Environmental Issues and their Potential Effects on Animal Agriculture Towards 2005

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Summary

In this presentation the potential direct and indirect effects of environmental pollution on animal and crop production is discussed. Water pollution, particularly with minerals and agricultural chemicals remains an internal problem. However, gaseous pollution through emissions of green house gases have implications for the world. The direct effects of global warming will create problems but they will not be so dire as the indirect effects that result from internal legislation to minimise or decrease emission and inter-governmental responses in market diplomacy.

There seem to be major opportunities for Australia because of its vast land areas and low population density to take advantage of the potential changes in commodity markets particularly in S.E. Asia. There must eventually be a major change to renewable sources of energy, but legislation to limit fossil fuel combustion (oil, petroleum, gas and coal) generally may impact on and reduce the amounts of grain used in intensive animal industries.

The huge and developing markets of Asia are our major potential markets for animal products. World surplus grain is produced at enormous pollution costs, particularly in Europe and USA. The increasing cost of fossil fuel will eventually effect profitability and will reduce production of grain farming particularly in Europe. This together with the high cost of pollution control and the problems introduced by animal welfare concerns for intensive animal production in the industrialised countries may lead to an overall major reduction in these industries. This in turn could provide the opportunity for Australia to enlarge its world market share of these commodities. But to do this we must develop effective sustainable grain farming and utilise the polluting effluents from intensive animal industries (and slaughter houses) as fertilisers to be recycled back from the land. If we can put in place effective strategies and also satisfy animal welfare concerns then overseas markets appear to be potentially large, particularly since there are strong indications that surplus world grain will not be available to give the intensive animal production industries in Asia the advantage they now enjoy.

It should be quite clear that the world's population, which is increasing at 90 million/year, needs to be fed and there are strong indications that constraints to continuing increases in grain production to meet the demand for feed grain in Asia might be unsurmountable. If pig and poultry production is promoted in Australia to meet the Asian markets then there will be direct competition for resources by the presently booming grain feedlot industries. The highly efficient feed conversion of monogastrics will give them a competitive edge for feed grain utilisation over cattle production. However, new technologies for using biomass (from pasture and crop residues) by appropriate supplementation, have shown the enormous potential for ruminant production throughout the region. The future again depends on the development of sustainable grazing systems in Australia. The main aims must be to increase growth rates of ruminants and decrease age to turn-off of animals. A most important objective must also be to optimise reproduction rate in the breeding herd. This should allow a decreased total breeding herd, that reduces pressure on the natural resource - pasture. At the same time there would be a huge development of ruminant production from crop residues and protein byproducts of agro-industries in Asian countries which may effectively compete with Australian grass fattened beef.

Introduction

Food production in the world has kept pace with increasing population despite great concern in the 1960's that mass starvation was imminent (Ehrlich 1968). However, under nutrition is still rampant and affects a large number of poor people on all continents. At the present time this is primarily a problem of purchasing capacity of the resource-poor and distribution of food rather than a limited supply per se.

Plant and soil scientists have achieved global targets for increased food (mainly cereal grain) production in response to population increase largely through the development of improved cereal strains that are better able to use water (irrigation) and

fertilisers together with improved pest resistance and improved pest management.

It has, however, to be emphasised that higher cereal yields and therefore food availability has come at a cost to the environment since it has been achieved with inputs that increase the need to combust fossil fuel directly or indirectly and contributes to the global atmospheric accumulation of carbon dioxide. Improved grain yield has been accompanied by an increase in the relative amounts of grain to straw but a greater total biomass (straw) production. Increasing C and N pools in soils through re-incorporation of stubble in rice paddys has been indicated to be a primary limitation that is causing a drop off in rice yields (Fischer, 1995). The larger quantities of straw give a greater potential for methane generation from this biomass when it is degraded anaerobically. In addition, applications of N fertilisers has led to increased release of nitrogen oxides into the atmosphere, a further potent greenhouse gas. Increased areas sown to cereals and improved yields have also resulted in greater release of methane in cultivation because weed control is through periodic flooding and the induction of anaerobic conditions in inundated soil. Rice cultivation contributes significantly to the accumulation of atmospheric methane.

The scenario of costs to the environment do not stop there - in the United Kingdom for instance, grain crops are produced once a year but the need for pest control has resulted in ground water contamination with pesticides which now results in the need to treat water with ozone in order for it to be safe for human (and animal) consumption.

The pressure to increase world food production in an increasingly over populated world has led to perturbations of many natural and previously stable agricultural ecosystems which are now unsustainable and may degrade to such an extent as to be unusable in the foreseeable future. For example, where ground water levels are close to the soil surface and trees are cleared to allow crop production, rising water tables with increased evaporation rates have resulted in salination of agricultural land at an unprecedented rate.

Water pollution - a National problem

Examples 'of pollution of water include the entry of large amounts of P into waterways from sources such as sewage, and manufacturing industries and run-off waters from agriculture with the subsequent outbreaks of toxic blue-green algae. A second example is the entry of toxic chemicals sprayed on plants to control insects that enter food chains potentially to be absorbed by humans at the detriment to their health and which often makes the product unsaleable. Even more harmful is the perception of "unhealthy foods" which then effects particularly the international markets.

