NEW ZEALAND NUFFIELD FARMING SCHOLARSHIP TRUST

Aspects of

EUROPEAN DAIRY FARMING TECHNOLOGY

A Study Tour of United Kingdom Ireland and European Dairy Industries - February - July 1990

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PHILIP C LUSCOMBE (B. Agr. Sc. Hons.)
Lwr Palmer Rd
R D 28 Manaia
Taranaki

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STUDY TOUR OBJECTIVES

My study included changes occurring in the European Dairy Industries and the European Community's Common Agricultural Policy. The future level of milk production and the future of milk quota's are major issues. Changes to the common agricultural policy could have a major influence on the world's milk product markets and affect the trading environment in which NZ must operate.

Pasture management studies included investigations into the relevance of aspects of European style set stocking to NZ dairy grazing management. Increases in pasture density, feed quality, species persistency, and greater animal intake and performance are likely with some set stocking of dairy cattle grazed pastures. Increased use of set stocking is likely in NZ pasture management.

Many current NZ feed conservation practices have high losses and disappointing cost effectiveness. It is likely that feed conservation practices will have to become more efficient to be viable in the long term. The Europeans have considerable experience in making high quality supplements. Seasonal supply dairy farmers may have to use increasing amount of high quality silage to produce more milk at the ends of the season in response to a payment regime that encourages a flatter milk production curve.

In New Zealand we are using an increasing amount of nitrogen fertilizer in our farming. We can learn from the Europeans nitrogen experiences. Ground water pollution is a major environmental problem in many areas. There is pressure on the Europeans to change their farming practices to reduce the pollution threat. These changes are relevant to NZ farmers as they provide an indication of the type of environment which we may be farming in the future. European environmental legislation may also affect agricultural trade as standards for food production in Europe are also applied to imported agricultural products.

THE COMMON AGRICULTURAL POLICY

My studies at the Centre for European Agricultural Studies (CEAS) of the University of London and discussions at EC headquarters in Brussels, included briefings on the history of the European Community and the Common Agricultural Policy (CAP), and likely future directions of EC and CAP.

The Development of the EC

The Treaty of Rome 1957 in Article 39 Agriculture states
"The objectives of the Common Agricultural Policy (CAP) shall be:

(a) To increase agricultural productivity by providing technical progress and by ensuring the rational development of agricultural production and the optimum utilization of the factors of production, particularly labour;

(b) Thus to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of those persons engaged in agriculture;

(c) To stabilise markets;

(d) To ensure the availability of supplies;

(e) To ensure that supplies reach consumers at reasonable prices."

The three principles of the CAP are based on Community preference, unity of market and financial solidarity.

Community preference favours EC agricultural products and discourages importation from third countries; reflected in the system of import levies, tariffs and non-trade barriers erected to protect high internal support. The Unity of the Market means a common market for agricultural products with common prices dominated by the European Currency Units (ECUs), with variations in prices to reflect differences in transportation costs and short term imbalances between supply and demand. Production will be located in those areas having comparative advantage. The CAP is financed jointly by member states for the common fund FEOGA, European Guidance and Guarantee Fund, rather than by direct national funding.

The CAP had its origins from the agricultural support systems found in France and Germany prior to the formation of the EEC in 1957. In France and Germany the Governments had traditionally played a major role and supported agricultural production. As the EC has grown to its 12 member status agricultural support and production has grown throughout Europe.

Food production grew rapidly through the 1980s. This was caused partly by the high prices being offered to the farmers, and also by new technologies available which meant yields were dramatically increased.

The trade terms of Europe have changed .Europe had gone from a net importer of food to a major exporter. Europe had achieved self-sufficiency and was being forced to sell surpluses on the world markets. For example in Europe in 1988 butter production was 33% above European requirements, cheese production 7% above European requirements and skimmilk powder 18% above requirements. The consequences of having to dispose of surplus production on the world markets became major issues, as markets for this food at the prices paid to the European farmers are not available.

There were serious financial consequences from this rapid production through the 1980s. One of the major consequences for the European people was the cost of the support which in 1980 to 1989 grew nearly three fold from 11.3 billion ECU to 28.3 billion ECU. The funding of the CAP became a major issue as Governments were forced to increase their funding to Brussels .

Environmental awareness also grew markedly through the 80's. With food in abundance, consumers increasingly indicated a preference for heathy products and food that was being produced in an environmentally friendly manner. Measures were introduced and are being promoted to retire land or to reduce the intensity of agricultural production, in areas that have environmental problems or have special characteristic which may be threatened by intensive agriculture.

THE COMMUNITY BUDGET

The ECU is currently worth about 70 pence or about $NZ2. Funds for the Community Budget are raised from the following:

Agricultural Levies	3%
Customs Duties	20%
Sugar Levy	3%
VAT	57%
GNP Base Tax	17%

The VAT provides a major part of the agricultural spending and is paid for by all consumers in the European population.

Expenditure of the budget in agricultural guarantees comprises 57% of all funds. The Dairy sector comprises approx. 20% of the total expenditure, principally from the agricultural guarantees portion (Figure 1.). The money used for agricultural guarantees is shared between storage costs, export refunds and subsidies or restitution payments.

There have been several studies on the income transfer effects of the CAP. In 1985 one study made by the Australian Bureau of Agricultural Economics concluded that 6% of the value added by agriculture came from payments made by consumers and tax-payers. In this study costs not paid into the Community Budget were included, eg. costs such as consumers paying higher prices for food are a major cost which do not show in the EC budget costs and led the group to conclude that the costs shown in the budget were perhaps only the tip of the iceberg of the European policy.

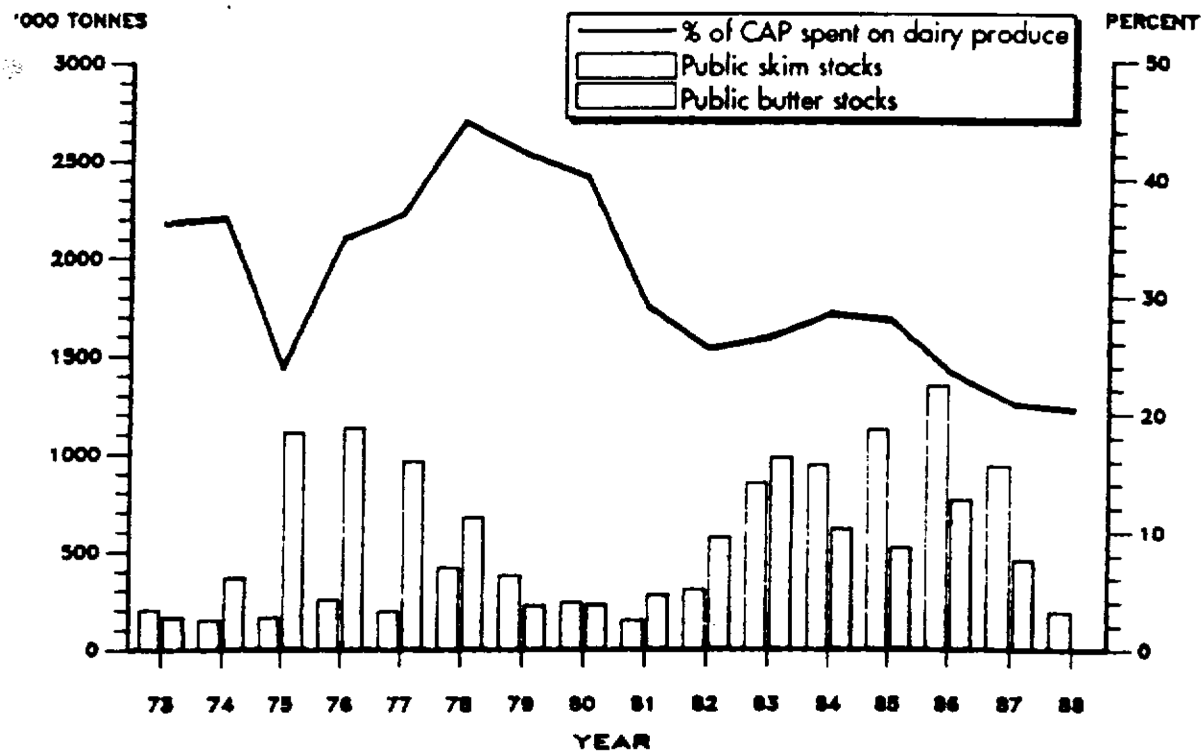
In terms of the GDP of the European countries approximately 2% - 3% of the GDP is transferred from consumers to producers. This is the equivalent to about 200 ECU per person, about $NZ400, or about 1,000 ECU per family, ie. $NZ2,000 per family. It is likely to continue in the foreseeable future as the farmers have considerable political pressure in the Community.

However, the voice of the consumer groups is increasing, and is likely to lead to greater targeting of assistance to the agricultural sector. A trend of support being paid on a stock numbers basis with limits to the support given to farmers carrying large numbers of stock is likely.

Changes to European agricultural policies in the late 1980s to reduce the cost of the food disposal were largely brought about by inability to balance the European budget. These schemes, including the milk quota scheme and the stabilizers for cereals, were adopted by the Community as the cost of the CAP was unsustainable at that stage. The pressure on funds in Europe is still considerable as there are many social objectives outside the agricultural arena for which funding is being sought. A reduction of farm support would allow greater channelling of these funds into social structural projects and are an integral part of the European Community policy.

It is likely that the Community will see the present GATT round negotiations as a chance to further reduce agricultural production in Europe and hence its costs on the European population. The Gatt round provides an opportunity to reduce support by international agreement , rather than unilaterally. It may be politically easier for the European politicians to blame international pressure for reductions in support , than to be forced to make cuts for budgetary reasons.

Figure 1. Stocks in EC public storage and the proportion of CAP taken by support for milk and its products.(From MMB 1989).



Future Food Production

Reduced agricultural production is consistent with environmentally friendly agriculture through reduced stocking intensities , waste disposal requirements and fertilizer usage. Environmental legislation is generally popular as it pleases a green electorate , and often leads to savings in the CAP budget commodity disposal costs.

It was evident though, when travelling through the Community, that farmers were not keen to reduce the intensity of their farming systems. They felt that the reduced commodity prices being received in recent times forced them to intensify their operation to maintain profitability, rather than to farm in a more environmentally friendly manner. Farmers are seeking state assistance for environmental measures .

There is questioning as to the future requirements of food production in the world. Some experts argue global climate warming, will mean that the food producing resource in Europe will ultimately be needed. New technology may lead to a large increase in agricultural production in the world, but many are sceptical pointing out that genetic engineering, for example, in the 1980s has not made the breakthroughs predicted.

