are already well entrenched in some markets, including organic meats and dairy products. 'Free range' eggs are available, and could be further developed for those meats traditionally raised in industrial housed systems. The 'grass-fed' attribute of most NZ meats is promoted by NZ exporters but the presentation of grain-fed meats in some markets (such as in Asia) by North American suppliers as being synonymous with 'high quality' suggests NZ marketers still have work to do to further develop a loyal segment for such products. What about other product attributes that could be developed? Where groups of farmers are able to reduce methane emissions from their livestock production systems, why not market their products as 'low methane' or 'low emissions'? Or if farmers can be shown to have substantially reduced nitrogen and phosphate run off to surface and ground water, their products could be branded 'clear water' meats or dairy products. 'Animal friendly products' could be marketed from farmers who can be shown to adopt higher standards of animal welfare. Animal products produced from 'local breeds' may be more difficult in NZ due to the lack of native breeds, but perhaps something can be developed in this area also.

Such new products and brands are not developed overnight. Appropriate standards and mitigation strategies need to be researched and adopted, and NZ is working in this direction with for example the clean streams accord, the ETS, animal traceability, and improved food safety and animal welfare standards. But in many cases farmers and other

agents in the value chain will need to go beyond minimum standards. Certification schemes will be required (as for organic producers), consumers must develop trust that products are true to the claims made by their producers and trust relationships will need to be developed along the value chain supplying these products. Monitoring systems will be required to ensure that products comply with the required standards, information from credible sources will be required to develop consumer trust and to ensure that consumers are informed on the standards. Traceability systems will be crucial in permitting consumers to make their own checks on production methods and practices. Labelling rules will be required that permit consumers to exercise choice between animal products that do or do not claim to recognise certain environmental standards or attributes. Differentiated value chains will necessary so that 'environmentally friendly' products may be separated from other products.

These all add costs to the supply chain of course, requiring sound benefit-cost analyses to be conducted during the market appraisal process. An example is given by Nocella et al. (2010) who use contingent valuation methodology to derive consumers' willingness to pay for certified animal friendly products. They discovered that retailers in some EU countries can easily identify segments of consumers who are ready to pay a premium for 'animal friendly' products, and that the agri-food sectors in these countries could take further steps to develop such niches. It seems reasonable that similar niches in some developed countries could be accessed and grown by NZ exporters of animal products should the vision and desire exist.

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