There are numerous examples of the unacceptability of chemicals entering our food chains. Politicians are willing to take "hard options" when humans are involved or "high priced overseas markets", are jeopardised but low level insidious pollution is probably more deceptively affecting the quality of every day life, particularly in big cities. Compared with pollution with toxic chemicals, industrial and agricultural systems that lead to slowly elevating levels of pollutants in water and air, are less easy to legislate against considering the vested interests often involved.

Water pollution is a major concern for Australia, water being one of the most limiting factors in plant growth and the huge demand for water for irrigation, by human habitation and industrial development. However, water pollution is a national problem in Australia with little repercussion at the international level. The exceptions to this include the pollution of the sea which may have implications in the future and the contamination via water of food products for international markets. Water pollution and water supply are major issues for land-locked countries and many people consider that the next war may well be fought over water rights.

Legislation in the European Economic Community against the disposal of solid and liquid effluents from intensive animal production because of already high levels of pollution in ground water is likely to result in a decrease in their intensive animal industries. It may also motivate a movement of these industries to countries where legislation against such pollution is absent or can be ignored. Countries such as Australia with some abilities to absorb pollutants may be able to take advantage of these developments. For instance in some areas, effluent water high in N, P or K from intensive animal production may be regarded more as fertilisers particularly for low fertility grasslands provided the technology to utilise the effluent water is being developed and is effective in retaining the minerals in the enterprise with beneficial effects.

Atmospheric pollution - a global problem

Gaseous pollution of the atmosphere is a national problem with international implications, gases being readily exported or diffusible across national boundaries and even between hemispheres. Gaseous pollution from carbon fluoro carbons (CFC's), which react with the earth's protective ozone layer, influence the quantum of UV light received at the earth's surface and the damage to plant and animal life is the important detrimental issue. Even though thinning of the ozone layer results in some increased greenhouse effects, it should not be confused with the major issue of global warming which is due to the build up in the atmosphere of CO_2, methane and to a lesser extent other gases which retain energy as heat previously irradiated to space. There are no clear cut ways to decrease gases already accumulating in the atmosphere the only resort is to limit their release. Legislation has been successful in limiting the release of gases that directly degrade the ozone layer.

Although the possible effects of global warming are being researched and models developed to assess their implications, at this point in time, the effects of global warming are largely unpredictable, uncompromising and unprecedented and could lead in some countries to chaos because of the socio-political factors involved . As an example of where chaotic conditions could result would be the inability of countries with low lying areas to resettle hundreds of millions of people from rich agricultural delta country that could become inundated with a rise in sea level, that will result if the earth warms. This is particularly dangerous where the changes are relatively rapid. Even with slow gradual changes the hard decisions are unlikely to be taken until a crisis is imminent. Displacement of people would be a major problem but the mostly fertile land that will be lost to inundation would massively compound this reducing the capacity for local food production. This could further increase the crisis and which would extend beyond the major coastal and delta cropping areas. Many of the displaced persons may become boat people hoping to be resettled if they can reach the less densely settled continents such as Australia and South America.

There is obviously an uncertainty about the effects of global warming and many people are happy to accept that such devastating scenarios as painted above may never happen. People and politicians all too often make the statement that "- the jury on global warming and its implication is still out" - but after centuries of stable levels in the atmosphere carbon dioxide and methane and other gases are now increasing in the atmosphere and these gases have long half lives. Therefore, the long lag time of effects of fossil fuel combustion now, will be felt some time in the next 20 to 50 years. There is only one responsible course of action which most governments now accept and that is to put measures in place over the next few years to prevent global warming from happening in the future. Thus political pressure is being applied world wide, to legislate to ameliorate or even reduce emission of gaseous pollutants to the atmosphere. This is the so-called "no regrets approach".

The problem is world wide. Any one country can point to contributing a minimal amount of greenhouse gas emissions from any one source. It is therefore necessary for all countries to agree to meet a quota of reduction of emissions. The point is that all countries have to set up their own amelioration programs voluntarily or this will be forced by international reaction and possible market or monetary diplomacy.

Greenhouse gas emissions

It is strongly emphasised that, the primary problem creating global warming is the formation of carbon dioxide from the combustion of fossil fuel. Figure 1 shows the global contribution of gases to atmospheric warming compared with estimates of Australian emissions (Anon 1994). The second most important gases are methane and nitrogen oxides. The contribution of carbon dioxide from combustion of fossil fuels is largely from industries, not agriculture, but agriculture contributes a large proportion of methane and nitrogen oxides released (Figure 2 and 3) into the atmosphere. The present problem of global warming is