Technologies developed in the future may not be acceptable to the consumers, regardless of their scientific safety . The dairy cow BST debate illustrates the power of the consumer in ultimately accepting technology. My impressions on this issue were that BST is unlikely to be accepted in the EC, regardless of scientific evidence..

The situation in Eastern Europe , is more certain and the political changes that have taken place are going to lead to a change in agricultural production on the world scene. The flow of western technology into agricultural production systems in Eastern Europe was already evident . The potential for markedly increased efficiency and output is clear. Furthermore, free market changes to the economy has meant a marked rise in food prices and already consumption in some countries, has fallen and more produce has been put onto the world markets. Much of the additional production is likely to be exported rather than be consumed internally, as foreign exchange is urgently needed.

Uruguay GATT Negotiations

Changes to the common agricultural policy are likely to be influenced by a number of factors through the 1990s. The most immediate of these is the prolonged Uruguay GATT round. The disposal of European food surpluses onto world markets at prices substantially below their cost of production, is clearly not acceptable to many nations. The pressure being exerted by the American Government and by the Cairns Group is being felt in Europe and is likely to lead to some concessions being granted.

The European Community pledged in the Treaty of Rome in 1957 in its commercial policy, article 110, that it will assist world trade "by establishing a customs union between themselves member states aimed to contribute, in the common interest, to the harmonious development of world trade, the progressive abolition of restrictions on international trade and the lowering of custom barriers. The common commercial policies shall take into account the favourable effect which the abolition of customs duties between member states may have on the increase in the competitive strength and undertakings in those states."

The decision was made in May 1986 to include agriculture in the current Uruguay GATT round. The high costs of agricultural policies were recognized by both the United States and the EC .

The Uruguay GATT round provides a great opportunity for the EC to reform its CAP and to meet Article 110's objectives to a greater degree. Politically it will be easier for politicians to use the Uruguay GATT round to change the CAP than unilaterally in the future or to be forced into major changes through budgetary problems over the next decade.

The European politicians, however, have considerable pressure being placed on them from the farmers within their own countries and therefore are not likely to yield major concessions easily.

The European Community has promoted the concept of aggregate measure of support as a basis for negotiation at this round. This proposal is that support given by Governments to producers be added overall commodities and compared and that a reduction in support when negotiated should be on the basis of the total support to the Industry rather than individual products. In 1991 it was calculated that the producer subsidy equivalent (PSE) for the European Community was 69%, USA 58%, Australia 36%, Japan 88% and New Zealand 2%. The EC contends from these figures that their support is not greatly in excess of other countries, and in fact compares well with other countries such as Japan. While it is likely that some liberalization of world trade will result this round , the European position at this stage ,is that changes will not be comprehensive or major. Changes are likely to be along the lines of an agreement of freezing of existing support and coupled with a reduction over perhaps a 10 year period. The intense domestic politics of member countries in the EC make it difficult for European Ministers to all agree on negotiating positions.

There is general agreement that changes are needed in the Common Agricultural Policy to meet its social objectives within the budgetary constraints. With 80% of expenditure going in income support many are asking whether this is an effective use of such resource to achieve the aims of rural policy. One possible answer is to have an income payment as support rather than to offer high food agricultural production prices. This approach while being acceptable in some countries of the European Community is not liked by other groups as it makes farmers appear to be social welfare beneficiaries rather than competitive producers.

It is heartening to see that European farmers appreciate that over production is not in their interests. Quite clearly they would prefer to regulate the supply of food rather than to accept lower prices. There have been many studies on the effect of over production on world market prices. While the effect in terms of absolute values will vary widely from product to product from time to time, quite clearly the effects are major and are recognized by the EC as a cost which must be faced. The Budgetary costs of present policies are such that the EC is most likely to change production quotas and the nature of the CAP to gain greater value from their Community Budget.

The trend of targeting support payments to the smaller farmers in Europe by limiting support payments to a certain number of stock, or to those farming in more disadvantaged farming regions is likely to continue.

DAIRY PRODUCTION AND MILK QUOTAS

The Introduction of Milk Quotas

In the early 1980s it was evident that under the CAP milk production was significantly above EC requirements and milk product stock piles were growing at an alarming rate. In 1984 milk quotas were introduced. A quota based on national production was given to each country in the EC.

The volumes were based on the production from the 1981 year. Some countries which had a relatively poor season in 1981 have felt that they had unrealistically low quotas. The Republic of Ireland has often lobbied to have its quota reassessed because it was based on production which was below other years .

Initially quotas were reduced to 5% below production levels in this base year. Each country had a choice whether to apply the quota by farms or by the Dairy Industry. In the UK and Wales the Milk Marketing Board adopts an overall quota position and farmers can under produce or over produce within this framework, and providing the total production does not exceed the quota there is no penalty on the farmers.

Other differences in the UK are that it is transferable and the quota can be sold quite separately from the farm land. The market price for milk quota is approximately 30 - 40 pence per litre, which is about twice the price of milk currently being offered in the UK. The sale of quota between farmers is not regulated by Governments. Farmers trade quota at their own risk, and accept variations in its market value. Farmers who believe that quotas will be phased out in long term would argue that investment in quota is not necessarily a sound one.

Quotas have been reduced through the 1980s and in 1991 were approximately 15% below the levels of 1981. The world has seen substantial benefits from this in that the large stockpiles of butter evident in 1988 year have largely gone from Europe. Currently production is again running at higher levels than demand for dairy products. This is a major concern as there do not appear to be export markets available, particularly in Eastern Europe, to take the surpluses being generated.

Extra production in the present season is a consequence of a 1% increase in quota given out recently. This quota was intended to assist new entrants to come into the Industry, and for farmers entitled to enter dairying after being out for a six year as part of a retirement scheme initiated in the 1983 year.

There seems little alternative that in the coming season a further reduction in quota will be required if milk production and consumption is to be kept in balance. Farmers are expecting quota cuts and to receive lower prices for milk.

Farming with Quotas

There has been much hardship and uncertainty and some producers have left the industry. Quotas have imposed a whole set of management problems for farmers to deal with. These include the control of output, quota purchase and lease decisions, seasonality concerns and how to influence milk quality at different times of the year. Producers have coped reasonably well with these requirements and now accept that managing the farm to a quota is part of their business enterprise. It is predicted that in the long term there will be a continuation of the decline in number of milk producers and a corresponding growth in both herd size from the average 57 cows now in the United Kingdom, and an increase in yield per cow over the 5,000 litres per cow currently given.

The Alternatives to Quotas

Farmers are keen to have quotas rather than accept dramatic reductions in the price for milk to reduce the quantity of production. It has been estimated that a 20% - 30% drop in milk prices would be required to reduce production down to levels that would equate with demand for dairy products in Europe. This would be unacceptable to the farmers and therefore politically not a practical solution.

The evidence suggesting that quota will remain in some form is that they are the only measure which has effectively halted the previous strong upward trend in milk supply. Earlier schemes tried before the quotas were imposed, included the non-marketing premium scheme which required producers who opted for it to give up supply of milk and milk products, and not allow any of the land to be used for dairy purposes for a period of five years. They also had to dispose of their dairy herds, either by slaughter or export outside the EC, and in return were compensated by varying amounts according to the amount of milk given up.

Another scheme also launched in May 1977 was the dairy herd diversion scheme, requiring producers to switch from dairying to keeping cattle and sheep for meat production for a period of four years. These schemes never really worked and therefore it is unlikely that similar voluntary schemes could replace milk quotas in the present European environment.

Another early attempt in September 1977, a co-responsibility scheme, which basically was designed to make producers contribute to the cost of managing the disposal of dairy produce stocks. While this levy generated funds for market development and disposal costs, it had little impact on production levels in practise which were the root of the problem.

The Future Shape of Quotas

Milk quotas remain in their present form until at least March 1992. The quota scheme is under review (MMB 1989), to decide on changes to be made beyond that date, although it seems almost certain that the majority of farmers would like to see the scheme to remain in its near to present form.

The launch of the single European market in 1992 could have an impact on quotas. It could be argued that this concept does not sit easily with the restrictions imposed by national quota systems. It could be argued that they go against the principles of free movement of goods and services, which is one of the basic aims of the Treaty of Rome.

It is suggested that quotas should be made more freely transferable in order to facilitate structural development, but the value attached to them should be eroded. The UK farmers representatives putting this view forward, clearly stated that they want quotas detached from land. However, the EC Agricultural Commissioner seems keen to retain the link of the quota with the land.

Those arguing for a free market situation with quotas tradeable across national boundaries, argue that this will rationalize the dairy industry more efficiently in Europe. The weakness in this approach, however, is that it overlooks the rural welfare objective of the EC policy and if these did not exist European production could be controlled quite easily through lower world prices.

A more likely scenario is that quotas will be controlled within each country, by producer groups such as the Marketing Boards. They would retain national and regional boundaries but would aim to provide quota for new entrants and restrict movement of quotas should this be deemed necessary. Transfers could be carried out more effectively under such a scheme by breaking the link between quota and land and substituting either centralized quota exchange or sales by private treaty.

This exchange should be administered by a special quota authority and could operate a tendering system which could include a facility to syphon off part of all transfers to create a reserve pool for new entrants and perhaps make transfers within family or landlord exempt. It could also require that all those who under produce in the year sell off their surplus quota and could ensure that those who purchase quota meet rules of eligibility. The number of these restrictions put upon the market, would both influence the price of quota to determine the balance between social and economic forces.

This scheme addresses the problem of new entrants. It is very difficult for new entrants to afford the price of land, stock and quotas. It is therefore currently considered that quotas provide a barrier to new entrants to the dairy industry. This is of major concern to many farmers and something which will have to be addressed in the near future.

Others argue that the best system for quotas is one where they have no value at all. A central authority would withdraw quota from those not using it and reallocate it to those deserving cases. This approach obviously puts heavier weight on social objectives, an important part of the EC policy, but presents the quota authority with a very difficult task of deciding amongst the merits of the many applicants. It could in the longer run lead to a higher cost industry than where quotas are transferred by market forces.

An entirely new approach supported by the Dutch, would be to have a two tier system similar to that used in the sugar industry. Production up to a quota value would earn the full target price for milk and after that any production would only get paid at the world market price. A variable levy scheme could be applied where production to a certain production over the quota would receive perhaps 50% levy on the target price, above this level a full levy rate would be payable. Many variations along these ideas have been put forward and have the attraction of not costing nearly as much, as the levies from the higher production would tend to fund the scheme. The disadvantage of these schemes, however, is that they would allow marginal production on the back of subsidised within quota production. This would tend to raise the total of product produced, which in turn must weaken the world market and increase the amount of domestic subsidy. Potentially they are seen as more complex than the existing scheme.

The EC Commission is sorting through the many ideas along these lines to try and sort out a workable solution in the near future.