Figure 1 Contribution of gases to the greenhouse effect

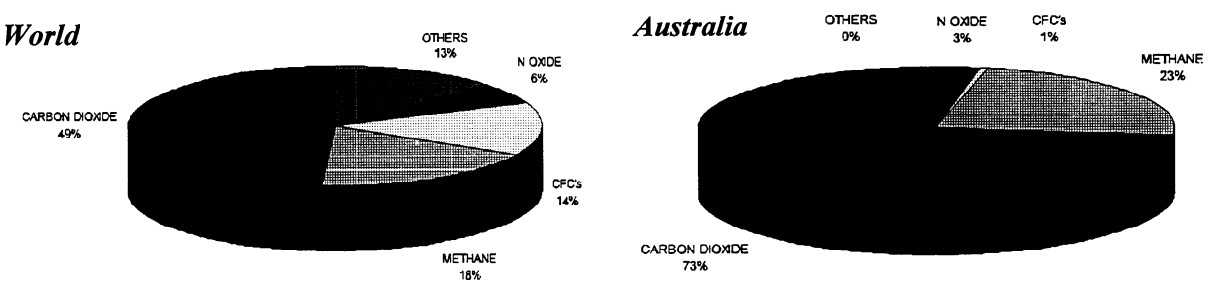


Figure 2 Sources of methane in the atmosphere

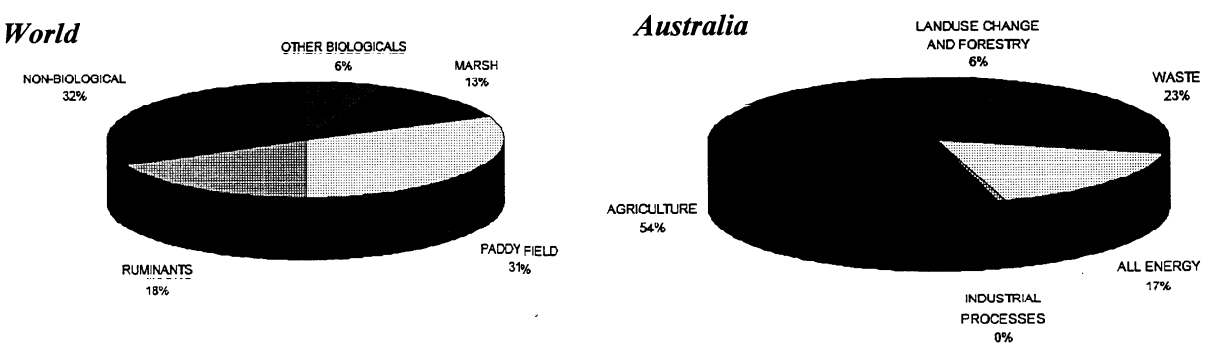
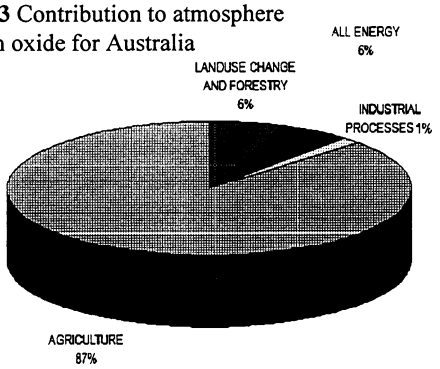


Figure 3 Contribution to atmosphere nitrogen oxide for Australia



largely a result of the combustion of fossil fuels in the industrialised countries (Figure 4). The future problem will be compounded because countries of Asia, Africa and the developing countries generally, as they become more affluent will also aspire to the same level of resource use per capita, which if achieved would be disastrous. This is especially serious as the population density of Asia is some 60% of the total world population (Figure 5).

Present strategic actions to reduce greenhouse gas emissions

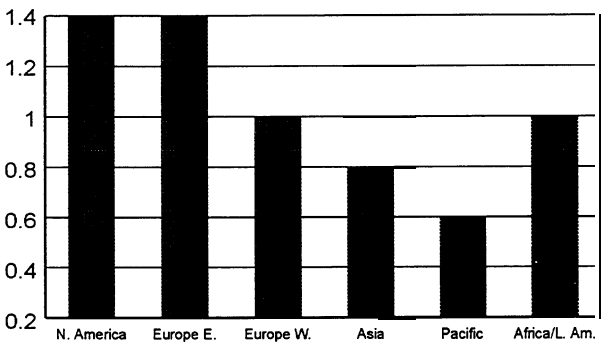
Under the United Nations Framework Convention on Climate Change, the OECD countries and some developing countries have made commitments to stabilise greenhouse gas emissions at their 1990 levels by the year 2000. The Australian Government has been even more ambitious than this with an interim planning target for reducing greenhouse gas emissions which involves lowering emissions to the 1988 levels by 2000 and to 20% below the 1988 levels by 2005. Australia produced 572Mt of CO, equivalents in 1990 and could reach an estimated 654Mt in the year 2000 (Anon, 1994).

According to recent research, the 'no-regrets' policies include reforms to interstate trade in electricity and natural gas, and the adoption of a combination of policy options in the transport sector to reduce emissions. Increased transport costs will directly effect agriculture both in terms of costs of production and costs of marketing the product.

Recent studies indicate that if Australia were to tax the release of carbon into the atmosphere - (a carbon tax) to lower fossil fuel use and encourage alternative energy sources to achieve the Government's 'interim planning target' for the reduction in CO, emissions, the cost to the domestic economy is estimated to be in the range of 0.5-2.0% reduction in annual real GDP.

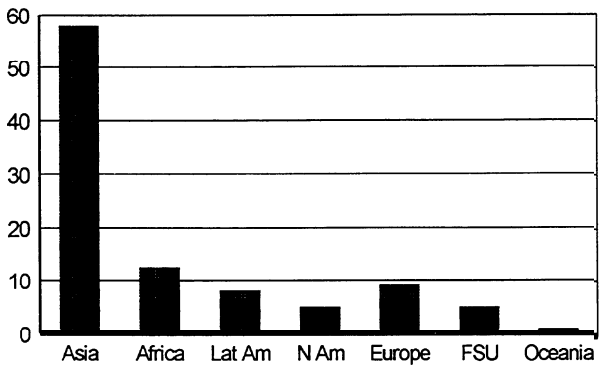
It is likely that greenhouse gas emissions in Australia will increase as the domestic economy expands. The industries likely to be most adversely affected by a unilateral carbon tax in Australia are the fossil fuel mining industries, electricity generation from coal combustion and the energy-intensive minerals and metals processing industries virtually all our major export earning industries. Agriculture would be directly affected through increasing costs of fossil fuel and fertiliser. The impact of the carbon tax on different industries would be likely to lead to uneven effects on employment in different occupations in the Australian economy, with the highest reductions in employment in blue collar occupations including plant and machine operators, drivers, labourers and tradespeople.

Figure 4 Contribution to global atmospheric carbon dioxide



(Source: World Resources Institute)

Figure 5 Percentage of world population by continent

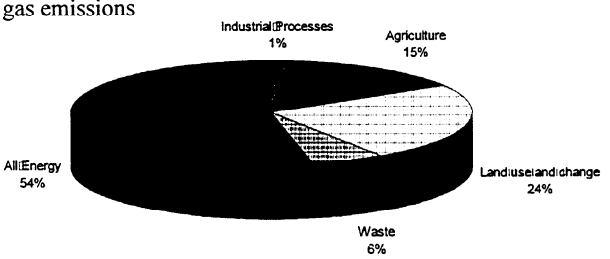


Source: United Nations, World Population Prospects, 1990

Agriculture and the fossil fuel economy

The major objective of the discussion presented is to suggest the impacts on animal industries that may result from a global drive to reduce, delay and/or eliminate any increase in global atmospheric gas accumulation and reduce the effects of global warming. Agriculture and land use contribute approximately 40% of Australian total gaseous emissions (Figure 6).

Figure 6 Contribution by sector to Australia's greenhouse gas emissions



Like those scientists that predicted, in the 1960's the advent of mass starvation because of increasing population and the exhaustion of fossil fuel reserves, the environmental impact scenarios that are painted here have an undefined time course. The concepts are necessarily based on future projections and will be highly dependant upon political decisions at the international and national level. The ultimate amelioration of detrimental environmental change on agriculture depends on governments throughout the world making hard decisions. It depends in addition on the ability of developing country governments to introduce mechanisms to reduce population and probably the willingness of people in developed countries to lower their standing of living and expectations of wealth so that the poor people of the world can have more. It also depends on the events such as war where environmental issues are usually totally and deliberately ignored.

In the first instance there is the drive to increase food production to meet an increasing world population expected to plateau at 1 O-12 billion from a present 5.4 billion. On the other hand there is the need to reduce environmental pollution because of potential devastation. The third major issue is the need to redistribute wealth from the "haves" to the "have nots" by allowing opportunities for the poor to develop. The last point is the need for the wealthy countries to acknowledge and accept the need to rationalise the use of fossil energy resources, allowing a reduction in their use and an even distribution of resources. This has to be accompanied by an increased access of both developing and developed countries to alternative energy sources. It is imperative in the future that renewable energy resources replace that from fossil fuels, these include technologies based on biomass, solar, tidal and wind energy. It will almost be mandatory that these are developed in the industrial countries and given at no real cost to the developed countries.

Global warming within the context of this discussion will have a number of repercussions for animal agriculture. These include :

- the direct effects of climate change in Australia;
- the indirect effects of legislation to enable the country to meet the reduction of its emission targets;
- the indirect effects of the policies and actions of the global community and in particular our close trading neighbours.

Direct effects of global warming

The vulnerability of Australian agriculture to climate change is a major issue since it is one of the world's major exporter of agricultural products. However, even with good modelling procedure it is far too early to be able to accurately forecast all changes that might occur but there are some predictions as follows.

Pests and diseases

Both introduced and native pests that are presently restricted to our tropical and subtropical areas may spread south with increasing day temperatures and a forecasted increase in precipitation, evaporation and humidity. The spread of disease is enhanced often by extreme events or the crossing of climatic thresholds which then advantages the pest. The diseases that are carried by the pests may then become endemic. This applies to plants, domestic and native animals and humans. The "colonisation" of temperate and southern Australia by the cattle tick is one such possibility, but others include the increased opportunity for pests and diseases such as screw worm and foot and mouth disease to come into a more humid North Australia and spread through the humid regions particularly if the periods of humidity are enhanced.

Pasture growth

Pasture growth will be majorly effected and more tropical species will undoubtedly replace both temperate and subtropical species - generally increasing biomass but decreasing nutritive value. However this increases the scope for improved supplementation leading to increased ruminant productivity generally.

The predicted increases in precipitation with higher temperatures and increases in rainfall extremes will be inducive to increased soil erosion, which is already a serious problem in Australia particularly in the changing pasture conditions. However, increased rainfall and increased evaporation may lower effective rainfall and may cause a move of our cropping areas towards the areas that are presently temperate.