Issues Influencing EC Quotas Policy Decisions
Declining milk consumption
The Commission must take into account a number of other factors when considering the future of quotas, particularly since the production and consumption of milk are likely to change through the 1990s. Milk consumption is continuing to decline in the UK particularly as health conscious consumers cut back on their intake of saturated fats. Low fat milk now accounts for about 30% of the UK liquid market, which means less wholemilk is being used for cream production. Butter consumption is still falling, as the dairy spread market grows and cheese shows only a small growth. Unless other outlets can be found and maintained for EC dairy products, the surplus problem is likely to remain in the future decade.

In the UK there have been recent publicity given to listeria and salmonella scares. Listeria was particularly associated with yoghurts and soft cheeses and has been a major setback to consumption.

The New Technologies

There are a number of factors influencing production on dairy units. New technology is likely to have a major influence in the near future. A great deal of recent public interest has be shown in BST. BST has been shown to have potential for increasing milk output at key times, e.g. in the summer period or towards the end of the quota area and it may reduce production costs. Embryo transfer and multiplication is being developed, and could have very wide reaching effects on the structure of dairying. They could also have unfavourable effects on consumption.

The Greening of Society

The last few years has seen a significant rise in the popularity of the Green Movement, which now holds several seats and considerable power in the European Parliament. This group has made the general public very aware of environmental issues and has promoted the idea of a return to more natural means of farming. BST has been criticised both in terms of animal welfare and from a natural produce point of view. Consumers are being more and more vocal in demanding food which is free from bacteria and additives and has been produced using methods which show concern for livestock and the environment.

Opposition to BST produced milk seemed to me to be growing in Europe and it was quite apparent that consumers desires were not necessarily based on hard scientific evidence. There is still questions about BST affecting cows reproduction and it would appear unlikely that the industry will adopt this technology.

Contamination of milk with lead and the problems discussed later with nitrates and pesticides in water courses, are further problems stacked against the Dairy Industry and milk product consumption. It seems certain that the EC structural and environmental policies, alternative enterprises, and schemes such as set aside where the land is retired will have a significant impact on dairying in the future, perhaps with more land being retired from dairying, but with greater production from larger units compensating.

One of the most important features on the UK and the European milk markets is the quick reaction of companies to the desire from consumers for a wide range of products. These products generally have added value to the raw milk as well as provided for healthier eating habits. It is likely that they will in part, assist in keeping consumption of milk products at a high level.

EUROPEAN AGRICULTURAL ISSUES

From the commencement of my study tour in London, a number of issues dominated discussions with agricultural policy organisations and farmers. Some of these issues are briefly reviewed in this section.

The Environment

Farmers, officials from the Ministry of Agriculture, Fisheries and Food (MAFF) and the National Farmers' Union (NFU) all emphasised the acute public awareness of environmental issues.Farmers have a new role as guardians of the land. They were now obliged to farm in an environmentally friendly manner, that would ensure the nature of the countryside was preserved for future generations.

UK farmers are farming in a very green environment. The high population density of the UK and extensive media coverage of environmental issues make farmers very aware of thé wider community expectations of farming methods and food quality. Food is no longer in short supply, and competition between supermarket chains for market share is frequently on the basis of perceived quality.

Control of Pesticide and Insecticide Use

In the UK new regulations are in place, requiring compulsory certification of farmers and spraying contractors. Many farmers are employing consultants to plan spray programmes as they are very concerned at the potential for accidental damage to neighbouring farms and residential areas. There are serious legal consequences of environmental damage in the event of an incorrect spray decision. A large percentage of farms are in close contact with residential properties.

The Countryside as a Place to Live

The low profitability and return on capital invested was also a major issue with UK farmers. Urban investors and dwellers had forced land prices to comparatively high levels, with these levels bearing little relationship to the lower commodity prices being received in recent times through commodity price cuts. There appeared to be little immediate relief from this trend of lower return to farmers as urban investment in rural land was still buoyant despite comparatively poor returns.

Surplus buildings on farms in the UK appeared to be in demand as holiday homes, retirement homes or for urban dwellers looking for a rural landscape. While this demand for surplus buildings has given farmers a source of revenue, it certainly adds to the price of land and hence the low return to capital invested in many farming operations.

The Preservation of The Traditional Agricultural Environment

A visit to the National Park in the Yorkshire Moors emphasised the potential environmental changes from intensification of agriculture. The desire is to preserve the traditional nature of many areas of English countryside.

Farmers are receiving assistance in order to voluntarily agree not to implement intensive farm practices which will materially change the traditional farming environment. The schemes appeared to be quite successful, although some farmers expressed frustration at having to farm in National Parks and felt at times that compensation was inadequate to allow them to farm freely in a traditional style, and farm with large numbers of recreational visitors.

Farmers and the their representatives, the NFU believed that they should be increasingly compensated for the role of land guardians. Politicians from all UK parties and particularly the European Parliament, generally support environmental legislation. The political reality is that environmental protection is popular with the voting community. Subsidies for UK farmers to meet standards for effluent disposal, nitrate ground water standards, and to reduce the intensification of agriculture make environmental legislation more palatable to the UK farmer.

Perception of Food Quality

Five supermarket chains sell 69% of the food in the UK and consequently many farmers are selling to one of these major chains, rather than to a local market or directly to consumers. One of the effects of the supermarket promoting and marketing produce as a healthy "green" commodity is to make the farmer a supplier of goods produced, according to the public perception of quality, and by desirable farming methods.

This change in market power can be seen in the egg industry. All the production from a producer is likely to be bought by the major supermarket chains rather than through local sales. Free range chicken eggs have been promoted and demand for the product has grown rapidly. The supermarket chains were demanding that farmers produced an ever increasing percentage of their production by this system, despite the fact that this method of production was more expensive, and there was not any evidence to suggest that the eggs produced were of any higher quality.

This example typifies something commonly seen, in that food quality was always an important issue, even more so than food cost. In fact, the high food price nature of the CAP does not appear to be major issue at all with the consuming public and the supermarket chains are more interested in promoting their produce on the basis of food quality and environmental health than straight value for money. The growth of the organic food market has been dramatic.

Food health scares such as the egg salmonella scare, mad cow disease in cattle, and listeria in cheeses attract immense public interest, and usually result in a drop in consumption of the product.

Research and Advisory Service Funding

Discussions with MAFF in London, included the user pay policies being put in place for farm advisory services, and for agricultural research funding. Farmers must now pay for their MAFF advisory services, unless the work fits into an exempt category such as environmental advisory work. MAFF officers have a greater regulatory role than their NZ counterparts approving government sponsored schemes and monitoring farm animal welfare and environmental requirements.

There are also recent changes in the funding for agricultural research. Research deemed to be near market, that is to say was likely to have an economic benefit within five years, would be on a user pay basis. Commercial funding of government research organisations has increased dramatically. Much of the government funded research in the UK has been moved into environmental areas as the Government has undertaken to fully fund this research.

The food surpluses in Europe provide a background situation that does not favour government funding of farm research to increase production. This is in contrast to the NZ situation where surplus primary production is a valuable export commodity. We should be wary in NZ in following UK trends of user pays as our economic base is dependent upon competitiveness in the agriculture sector.

Continental Agriculture and Production

A section of my tour took me into France, with visits to farms, and related industries . My perception of French agricultural was quite dramatically changed in that I had expected to see many small units and not to have seen such a healthy state in the agricultural sector. The state funded programmes in place to restructure farms in France are changing the traditional nature of farm units, with many younger farmers farming good sized holdings.

A visit to the Bress Bleu dairy company in Bourg en Bresse in Southern France was very interesting. Their soft cheese products commanded a very high price and cheeses were being exported to a number of countries, in spite of a comparatively short shelf life. There were six manufacturing sites and the company was already making big in-roads into Eastern European markets. A factory was under construction in Poland using very low cost Polish milk and air freighting the entire output to the Japanese market, capitalising on the growth potential of Asian food market.

This typified the flair of some of the progressive, established, European Companies, in that they were wasting little time in exploiting the opportunities of the opening up of the Eastern Block to the European Community. French and German companies were taking considerable advantage of the Eastern European opportunities and had successfully already undertaken a number of joint ventures.

Discussions with a Russian study tour colleague emphasised the changed attitudes by the Soviet Government towards co-operation with the West. My colleague was very keen on organising joint ventures with Companies and encouraging a sharing of technology to bring a rapid lift in Russian production.

Irish Dairying

The Republic of Ireland portion of my study tour included visits to the major grasslands research institution at Moorepark and visits to dairy farms in the Republic. They contrasted in that one farm was similar to New Zealand operations with approximately 70 cows, while the other in the South was a more traditional system with 30 cows and a very low cost system with much smaller returns. Farmers valued the CAP and high commodity prices and saw them as essential to maintaining their traditional farming methods and indeed felt that a lowering of commodity prices would severely undermine their community structures.

A visit to the Kerry Dairy Company in Southern Ireland was particularly interesting from the aspect of industry ownership, as this Company had previously been a Cooperative Dairy Company and had more recently been bought out by a newly formed public company (PLC).

The company management enthusiasm for the PLC contrasted with the views of a dairy farmer visited who felt a degree of mistrust with the perceived loss of control of the company, when the shares were sold to the PLC. New Zealand's single market seller position was envied by many farmers visited in Europe.

New Zealand's Clean and Green Image

My visit to the UK left me with the impression that there is a tremendous amount of goodwill towards New Zealand. The traditional ties are still important, with industry leaders in the UK seem prepared to accept a New Zealand presence in the British dairy food market. The high profile of the Anchor Butter in the UK is important for our continuing trade access, and for the continued promotion of the butter market. New Zealand's green unspoilt image, and the appreciation that our industry is largely free from subsidies is a strength in our trading position.

THE UK DAIRY FARM

Dairy farms in the United Kingdom are typical of those in Europe with cows being housed, each winter, for four to six months of the year. Even in the warmest southern parts of England, the climate is no warmer than in the very south of New Zealand. less than 1% of the cows in the UK are wintered outside. By EC Farm Standards the average U.K. herd size is large (Table 1.).

A large reserve of conserved feed is required for indoor winter feeding. This is typically about 10 tonnes per cow of silage, compared with about 1 tonne per cow required in a typical NZ wintering system. Approximately 1 tonne of the winter feed is likely to be a cereal based concentrate mix. Traditionally hay was the main winter feed but over the last 2 decades there has been widespread adoption of silage.

Stocking rates average under 2 cows per ha, typically using approximately 300 kg nitrogen /ha on grasslands.There typically was little contribution from clovers to pasture yields. Many farms would have an arable area, with regular grassland replacement by cultivation.