Sea level increases will erode land areas and its availability and as in Australia over 90% of agricultural land is used for grazing (2/3rds of the land surface or 466 million hectares are used by agricultural and pastoral properties) it will mainly impact on animal production. Australia's coastline is 36,700 kilometres enclosing a land area of 7.7 million square kilometres but only 10% of the land area is arable.

Increases in the number of hot days may lead to a reduction in area where ruminant can be raised as these animals are highly sensitive to heat stress particularly on the low quality feeds available in tropical grazing areas.

A hotter climate will require more effective environmentally controlled housing of poultry and pigs.

Drought incidence

This is an area of great uncertainty dependent on

many factors but it seems that if Australia's climate becomes more extreme the potential for drought increases. High evaporation rates with increased day temperature means that the onset of a drought can be more rapid and less predictable.

Overall

The overall direct effects of global warming on animal production does not appear to be so dire as perhaps the effects on plant growth, but serious problems will arise with disease and pests and there will be a need for increased action to prevent soil erosion and amelioration of pollution from water run off from grazing lands or from effluents from intensive livestock systems. There may be a need for more comprehensive plans to provide for drought feeding of ruminants and drought may occur at more frequent intervals.

Indirect effects from changes in our markets

The developing economies in S.E. Asia provide the largest potential for future livestock markets for three reasons.

1 Population is large, 60% of the world population reside in Asia (Figure 5) and the population is increasing in contrast to the stable populations of the industrialised countries.

2 A greater proportion of the population are moving into an income bracket where the proportion of their diet as animal protein (meat and milk) is significantly increased (see Figure 7).

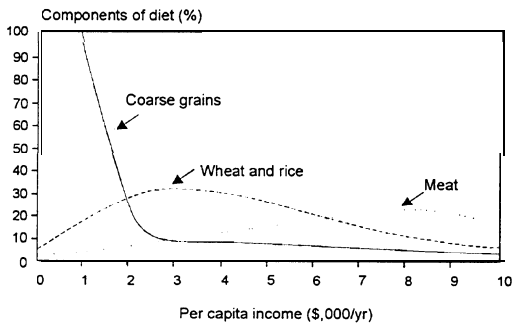
3 In Asia there are different priorities placed, particularly on ruminant products, where draught use is often the major reason for keeping such animals. The supply of meat is a by-product, it is of poor quality where most meats are produced from slowly grown mature animals. This is not true for poultry and pigs as these industries are well established on know-how and technology transferred directly and without modification from the industrialised countries. The same industries are also largely based on inexpensive surplus grain purchased on the world market and their future then appears to be precarious since these surpluses are ephemeral and production in these countries barely meets human requirements at the present time (with some exceptions).

Although pig and poultry meat production in developing countries has increased most rapidly in the last few years (see Figure 8) - this has been promoted by the availability of inexpensive surplus world grains. Even under these conditions the importation of all animal products has been massive (Table 2) Will the surplus world grain continue to allow pig and poultry production to continue in the developing countries? There are now strong schools of thought that believe that in the future there will be massive deficits in world grain availability due to numerous factors. Amongst the strongest arguments are that increasing rates of development in Asia and increasing demand for food will limit the amounts available to feed animals particularly with the rapid development that is occurring particularly in China.

Indirect effects of high fossil fuel prices

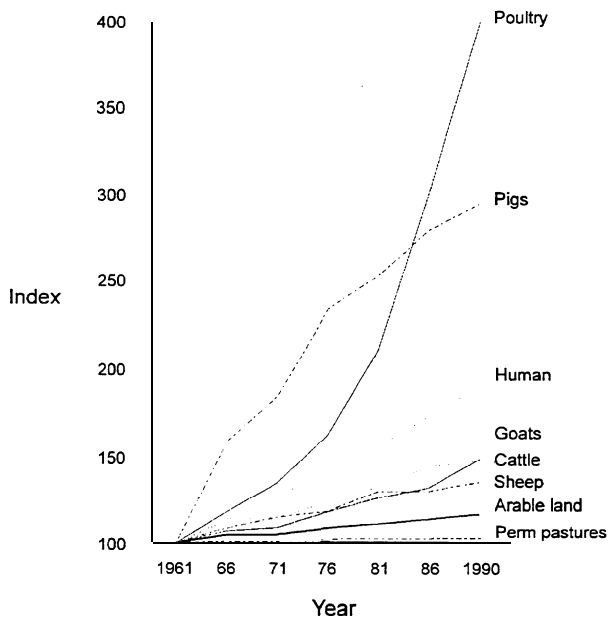
There are no alternatives to an eventual reduction in the use of fossil fuels in all forms of energy consumption. History shows that a relatively inexpensive source of fuel will always be mismanaged by the majority and will often be cornered for the benefit of

Figure 7 Trends in consumption of meat, wheat & rice and coarse grains by economic status of people



Sources: Marks & Yetley, 1987
Brumby, 1989

Figure 8 Change in relative population sizes of animals, arable land and farm pastures (Sansoucy & Auriol, 1986)



the wealthy, the latter will certainly continue even if there are steep price hikes. In spite of a four fold increase in energy consumption and a doubling of per capita energy use in non-OECD nations since 1960, the developing countries are still using only a fraction of. the fossil fuel that is used in most industrialised nations. Most developing countries resent the suggestion that their development should be slowed to minimise fossil fuel consumption and voluntary restraint in such countries is out of the question. Eventually the only way to reduce fossil fuel energy use is to factor into its price the costs of environmental pollution. This will mean very steep price hikes. The industrialised countries cannot expect the third world to unilaterally slow their rate of use of fossil fuels until all countries more or less have equal access to energy resources, both fossil fuel and the alternatives.

Availability of feed grain

Inevitable fuel cost increases will set an upper limit on crop production through its effects on the cost of power, fertiliser, pest management and water. The constraints imposed by rising fuel costs, together with plateauing genetic improvement in cereal yields, increasing land degradation and decreasing land size per head of population with increasing population growth, indicates that inevitably intensive pig and poultry production based on cereal grains will become unacceptable or uneconomic in most developing countries. This trend is already apparent in a number of European countries because of the unacceptable animal welfare and pollution issues.

At the present time, intensive pig and poultry industries are the major growth areas providing meat and eggs for the Asian region even though there is enormous potential to increase total meat and milk production from ruminants.

There is a school of thought (Mitchell and Ingco, 1994) that there will be a continuing availability of surplus cereals on world markets at competitive prices for pigs and poultry production to meet urban middle class markets in Asia. On the other hand China alone is projected to require to import 300 x 1 0^6 MT of feed grain by the year 2010 (Lester-Brown, 1994). This is almost double the predicted 120 x 1 0^6 MT surplus at that time.

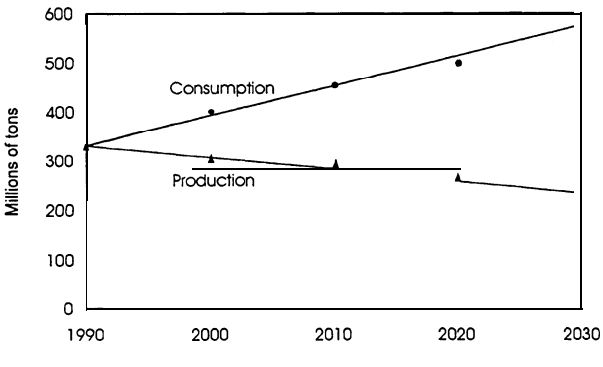
Thus it appears that the dependency on grains for extension of pig and poultry production is at the best a precarious option for the developing countries. A collapse of burgeoning and established pig and poultry industries because of increased costs of grain could be devastating for many developing countries but may create opportunities for Australia provided that certain safe guards are put in place or developed.

Grain surpluses and animal production

Grain is produced in industrialised countries with large inputs of technology and low labour use, and is one of the cheaper feed/food resources. However the economics are superficial and profitability of grain production by farmers in industrialised countries often depends on subsidies. Agricultural research technology has boosted grain yields enormously but only where there have been increased inputs such as water and fertilisers. Cereal production is expensive in terms of fossil fuel inputs and the depreciation of soil fertility and soil erosion. It also requires large inputs of water with resultant costs in fossil fuel use in the production of cement for water ways or canals and the cost of pumping and the removal of nutrients in effluent that eventually reach the permanent water courses of a country.

The cost of fuel energy for grain production on a megajoule for megajoule basis is shown in Table 1. It is important to emphasise the immense cost of grain production when this is produced by industrialised technologies as compared to that produced by human and animal power in small farmer systems in developing countries. The huge inefficiency then of feeding this to monogastrics is obvious where the conversion of grain to liveweight are for poultry about 3 to 1 and pigs 4 to 1. The even greater energy deficit when grain is fed to ruminants (ie. 8: 1) may mean reduced intensive production of these animals in the future. If the

Figure 9 Projected grain production and consumption in China (1990-2030) (after Lester Brown 1994).



Source: Worldwatch, 1994. Lester Brown.

Table 1 Maize Grain Production - Energy Budgets

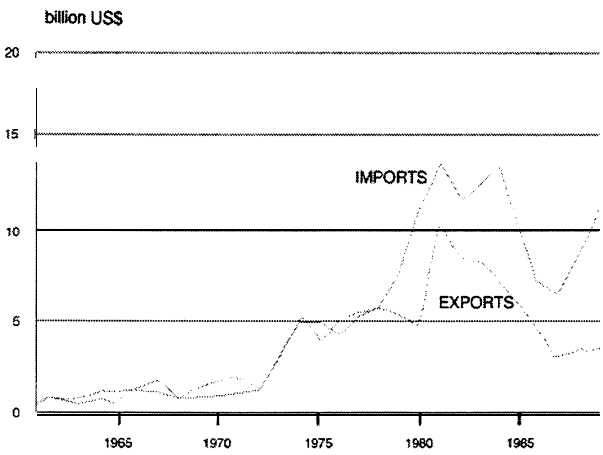
	Ration, Energy out/energy in	
	Grain MJ/MJ	Biomass MJ/MJ
Mexico	30.6	80.8
Guatemala	4.0	11.2
Nigeria	10.5	29.8
Philippines	5.1	14.3
India	5.0	13.3
United Kingdom	2.3	
United States of America	2.6	

(FAO 1990)

price of grain doubles in response to removal of subsidises and a large price hike in fuel then the intensive industries will be much less economic in all countries without steep price rises for the commodity. Thus there may be a move to alternative feeds for such livestock in developing countries which would mean a general lowered productivity but a more sustainable industry.