Straw is the most popular bedding in the wintering houses, with a cubicle system being the most popular housing method. Effluent from the wintering houses and dairy shed has to be stored until the weather is appropriate for it to be spread onto grasslands. The indoor housing systems tend to place stress on the feet and the udders and the average cow life expectancy is low by NZ standards.

Most milking sheds are herringbones (approx. 64%) with the remainder being mostly walkthroughs. There are very few bucket systems left (< 2%) compared with 20 years ago when they were the most common milking shed type (MMB 1989).

By NZ standards the farms are machinery and labour intensive, this being a reflection of the need to winter the cows indoors. Most farmers would employ labour often on a part time basis to help with the milking, and feeding and cleaning the wintering houses when they are being used. The silage making operations and effluent spreading can also be very machinery and labour intensive.

Table 1. Average herd size in EC countries. (From EEC Dairy Facts and Figures (1989).

Country	Number of Cows per Herd					
	1983	1984	1985	1986	1987	1988
Germany	14.9	15.1	15.3	16.0	15.9	na
France	16.8	18.4	19.8	19.9	20.0	20.8
Italy	7.2	na	9.1	9.1	9.7	na
Netherlands	41.3	42.3	40.8	41.5	39.8	39.2
Belgium	20.1	21.1	21.7	23.3	24.2	24.9
Luxembourg	27.4	29.3	29.7	30.8	31.2	na
United Kingdom	57.8	58.2	58.2	60.0	60.9	na
Irish Republic	17.8	na	19.9	na	20.9	na
Denmark	28.3	28.4	28.2	28.0	30.0	na
Total Nine[a]	16.7	na	18.6	na	18.6	na

Notes: a Average estimated size of herds (all cows) in Greece: 1983 - 3.1 head; 1985 and 1986 - 3.0 head; 1987 - 3.7 head.

Average estimated size of dairy herds in Spain and Portugal respectively: 1985 - 6.1 and 3.2 head; 1987 - 7.1 and 3.6 head.

Sources: EEC Census; MAFF; National statistics.

Dairy farms tend to be more diversified than in NZ with beef offspring often being reared. Cropping is common on many dairy units and is complimentary to the dairy operation.

The systems of land tenure varies from wholly owned properties (approx. 40%), to entirely rented (approx. 20%), with the remainder mainly being combinations of owned and rented land.

Dairy Herds

Production per cow is considerably higher in the UK than in NZ, presently averaging 5,500 litres of milk at a 4.3% fat test and 3.8% protein test. NZ production levels are approximately 3,200 litres of milk at a 4.72% fat test and 3.63% protein test.

Cows and herd replacements are considerably larger than NZ dairy stock with target liveweights for heifers in excess of 500kg at 24 months. The target liveweights housing and feeding regimes (Figure 2) are recommendations from the Hillsborough research station in Northern Island (Mayne 1988), and are typical of recommendations.

Cow herd size in the United Kingdom is large compared with Europe. In England and Wales the average herd size is presently 67 cows, and even these smaller herds are large compared with many in the rest of the EC community. There has been a decline in the number of dairy herds over the last decade, with an increase in herd size (MMB 1989). Figure 3 illustrates these trends.

The total number of dairy cows milked has not increased rapidly since 1984, when quotas were started. In order to meet lower quota levels and in response to lower milk prices there has been a reduction in the amount of concentrates being fed, down to an average of approximately 800 kg per cow presently. The introduction of quotas encouraged lower costs of production as profitability could be increased by lowering the costs of production rather than increasing total milk volume.

Dairy farm profitability has fluctuated widely over the last couple of decades. From the limited data published (Poole and Stock 1989) it is apparent that in real terms profitability slumped to a low in 1984 after the introduction of quotas, but has increased over the last decade as milk prices have been raised. (Figure 4). A breakdown of farm income and costs shows approximately 12% of income comes from calf sales. The major cost of purchased concentrates typically equates to approximately 20% of farm income (Table 2.).

Figure 2. **The Hillsborough replacement dairy stock rearing system for spring-born calves. Target animal liveweights, required weight gains, and feed and housing system systems are shown (From Milk Production - Mayne 1988).**

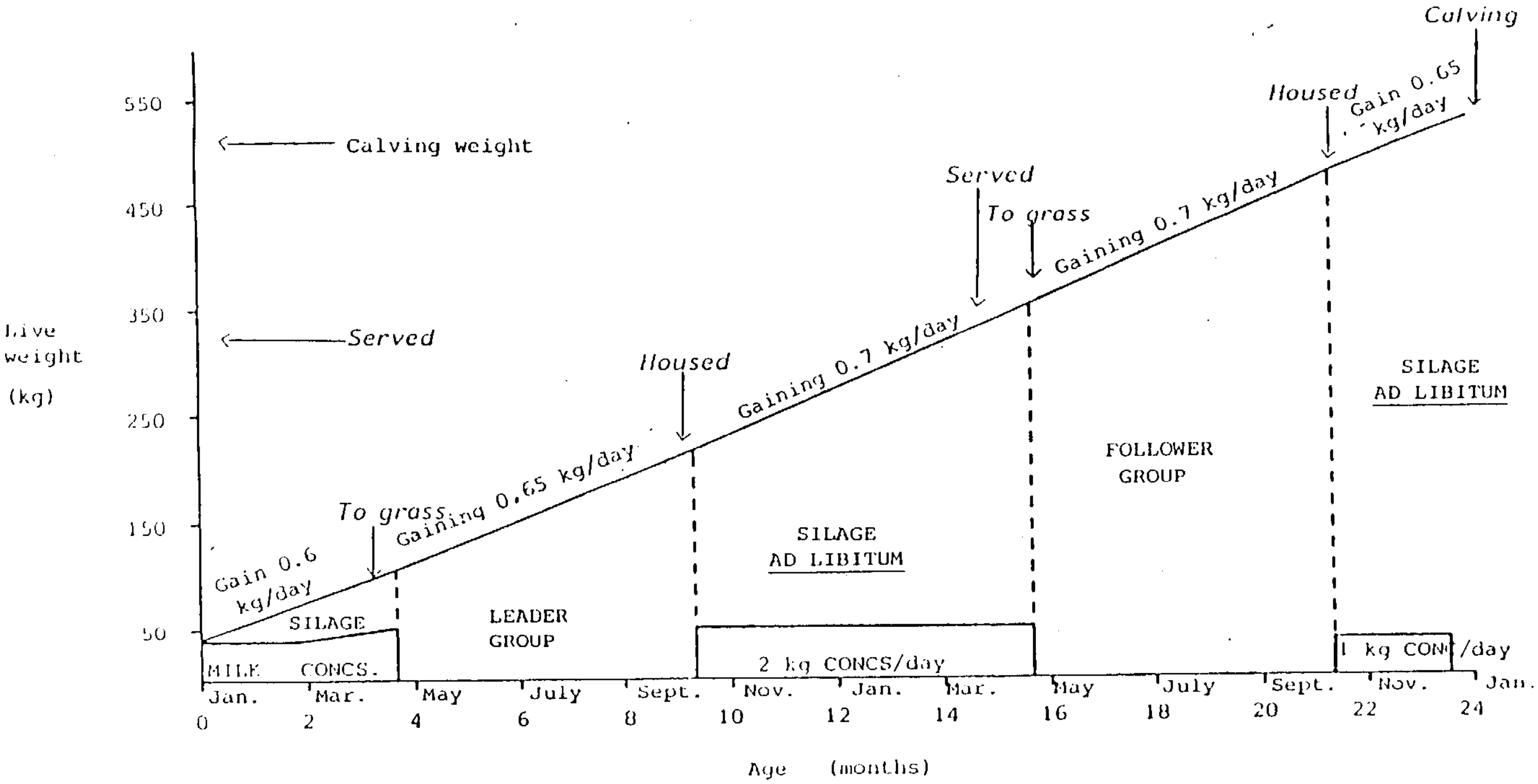


Figure 3. **Changes in the number of dairy farmers, herd size and dairy cow numbers in England and Wales, between 1973 and 1989. (From MMB 1989).**

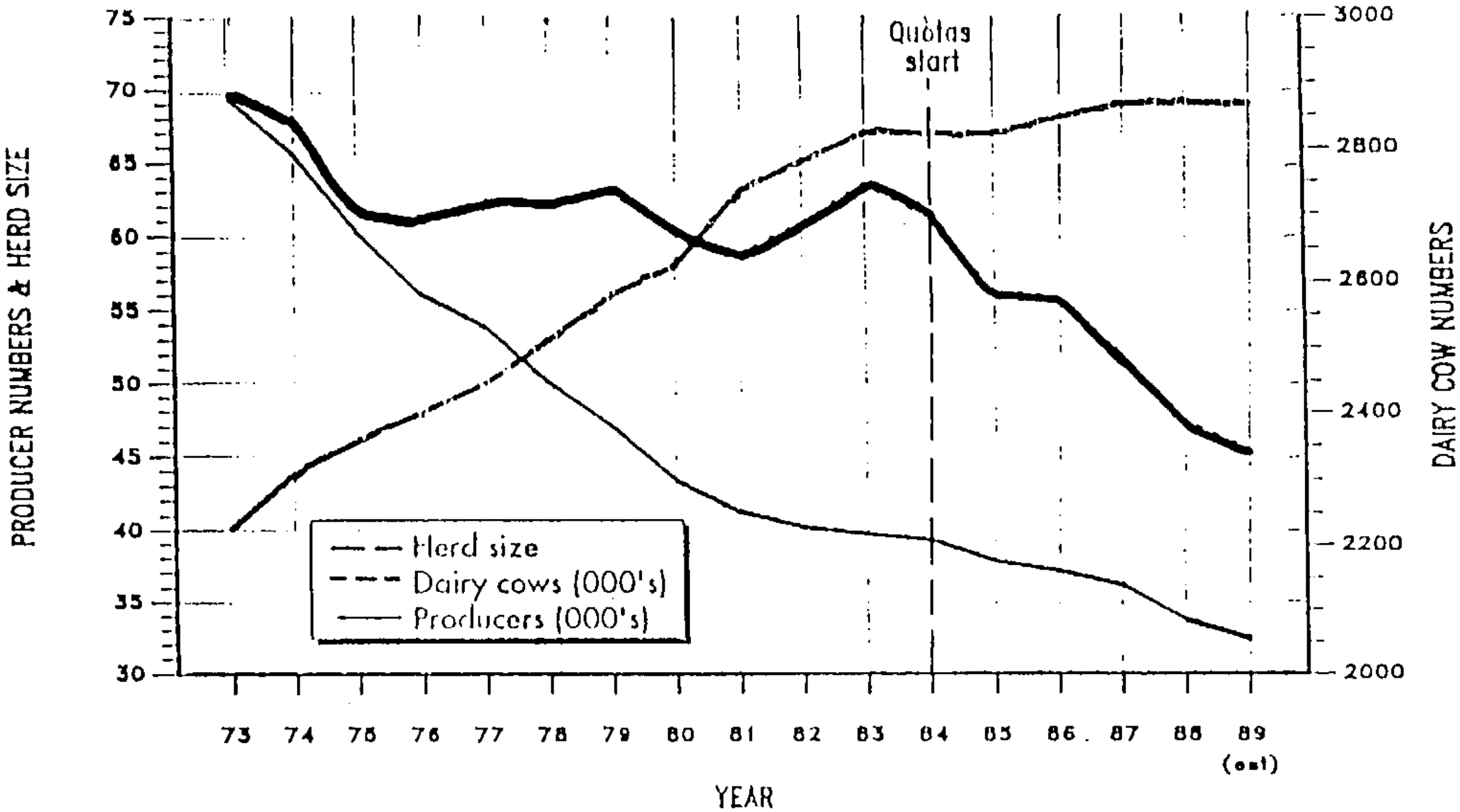


Figure 4. Indices of net margin in real terms (base year 1970/71 - 1974/75), for dairy farming in England and Wales. (From MMB 1989).