At the same time the monogastric industries in industrialised countries are increasingly under pressure from both the environmental and animal welfare lobbies. For example in Denmark over 60% of egg production is now from free ranging poultry because of people actions based on welfare considerations. Legislation in some countries no longer allows manure to be spread on the land because of ground water contamination and in some cases manure is now finding its place as an aide 'payment' to developing countries and is being exported from Europe to countries such as India. Whilst these countries may have to reduce these industries and therefore the production of monogastric meats and eggs, they will automatically ensure the supply for their own needs, but they will not be able to fill a deficit in developing countries in the future. The present markets for imports of animal products into developing countries are shown in Table 2 and the trade of grain is shown in Figure 10. This undoubtedly indicates the present "bullish" nature of such markets and its resilience to environmental argument that attempts to rationalise grain production for such purposes. It is apparent that most intensive animal industries are in the hands of entrepreneurs rather than farmers in developing countries.

Figure 10 Feed grain imports in developing countries (Sansoucy, 1995)



The imposition of a carbon-tax, as presently applied to fuel in Holland should reduce the economic stimulus to produce grain. However, it is difficult to adjust to these pressures quickly. In Denmark for example, even now grain is being grown for direct combustion to provide a solid energy resource in order to just utilise agricultural land and provide employment.

Table 2 Net Trade of Animal Products by Developing Countries (1990)

		1990 (tons/annum)
Milk	Import	21,201,000
Beef (meat)	Import	722,000
Pig	Export	93,000
Sheep & goat meat	Import	604,000
Poultry meat	Import	511,000

(FAO 1991)

The overall changes that may ensue indicate opportunities for Australia, provided that its natural advantages are used sustainably to increase meat production and export these commodities into S.E. Asia. Australia has fragile cropping lands but does have large land areas which subsidises the costs of grain production below that of countries with intensive agriculture. This together with an ability to absorb the intensive animal production industries with appropriate pollution control, should see a large increase in these industries to supply S.E. Asia demand where this is not satisfied by Asian businesses. Already Danish commercial enterprises are seeing major opportunities in Australia for commercial pig and poultry industries aimed at Asian markets. This is based on access to inexpensive grain and to minimum costs of pollution control. The important issue for Australia will be how to position these industries so that the effluents and wastage from them can be utilised as fertilisers and in addition the gaseous pollution is minimised and alternative energy resources are mobilised. Most importantly the cereal industry must be protected against loss of soil fertility in all ways. If these precautions are taken Australia could provide considerable amounts of monogastric products, the preferred meats, to Asia particularly from the northern area such as The Kimberley's which are close to major potential export ports. The objective with grain growing would be to minimise energy inputs and also maintain or prevent soil erosion and soil degradation.

Effects of global warming on ruminant production

Undoubtedly ruminant production should be the major source of meat throughout the world because of the capacity of these herbivores to utilise fibrous materials unusable by man or domestic monogastric animals and which are copiously available and have been produced often at no cost to, or their production has been beneficial to the environment.

Animal nutrition research has demonstrated that moderate to high levels of production of the order of 800 g/day liveweight gain can be achieved with cattle given forages with digestibilities around 50% - This

creates the potential for the production of high quality meats from ruminants independent of the availability of grain but it requires a source of bypass protein. Biomass is either a by-product of grain production (ie. straw) or is grown extensively (pasture) because land has no other profitable use. The massive availability of forage in Australia and the world suggests that the requirements for high quality protein in the world can be met from these sources. The problems are the provision of supplements that allow forages to be used efficiently by productive cattle (Leng 1990).

Crop residues are the obvious source of much of this biomass for ruminant production in the developing countries and in fact the systems are in the process of development in China, where in one project in excess of 3 million cattle are being fattened annually on ammonia-ensiled straw. This is using only a tiny percentage of the straw available (Dolberg and Finlayson, 1995) and indicates the massive potential.

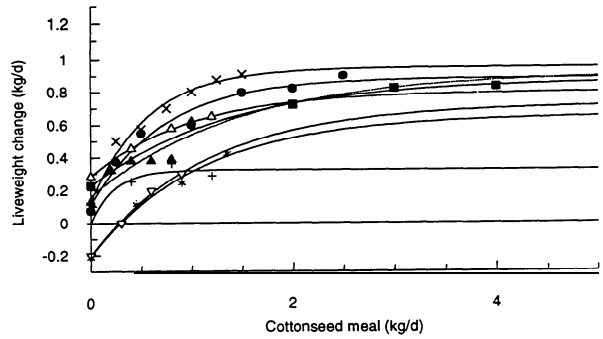
The increasing demand for meat will be ahead of the development of such systems in S.E. Asia. At the present time about 350,000 cattle annually are being exported from Australia to be fattened in feedlots in S.E. Asia using inexpensive world surplus grain The availability of the inexpensive grain will surely decrease allowing Australia to take the opportunity to service the newly established markets and the greatest opportunity we have is the sale of lean beef, produced from grass or other sources of biomass into the urban middle class that is rapidly developing in these countries.

The competition for feed grain between an expanded pig and poultry industry and ruminant feedlot production will be an interesting one. The size of the markets and the ability to pay the cost of feed will be important, but feedlot beef production, because of the poor feed conversion efficiency, will have difficulty competing with a poultry and pig industry servicing the requirements of S.E. Asia. A grazing industry that is prepared to supplement livestock under grazing, appears to be potentially the most efficient industry to supply lean meat to Asia, however, it will have to compete with meat produced with low cost agro-industrial by-products in Asia. Thus the potential for production of meat from straw becomes a primary concern. This is reviewed by Sansoucy (1995) in this symposium but the key aspects are also given here.

Strategic supplementation of cattle/sheep fed straw

Growth response relationships in cattle fed ammoniated straw plus cottonseed cake inputs are shown in Figure 11. This technology of using treated straw and supplements is being taken up by more and more farmers, particularly in China for finishing young cattle at an early age (Sansoucy 1995). The rate of development of these industries will be a major factor in Australia's ability to access the potentially large markets in Asia for beef. Undoubtedly wool and sheep meats are also readily produced with the same diets but have not yet receive the same attention as cattle production.

Figure 11 The response in liveweight gain of cattle fed basal poor quality forage from various sources supplemented with cottonseed meal (after Leng, 1995). Data for cattle fed ammonia-treated straw in China are show as filled circles (●) and filled squares (■).



The lack of appropriate supplements or the infrastructure for manufacture and distribution of supplements are primary limitation to such developments in Asia. However, India and Pakistan have enormous export markets of vegetable protein meals that can be used in the region.

The future for beef production for sale to S.E. Asia looks bright. However, pig and poultry meat production in Australia may also be in demand if sustainable grain production systems can be devised that will maintain grain prices low. However, pig and poultry will out compete ruminants for grains in a limited grain market.

Grain production andfuture feedlot beef production

As indicated above grain is likely to increase disproportionately in price as transport, power, sprays and fertiliser prices increase and sustainable soil management systems have to be used to minimise fossil fuel use. This being the case the value of concentrate (ie. grain) relative to the cost of biomass production must widen. The feed-lot industries producing for the value added markets of Japan may be buffered as the consumer pays a premium for meat. However, there is still a vast difference between the value of carcase meat in Australia and the value of the same meat sold through butcher outlets in Japan. However, less lucrative markets may close as prices rise and competition from cattle and sheep fattened on pasture with judicious use of supplements and also cattle fattened on crop residues internally out compete these systems. Increasingly, run-off pollutants from intensive cattle production will be costly to control and will add to their retail prices significantly.

The worst scenario is that the combination of demand for grain and meat will be supported by increasing the areas of marginal land put down to grain production with resultant increasing areas of land degradation within Australia.

The answer here might be the application of a soil-erosion tax, applied to grain production to stimulate the uptake of sustainable practices such as no-plough seeding and stubble retention and to dissuade the ploughing of marginal lands. Some estimates of soil erosion suggest that 30 tons of top soil are lost in parts of Australia for each ton of grain produced depending on seasonal conditions. The acceptability of the intensive animal industries must be judged in this light; on the other hand, overgrazing particularly in drought leads to extensive soil erosion which likewise cannot be tolerated for the well-being of future generations.

Future ruminant production system

Production from pasture is extremely low in the majority of the grazing areas particularly in the north. It is difficult to achieve growth rates of more than 300g/day from grazing cattle throughout a year. Often reproductive rates of breeding herds are well below optimal, requiring larger breeding herds to be maintained than would be necessary if reproduction was maximised.. The future must see the implementation of nutritional practices that increase animal production per animal rather than per hectare as has been promulgated to the present time. This is essential because this is the major way to significantly reduce pollution costs per unit of product. A two to three fold increase in growth rate would see a considerable reduction in the feed requirements for finishing cattle with concomitant decreases in energy costs and enteric methane production (see Leng 1991). The future for the grazing industries will be improved levels of liveweight gain, with a smaller breeding herd with each cow producing one calf/year. The smaller herd size would reduce pressure on pastures and acceptance of conservation management by graziers would result in increasing potential sustainability. The conservation management costs however must be met by the consumer.

Conclusion

The growing preoccupation of all countries with the problem of global warming are likely to result in massive changes in animal production practices throughout the world. These changes could be beneficial to Australia and open up opportunities provided this country can find ways and means of reducing its own green house gas emissions and at the same time developing sustainable practices.

Australia has an economy which is supported by energy intensive industries with the need to transport goods and people over long distances. This then results in Australia's per capita gas emissions being higher than the other OECD country averages. On the other hand greenhouse gas emission in Australia are less than 1.4% of world emission. However, this will not excuse us from playing our role in global emissions control at the risks of in particular trade embargoes.

Australia's inherent low soil fertility and mostly semi-arid climate together with an ability to produce grain economically and at the same time sustain the farming practices, coupled with its large pastoral areas creates opportunities to supply S E Asian markets both monogastric and ruminant products. The major process being that in the long term the systems are developed without significant pollution and loss of soil fertility. If this can be done the future for the animal industries is bright. For our market competitors, already enduring high levels of pollution, environmental constraints will set an upper limit to production and increases in costs. This should allow Australia and other countries such as those in Latin America to take up the role of producing the worlds high quality protein from animals.

The largest markets are in Asia and S.E. Asia where the majority of people live and which are creating the global population explosion. These are the countries with an expanding middle class economy that Australia should aim to supply with products that have added value and are economically priced for these markets and are environmentally friendly to the country.

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