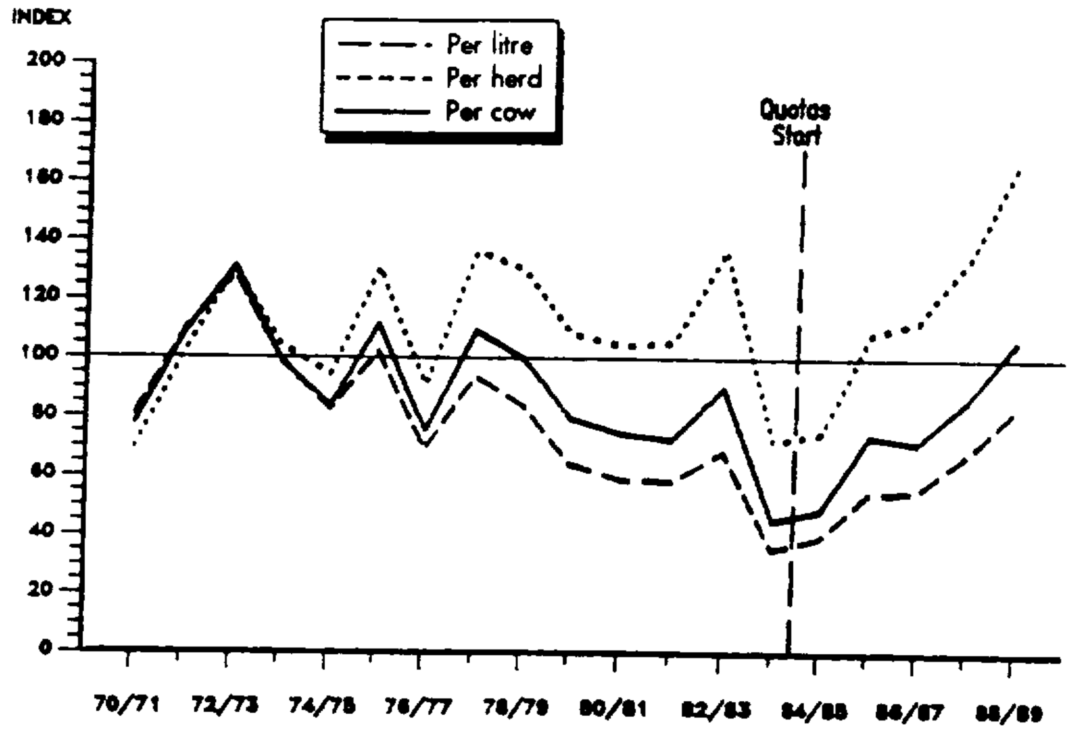


TABLE 2. Estimated Costs and Returns of Milk Production in England and Wales, in terms of per litre milk produced and per milking cow. (From MMB 1989b).

ITEM	1986-7	1987-8	1988-9
		pence per litre	
OUTPUT:			
Milk returns	15.91	16.40	17.53
plus calf returns	1.44	1.85	2.42
less herd maintenance	-0.69	-0.58	-0.54
less quota adjustment	-0.24	.....	.....
equals **Gross Livestock Output**	**16.42**	**17.67**	**19.41**
VARIABLE COSTS:			
Home grown feed	1.62	1.55	1.58
Purchased feed	3.85	3.58	3.82
Miscellaneous	0.87	0.92	0.97
Total	**6.34**	**6.05**	**6.37**
GROSS MARGIN	**10.08**	**11.62**	**13.04**
FIXED COSTS:			
Labour	3.09	3.36	3.48
Others	3.70	4.03	4.25
Total	**6.79**	**7.39**	**7.73**
NET MARGIN	**3.29**	**4.23**	**5.31**
		£ per cow	
OUTPUT:			
Milk returns	834	842	907
plus calf returns	75	95	125
less herd maintenance	-36	-30	-28
less quota adjustment	-12	....	....
equals **Gross Livestock Output**	**861**	**907**	**1,004**
VARIABLE COSTS:			
Home grown feed	85	80	82
Purchased feed	202	184	197
Miscellaneous	46	47	50
Total	**333**	**311**	**329**
GROSS MARGIN	**528**	**596**	**675**
FIXED COSTS:			
Labour	162	173	180
Others	194	207	220
Total	**356**	**380**	**400**
NET MARGIN	**172**	**216**	**275**
Average herd size *(cows)*	70	69	70
Average yield per cow *(litres)*	5,239	5,136	5,172

GRASSLAND MANAGEMENT

The importance of the silage harvest

Dairy herds are kept indoors over the winter period, and turned out onto the pasture in early spring, as soon as grass growth is adequate. Pasture management is planned to feed the stock through to spring, summer and autumn and allows sufficient supplements to be conserved for winter requirements for indoor feeding.

The supplements required typically range from 8 - 11 tonnes silage per cow, which is around 10 times the typical NZ cow winter requirements. The large winter conserved feed requirement has a major influence on grazing principles. Heaviest crops of silage are taken from early spring growth and a large percentage of the farm is devoted to silage making over this period. These first cut silage areas will often not be grazed prior to being shut for silage.

Second and third silage crops are often taken from the same areas, but with a reduced percentage on the farm as the cow requirements are greater in relation to growth over this period, and much of the farm is needed to meet their grazing requirements. By late autumn time the cows will be typically be grazing the whole of the farm area and all supplements will have been conserved ready for the indoor wintering period.

Grazing systems

Grazing systems can be broadly be divided into continuous set stocking grazing, and rotational grazing. Continuous grazing is defined, that cows have access to one large area of grass; or two or three small areas, and none of the areas are left ungrazed for more than a few days. In contrast rotational grazing generally refers to cows strip grazing large paddocks or fields. Cows graze each new area for 1 - 7 days, then it is allowed to regrow ungrazed for two weeks or more.

The differences in practice between these grazing method is somewhat less marked, as often farmers mix both continuous grazing and set stocking using a mob stocking approach.

Often cows would be in a set area for several days before being moved on to another area. Mob stocking is probably the most popular grazing regime in the UK as few farmers generally set stock over the whole farm every day. It also allows farmers to choose particular areas of the farm for either day or night paddocks, or farm areas that are divided by roads or other boundaries. Stock continuous graze each area of the farm before moving onto the next section of the farm.

Autumn or Spring Calving Systems

Another variation in grazing management occurs between spring and autumn calving herds. The majority of the herds in the UK calve in the autumn, and then are wintered indoors and finish the season on pastures over spring and summer, before being dried off. Spring calvers on the other hand calve near to the turn out time in February or March.

Calving time affects grazing management, in that spring calving cows will be offered more grass than autumn calving cows over the spring/summer period. However, the autumn calving cows require greater silage reserves, as these cows are in the peak of their lactation period while indoors. The concentrate feeding would generally also be higher in the autumn calved situation as concentrates are essential to maintain high milk yields while being housed indoors.

High milk prices tend to favour the autumn calving system as cows can consume high levels of concentrates profitably and achieve high levels of production while the cows are being housed.

Farmers aiming to minimise concentrate feeding will tend to opt for a spring calving situation so they can maximise utilisation of pasture and only feed maintenance requirements for some of the winter housing period.

Summer Calving

A new challenge currently under research in the UK is that of summer calving in July. The Milk Marketing Board is trying to encourage the supply of July milk and is offering a premium for milk at this time of the year. Research is under way to see how pastures can best be prepared by hard grazing in the spring period so that summer calved cows are offered highly nutritious leafy material to milk on.

The intensity of spring grazing in these situations with dry cows is something rarely seen in New Zealand outside sheep pastures. It certainly demonstrated that very hard grazing on a continuous graze basis can produce the dense leafy sward in the late spring/summer period.

THE ADAS GRASSLAND MANAGEMENT SYSTEM

The MAFF Advisory Service Section, ADAS, have put together a comprehensive grassland management system with recommendations for grazing management in the UK. The system is based around measurements of grass height and recommendations are given accordingly for either continuous or rotational grazing systems.

The Grazing Calender and Sward Ruler

Farmers are provided with an action calendar which provides monthly recommendations. They are also provided with a field recording notebook and a sward measurement rule so that pasture height can be measured in each paddock.

The grass ruler is used by sliding your finger down the ruler until you touch the first blade of grass, and reading off the grass height at this point. By pacing across the field and taking regular measurements a field can be categorised according to average pasture height.

For continuous grazing systems the height recommendations are given and farmers manage pastures to achieve this height by either excluding areas of pasture when the grass is too long, or increasing the area on offer to the cows when pasture height is getting down to a critical level. This is called "buffer fencing" and often means moving an electric fence or portable fence up or down the paddock to achieve the optimum grazing level.

For rotational grazing systems recommendations are given on residual grasses left after grazing.

Research Background for the Recommendations

These recommendations are based on research at Hurley (Hodgson 1986) on optimum heights of grass cover at the various times of the year. Figure 5 shows how the total production from grass varies according to the height of pasture under continuous graze sward. An important point here is that even though the total amount grown increases up to 30,000 kg dry matter over a very long sward, the amount wasted increases dramatically if the sward height is not kept at a relatively low 6 - 8 cm height.

While utilisation is similar over this 4 - 10 cm period, milk production per cow is higher at 8 - 10 cm (Figure 6). This work is based on Hodgsen's and others work on spring calvers over a whole season.

Figure 5. The effect of pasture sward height on the amount of pasture eaten and on pasture wasted. (From Hodgson et al., based on spring calving cows).

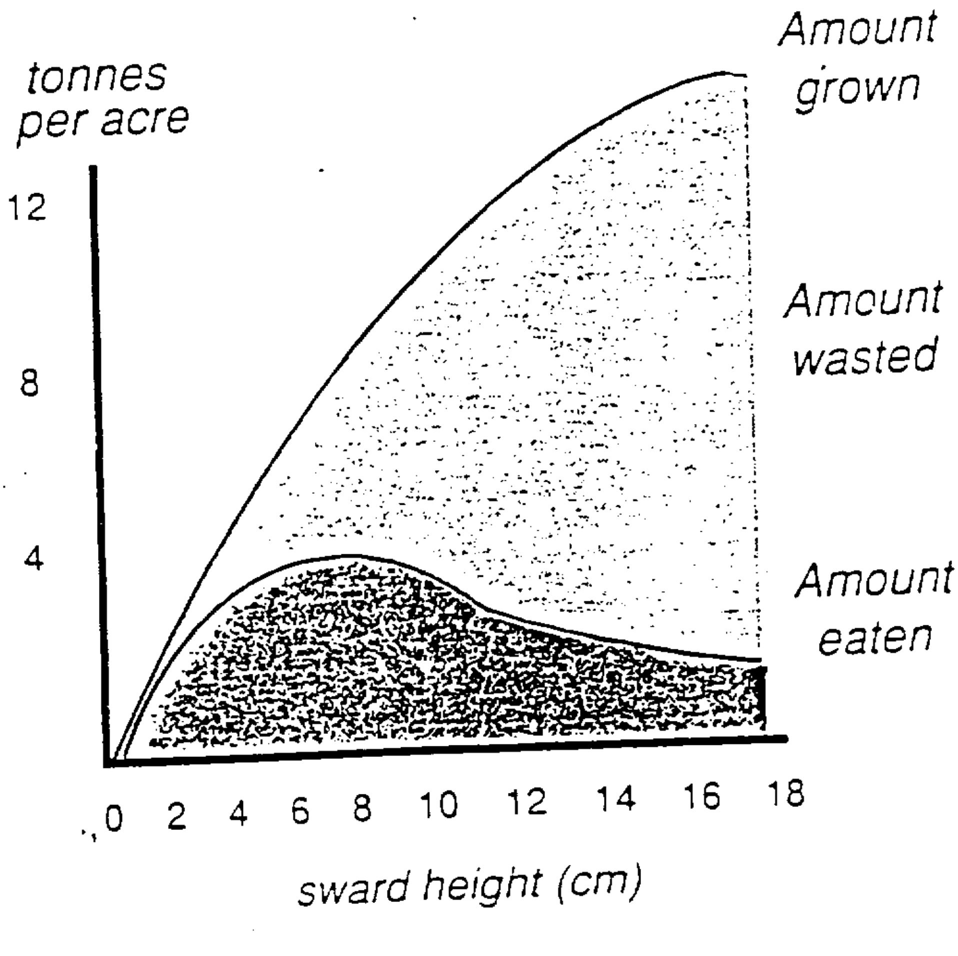
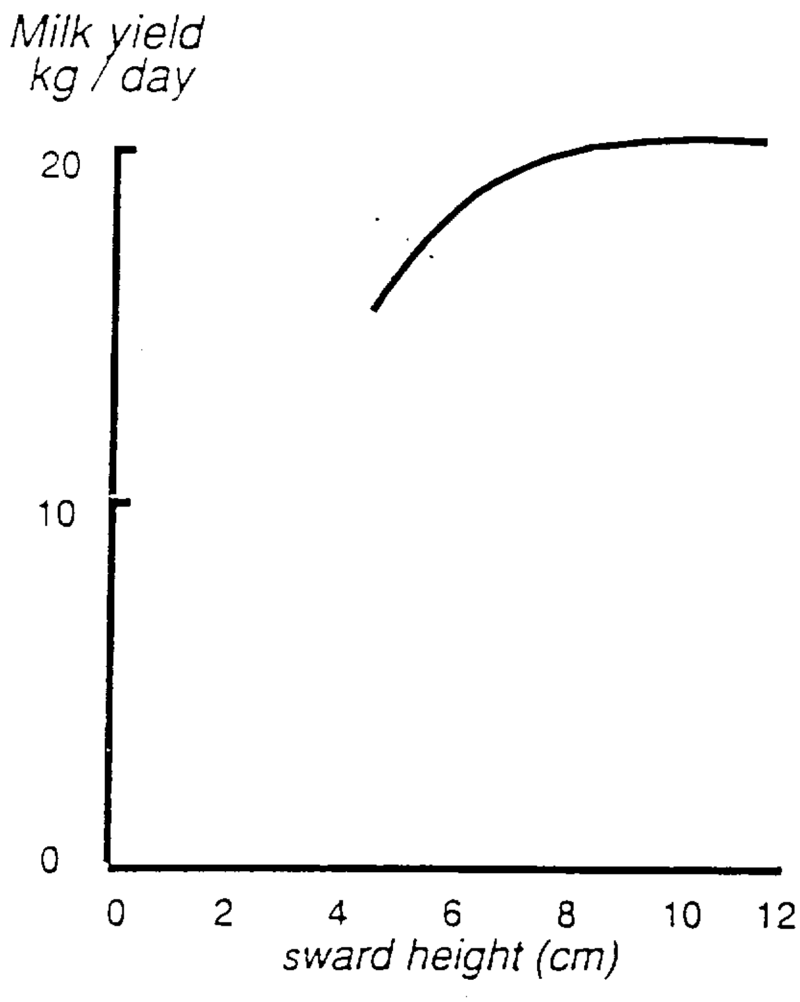


Figure 6. The effect of pasture sward height on the milk yield per day. (From Hodgson et al., based on spring calving cows over the whole season).



These graphs emphasise that grass leaves have a limited life, often only about 30 days, and will die if not consumed by cows. The leaf turnover is not particularly visible, as leaves can decay quickly and disappear. Grass height must be controlled, if pasture is to be efficiently utilised.

The recommendation is that although under continuous grazing the maximum amount of grass per acre available for utilisation occurs at a 6 cm grazing height, the greatest milk production per cow is at an 8 - 10 cm grazing height. The recommendation is to keep the grass between 6 and 9 cm over the main grazing season. While this is much shorter than most people are used to, research would indicate that the longer grass would not give any higher milk production.

The importance of regularly measuring the sward height is emphasised. Adjustments can then be made to the grazing area by closing up paddocks or parts of fields with electric fencing. In a good year grass stored up, can either be taken as a bonus cut of silage, or if growth slows can be grazed. The recommendations suggest that estimating grass height by eye is not accurate enough, and that the farmer should use the ADAS thumb stick.

The benefits from this system are that the farmer has an efficient grazing system with minimum waste and is able to make an adequate amount of good silage. He should also be able to minimise his use of concentrates. Summer production should be enhanced by keeping a leafy sward. A dense leafy sward will last longer into a dry summer period.

Nitrogen Fertiliser Requirements

Nitrogen is an integral part of the grazing system. The optimum application of N on grazing fields varies between sites and depends on soil available water capacity and rainfall. On most land used for dairy production the recommendation is for 300 - 350 units per acre. In dry years less nitrogen may be required and nitrogen use in later summer may not be justified.

On rotational grazing systems recommendations are that 40 units of N per acre be applied after each grazing, until in July when this should be reduced to 30 units per acre.

Nitrogen applications will begin around the middle of February in the warmer southern and westerly areas of the United Kingdom and in late February further up the north and on the colder eastern dairy areas. Fertiliser is applied on the basis that about 60% of the farm will be shut for silage and not be spring grazed at all. 25% will be allocated for grazing, with perhaps only 15% being used for either silage or grazing depending on the growth. This is the buffer grazing area.

Cows Turned Out in March/April

In March farmers would be looking at their sward height. Ideally recommendations are that you should turn out on to set stock sward at a height of 7 cm. At this time nitrogen fertiliser at 60 units of N per acre would be applied. Pasture height measurements during this month should be made once or twice a week and graphed to monitor changes in pasture height.

In the rotational graze situation, recommendations are that you should not turn out until you have got the longest paddock at 12 cm and the height is increasing rapidly. This would normally come in April when spring pasture growth really takes off. Stocking rates on grazed areas would be 3 - 4 cows per acre at this stage.

It is important in March to react quickly to the changing height and if in a continuous graze situation the sward height fell below possibly 6 cm, it is advised that you increase the grazing area. Conversely, if the height raised over 8 cm it is recommended that you bring an electric fence in and close up parts of the field.

For rotational grazed swards the first rotation recommendation is at a quick round of 8 - 12 days be used, but afterwards that a 16 - 18 day round be held for spring time. If residual height is 10 cm and paddocks are over 14 cm, then it is recommended that you take out more pasture on a rotational graze sward as this is a sign that grass growth is getting ahead of you.

Nitrogen applications of 50 - 60 units of N per acre would typically be applied through the spring months.

Target heights through May and June for rotational grazed swards are to leave a 7 - 9 cm residual sward with a 16 - 18 day round. Continuous grazed pastures should be held at 6 - 8 cm and for dry cows even tighter, around 5 cm. This intensive spring grazing is considered essential in order to maintain leafy pastures, largely free of stem material, and to allow a maximum area to be cut for silage.

Stocking rates may have to be lightened a little to 2.5 cows per acre, but this is only recommended if sward height falls below 6 cm or if you cannot maintain your 18 day round, or you are have to graze harder than a 7 cm residual height.

First Silage Cut in May

The first cut silage will normally be made in May. Recommendations are that pasture should be at 70% digestibility, to give a 67% - 68% digestible silage. Normally this would happen in the first six weeks after applying fertiliser and shutting up.

By June growth will be slowing as summer approaches, and stocking rates will typically be run at 2 cows per acre, with a much smaller area for silage. Rotational grazed stock would normally be at 18 - 21 day round leaving a 7 - 9 cm residual sward height. Continuous milkers will still be on leafy pasture 7 - 8 cm in length, or if cows were dry and continuously grazed, they will be grazing to approximately 5 cm. Second cut silage would be cut in June and there may also be buffer areas which could be cut and put in to silage at this stage.

Farms may also have higher stem areas and if this is the case by June, a decision would normally be made to cut them for silage or top them or to graze with dry stock to approximately 6 cm.

Longer Autumn Rotations

By July it is recommended that rotations be lengthened to 21 - 24 days, still with a 7 - 9 cm grazing residual height. Continuous grazed stock would still be grazing 7 - 9 cm, dry cows 5 - 7 cm. Buffer feeding is common at this time of the year with stock having access to silage, often at the cowshed to allow pasture to be left at an ideal growing height. A summer drought is likely to prevent a farmer from maintaining the ideal 7 cm residual height for milkers and therefore buffer grazing would be used in this instance. Silage is recommended for buffer feeding rather than concentrates, unless cows are newly calved.

Through the August/September autumn period rotational grazed stock would be on a 24 - 28 day round. Continuous grazed pasture would still be in the 7 - 9 cm range if grazed for milkers or 6 - 8 cm range if the cows were dry. Third and fourth silage crops would be taken. Fertiliser N would be reduced at this stage to minimise leaching losses and as the weather becomes wet in October/November, housing is recommended for all stock.

Winter Sheep Grazing

It is recommended in November that sheep be used to take the sward height down to 4 - 5 cm as early winter grazing by sheep is extra income at little or no cost and significant increases of sward density as well as reducing the winter kill from the cold temperatures.

Sheep would normally be removed by the start of February, as otherwise they are likely to reduce grass available for the main cow grazing season. Research has shown that grazing dairy paddocks by sheep up to early January had no effect on milk yield of cows in the following season Sheep grazing in the Autumn improved sward quality and this compensated for the lower yields of herbage available at turnout (Mayne and Newton 1986).

Management of Clover Based Systems

With high fertiliser nitrogen use on grassland swards, it is not surprising that clovers have a traditionally had a minor role in UK agriculture. Clover is usually included in grassland seed mixes at low rates, but typically rarely features in swards. It was interesting that some farm had much greater clover persistence than others despite high fertiliser nitrogen inputs. This effect appeared to relate to higher initial clover sowing rates, early management and planning of silage crop rotations.

Until recently most research in the UK was on predominantly grass swards in which clovers play a relatively minor role. There is now a lot of research looking at clover systems as an alternative to high nitrogen fertiliser usage. Government funding of environmental research has led to considerable research in this area as clover based pastures are seen as an alternative to high fertiliser N rates in areas where ground water pollution is a major environmental problem.

The concept of limited fertiliser N use with increased clover contributions in swards would be a sensible approach. At current nitrogen prices profitability is similar, with N fertiliser savings offsetting loss in grass yields in many instances.

There is considerable interest in management of NZ clover based swards. The level of adoption of this technology will be determined by the seriousness of the nitrate problem, and future nitrogen fertiliser prices.

It can be argued that a clover based system may favour rotational grazing as a management regime as the clover plant puts a greater percentage of its photosynthetic material into productive leaves rather than structural stems. This means that a greater spell between grazings should allow higher growth rates by allowing more intense canopy formation and interception of light. In contrast, it is speculated that grasses put a considerably greater percentage of their energy into the structural vertical leaf and stem and therefore do not benefit to the same extent from a more intensive dense canopy for light interception.

From the limited trial work , there would appear to be little difference in pasture growth with rotational or set stocking of clover based swards. The clover based trial swards in the UK are generally being set stocked with few apparent problems , and are achieving a high level of animal performance.

Rotational Grazing or Set Stocking

Often the question is asked as to which system gives the greater production. Reviews of the trials where set stock and rotational grazed pastures were compared (Ernst etal. 1980) suggest that there is no conclusive major advantageous of either grazing regime over the other. Irish research would tend to favour a small advantage to rotational grazing (MacCarthy 1988).

UK advisory services have not tried in the UK to encourage or promote one particular grazing method over the other, but have left it to each farmers preference. Often physical characteristics such as farm block size and typography have influenced the farmers' choice, although in the United Kingdom many farmers have followed prominent researchers and have adopted essentially a continuous graze system.

At the Trawsgoed Experimental Husbandry Farm in Wales, where there is an autumn calved herd and a spring calved herd, the decision was made to rotationally graze the spring calving herd, but set stock the autumn calving herd. The rationale was that rotational grazing system gave more control and therefore was used in the spring calving herd as this herd was at a crucial stage of its lactation. On the other hand, set stocking was preferred for the autumn calving herd as this herd was nearer the end of their lactation, and if there was mismanagement by the staff and the set stocking pressure was not maintained in the spring period any rough pastures had a minimal effect on the farms output.

The importance of intense spring grazing under both regimes was emphasised. The lower end of the recommendations for the grazing pasture height was preferred in order to maintain leafy pastures.

In other research institutions in the UK there seemed to be a clear preference for the set stocking regime. Researchers felt the farmers were keener to adopt this strategy. It was simple, required less outlay and left a denser pasture. There is good data to support the pasture density and where tiller measurements have been made set stock pasture frequently have twice the tiller density than rotationally grazed pastures. The greater tiller density under set stock pastures is a feature of the system which provides a tighter pasture compared with a more upright pasture with a greater stem component.

Another feature of the set stock system is that over the spring period when seed head formation is occurring at a very fast rate, set stock pastures were able to be kept under the ideal grazing height, but rotationally grazed pastures invariably had a range of heights on the farm at this time of the year. That is to say it was not possible to graze all rotational pastures at the optimum time and by the time some pastures were due to grazed, a large amount of stem had formed of lower palatability, making it less attractive for the stock to harvest.

This is a reason given for not having a long round over this period of rapid seed head formation in the spring time, as the longer the period of interval between grazings the greater the percentage of the farm that will not be grazed at the optimum time to keep the pasture in the leafy state.

Flexibility

Discussions on grazing management at The British Grasslands Conference field day on a very high producing dairy farm, lead to a conclusion among farmers that flexibility in grazing management was important for achieving high production. Mixes of continuous and rotational grazing were used and changes made according to the season and to the weather prevailing at the time. To truly ad lib feed cows in the spring, a continuous graze system was preferred, probably in the form a block grazing, giving the cows three to four days on an area before moving them on. This practise was common on farms in the area.

THE LESSON FOR NZ GRAZING MANAGEMENT

The principles outlined in the UK grazing strategies have basic similarities to those used in New Zealand. The need for close grazing in spring to maintain pasture quality is widely accepted, even if it is typically achieved by differing methods. Intensive set stocking or quicker spring grazing rotations will both assist in the maintenance of feed quality through the season.

Similarly later in the season the benefits of raising grazing heights and average farm cover, by reduced grazing pressures and longer spring rounds to exploit greater summer and autumn growth potential and to provide some high quality feed accumulation on paddocks in anticipation of periods of lower growth, are well accepted.

Pasture Growth Rates

There is no evidence to suggest set stocked pastures will grow at lower or higher rates than rotationally grazed pastures, where the pasture heights are maintained within appropriate limits. The comparatively small differences in total production between grazing management treatments in the Ruakura trial (Bryant 1991) supports this observation.

A trend of slightly higher spring production in frequently grazed treatments compared to traditionally grazed rotational grazing treatments (A. Bryant pers com.), supports the hypothesis that even well managed rotational grazing can restrict pasture on offer to a degree that insufficient herbage is available to maximise intake. The bank of feed building up in front of the herd may assist in building conservation reserves at the expense of cow intake.

Perhaps it is relevant to ponder the light hearted advice that I was offered in the UK, that "rotational grazing at a time when you were trying to maximise cow intake was controlled starvation." The highly nutritious set stock leafy pasture could encourage higher per cow intake under set stocking allowing the cows to milk to nearer their potential.

In the New Zealand context a period of set stocking or continuous grazing over the spring period, with higher intakes could lead to reduced feed conservation (A.Bryant pers com.), or over grazing in subsequent seasons in the absence of the provision of addition feed. In practice, a lower stocking rate system with higher production per cow and per ha, as a consequence of reducing total cow maintenance requirements, seems a logical development.

A fundamental component of the UK set stock system was the feed buffer system. Farmers moved the buffer fence according to pasture height. Buffer feeding in periods of feed deficit was also an option, to protect pasture from over grazing. A set stocking system in NZ without a buffer system runs a considerable danger of running outside the optimum grazing herbage availability levels. Over grazing could seriously reduce subsequent pasture growth. Deferred grazing may have a role as a buffer system.

Tiller Effects

Grass tiller studies at Hurley (Parsons and Penning 1988) has led researchers to conclude that longer spelling of pastures between defoliation does not necessarily give a greater total level of photosynthetic material available for consumption, as leaf will be lost at the expense of a greater stalk yield, but total photosynthetic output will not be increased.

Intensive continuous grazed system will mean that tillers that are flowering will be grazed at a younger stage and die at an early stage therefore allowing other tillers to come away in their place at an earlier stage (Hood 1974). A dense continuously grazed pasture with a higher tiller density will also have a greater number of tillers to take the space of those that die as a result of the flowering process.

Intensive spring grazing therefore, may effectively move the shape of the growth curve and provide high quality feed later in the season, rather than a heavy crop of stalk or material less suited to intensive livestock production at that time of the year. (Johnson and Parsons 1985; Orr et al. 1988). Unfortunately this Hurley work was carried out under sheep grazing of varying intensities, and therefore requires caution in the extrapolation to dairy cattle.

Work at Moorepark with rotationally grazed dairy cows examining the effects on of intensity of spring grazing on tiller behaviour (Carton etal. 1989a, Carton etal. 1989b) supports the hypothesis that a period of spring set stocking could improve pasture quality later in spring and summer.

A benefit of a period of set stocking of rotationally grazed dairy pastures is an increase in sward tiller density. This effect is frequently observed in the UK with winter sheep grazing, and was a feature of the recent Ruakura trial (A.Bryant pers com.). Milk production was increased in UK trials (Mayne and Newton 1988) in the following spring on the higher density pastures.

The importance of tiller density in intensive dairy systems was discussed at Moorepark in the Republic of Ireland. Considerable emphasis is placed on the maintenance of a leafy and densely tillered rotationally grazed pasture. Current research on the optimum residual height to graze pastures to support UK recommendations (Dillon and Stakelum 1988). An interesting observation was that pasture density was important to early season production. It appears that dense pastures gave greater production in the first couple of months of the milking season, but after this period pasture density had less affect on milk production.

A feature of the Ruakura trials of relevance to these observations was that changing to slower rotational grazing after a frequent grazing system of higher tiller density gave a rapid accumulation of pasture (A. Bryant pers com.). This assisted meeting winter feed requirements of the farmlet, where the change to rotational grazing occurred in late Autumn.

Little is known about critical pasture densities, and there limitation to pasture production. Given that tiller densities can take months to develop but can be reduced literally over night by winter damage, the importance of wintering systems that minimise pasture damage and tiller density reductions may be under estimated. The role of management strategies such as; set stocking, short rotations, 2 or 3 day blocks, increased use of off wintering, total removal of some stock for the winter to lighten winter stocking rates, and autumn fertiliser nitrogen, on tiller density and early spring production have not been well quantified.

A combination of the two grazing managements could be the optimum regime. Given the desirability of adlib feeding in spring, and the potential for set stocking to effectively control stem formation, the spring period would seem the logical period for set stocking. The important consideration of such a regime in the New Zealand situation, would be to ensure that the set stock period over the spring time was managed in a manner that gave sufficient flexibility to avoid over grazing or too lax a grazing should cow intake not matched the predicted growth rate over this period.

One of the possible additional benefits here could be a reduction in cow stress, particularly younger cows, as for much of the grazing interval there is abundant feed for all and any pasture control work is restricted to a comparatively small part of the total grazing time.

The Ruakura farmlet trial (Bryant 1991) results support the concept that frequency of defoliation will modify pasture structure and animal performance. Further work is needed to understand the behaviour of tillers, to construct a robust grazing regime for increased animal performance and low cost milk production.

UTILISED METABOLISABLE ENERGY (UME)

UME is defined as a ruminant's total annual requirement for metabolisable energy (ME) obtained from grass and grazing. A calculation of UME is commonly used in the UK to compare different systems of grassland management (Thomas and Young; Frame et. al. 1987) Dairy systems for milk production vary widely in the UK, requiring different inputs according to individual farm circumstances. In many systems grassland output and utilisation are important factors, but have to be related to concentrate use, stocking rate and milk output. The balance of these factors can be assessed on an individual farm by the calculation of UME.

The contribution of grass to animal production can not easily be measured directly. UME concept enables the grassland energy input to be quantified by an indirect calculation. It is simple and accurate provided the farm information is good. The method can deal with all classes of grazing ruminants and avoids the anomalies created by changes in cost and prices found in other analysis.

The system is of considerable use in the UK where large amounts of bought in concentrates are frequently used. This bought in feed makes it very difficult to assess the efficiency with which grassland has been utilised.

In the New Zealand context, there may be some place for a UME type measurement, as many farms at the higher end of the output of milkfat per hectare have feed bought in from runoffs, purchased feeds, such as Proliq, and in some cases meal. In addition, grazing off of young stock or dairy cows over the winter period makes an assessment of grassland productivity extremely difficult. The adoption of a UME type measurement would clearly help in these circumstances, to identify accurately the conversion efficiency of grassland to milk products.

An interesting application of the UME concept in the UK is the comparison of milk production from commercial farms, with that from the experimental situations. Experimental farms have UME outputs of over 120 GJ per ha and efficiencies of utilisation of over 90% being achieved on experimental farms. These farms are growing up to 12,000 kg of dry matter per ha, in a short growing season.

NZ Style Feed Budgeting

Farmers frequently discussed with me New Zealand's rotational grazing feed budgeting systems. There was considerable interest in the UK in feed budgeting. The use of pasture meters and assessments in kilograms of dry matter per hectare are a development which may be adopted in the near future by advisory services. They would compliment the height measurements currently used. The obvious advantage of the height system in use, is that assessments can be made without quantitative measurements, as any farmer walking through his paddocks can assess the length of pasture on his gumboots. While this method may not be the optimum way of monitoring the farm, at least the recommendations provided are of some use to all farmers in that they are very plain and simply presented.

PASTURE SPECIES

There is a multitude of species available for the UK. The correct species mix recommended would depend on the type of stock, whether or not he wants a permanent pasture and to what extent the pasture will be cut or grazed, or both, for hay or for silage. Clover nitrogen is also another choice now and will affect his seed mixture.

Perennial Rye Grass is unquestionably the most important grass to the UK farmer. It dominates seed mixtures used for reseeding with Italian rye grasses also being popular. There are over one hundred varieties of Perennial rye grasses available on the UK national list, compared with only nine varieties on the New Zealand market.

In the UK late and medium flowering types dominate seed usage compared with the New Zealand situation where the majority of Perennial rye grasses used are early flowering types, as these types have traditionally being considered to produce higher early spring yields.

Tetraploid ryegrasses

Tetraploid Perennial rye grasses are frequently included in seed mixtures in the United Kingdom. There is no Tetraploid Perennial rye grass currently available in New Zealand. The performance of the Tetraploids is impressive and they now account for about 30% of seed usage of medium and late perennials in the United Kingdom.

The main characteristics of Tetraploid rye grasses compared with normal Diploid varieties, are; a larger seed size, some growth patterns differences but often similar total dry matter production, herbage has a higher sugar content and lower dry matter content. They are frequently more palatable for stock, particularly over the summer period. The high water content makes them less suited to drying for silage and hay crops. The higher water content could present problems for NZ cattle grazing. Their growth form is more open.

There has been a considerable amount of research in recent times of suitable companion grasses for clovers that are being introduced into mixtures. Recommendations in the UK are for medium heading perennial rye grasses, including some of the tetraploids. These varieties are considered the best companion grass for clover as they are more erect and give a more open sward that can allow the clover to spread.

The more popular tetraploid rye grasses include Condessa which has high yields under both rotational grazing and continuous grazing management. Although it has slower growth in the early spring than some varieties it has very high growth later in the year.

There is trial work now which suggests that improved palatability from tetraploids offers higher animal performance than from diploid grasses (Lantinga 1988). It also appears that the addition of clover to a tetraploid ryegrass sward, offers considerable potential for the UK farmers to improve animal performance , compared with pure perennial rye grass swards (Swift etal. 1989). This work was with sheep grazed swards.

Wild Flower Species

Another interesting aspect of pasture breeding research at the Welsh plant breeding station and other sites is the work to identify and protect many wild species. There is increasing public awareness of the threat of intensive agriculture to the wild flowers. It has in recent time, been a research priority to identify the problem of declining species diversity of grass and swards. Aspects currently being monitored include the effects of fertiliser and conservation practises on the botanical composition of field margins (Frame and Tilley 1989).

SILAGE TECHNOLOGY

Silage technology is a major area of research throughout the UK and Europe. There is continuing research into conventional silage making, particularly in regard to the use of additives to improve its quality, and more recently the development of big bale silage.

BIG BALE SILAGE

Background

Big bale silage was pioneered by a Northumbrian farmer, Lloyd Foster, in 1978. He had hay out for 10 days and had been unable to get it dry in the wet conditions. He decided to bale it at 50% dry matter and was pleasantly surprised by the quality.

He subsequently worked with the MAFF to develop the technology. It was soon realised that the technology had potential for high rainfall areas where hay was not easily made. It also had a lower capital cost in not requiring pits or feedout wagons. The system had appeal to arable farmers who already had big balers as these could be used for the dual purpose of baling straw and for consuming grass.

It was soon appreciated that by baling silage in a far shorter time normally required to dry hay, there were considerably reduced field losses, down from around 30% to nearer 10%, and a lowered weather risk (Kennedy 1989).

The growth in big bale silage has been spectacular. Currently 20 - 30% of the 11,000,000 tonnes of dry matter conserved as silage annually in the UK is baled and either bagged or wrapped. The growth in Europe has also been spectacular with for example, Sweden, now baling over 20% of the silage crop instead of being made into conventional silage.

Big Bale versus Clamp Silage

Big bale silage has appealed as an alternative to clamp silage for a number of reasons. In many instances big bale silage was tried because of shortage of conventional pit space.

It has become apparent that where small pits of silage were being made, (perhaps less than 250 tonnes), high pit losses were occurring, a factor very relevant to many NZ situations. Most pit losses are not visible as compost, as respiration losses occur through the entire pit.

In other situations the main pit would be sealed, and the farmer may be cutting an area of buffer grazed pasture which did not warrant opening up the main pit. Big bale silage was often ideal in this case as small amounts of feeds could be harvested independently of the main silage crop.

More recently effluent control has become a problem in some areas. Big bale silage offers much easier effluent control and maybe preferred for this reason in some circumstances.

Other advantages farmers attribute to big bale silage, are that there is less capital tied up in pits. Pit structures are required to meet UK construction standards and can cost tens of thousands of pounds. All joints must be sealed and an effluent collection systems installed. Earth walls are no longer acceptable.

Big bale silage is also easily self-fed in rectangular or round feeders, eliminating the cost of a feedout wagon. Other farmers prefer big bale silage as it can easily be sold and transported off the farm.

The disadvantage, however, of big bale silage is the higher direct cost. The costs of baling in the UK is approximately NZ$10. It can also be slower to conserve feed and more labour intensive.

Guidelines for making Big Bale Silage

Guidelines to make big bale silage are to wilt to a 30% dry matter. This recommendation reduces the number of bales and the cost of conservation. Reliability of the fermentation is improved with reduced effluent, with the 30% dry matter wilt. Higher dry matter wilts are not recommended as field losses can increase beyond the typical 10% figure. Normally this wilt can be achieved in 24 - 48 hours. Since the advent of wrapping, a wilt has become almost mandatory as very wet bales below 25% may not be suited to wrapping.

A recent survey of farmer practise suggested approximately half the farmers baled their big bale silage in the first 24 hours, while the remainder preferred 24 - 48 hour wilt. The popular bale size is a 4ft by 4ft bale, weighing approximately 500 kg.

Farmers have been keen to adopt the recommended 24 hour wilt as trial results have shown that higher dry matter wilting does not give extra animal performance despite the appearance of an attractive drier material.

In recent times wrapping has become common practise and now the majority of farmers prefer to wrap than bag their silage. Research has shown no effect on silage quality of either wrapping or bagging, but where damage has occurred the wrapped bales have shown less wastage than where bags have been damaged.

In one trial storage losses of 13.5% were recorded with wrapped silage but 27.7% from bagged silage, with the difference largely being due to much more waste silage around damaged areas in bags.

There have been many trials into big bale and clamp silage comparisons. In general results have shown big bale silage to have a higher pH (4.7, compared with 3.7 pH), similar energy value, but much lower storage losses. Typically 9% storage losses for big bale silage compared with 26% for clamp silage. It is suggested that the air increase in the stack during the ensiling process may be a key factor in the far higher losses recorded in clamp systems compared with big bale silage.

Research Developments in Big Bale Silage in the UK

Current research programmes with big bale silage includes studying the inclusion of concentrate feed within the bale and ensiling in order to increase dry matter content, improve fermentation, and to make a feed that is a complete feed requirement, which requires no further addition of concentrates.

Preliminary trials at the Welsh Plant Breeding Station, using a prototype applicator, have shown that a proprietary additive has made excellent quality silage with advantages in feed conversion compared with grass silage fed with a concentrate supplement.

Big Bale Silage in NZ

Big bale silage is growing rapidly in acceptance in NZ. and looks to have a big future. The extent to which big bale silage captures the New Zealand market will depend on the cost effectiveness of the technology. The technology is well proven in the UK now and if recommendations of a 2 + 2 50% overlap system for wrapping are used, there appears to be little reason why efficiencies over conventional silage could not be achieved under New Zealand conditions.

The tendency towards less silage conservation within New Zealand systems would favour a big bale system, as the small areas may not be able to be made efficiently into clamp silage in some circumstances. It also offers the flexibility of conserving small parts of the farm as surpluses arise and therefore allowing grassland back into the animal rotation at the earliest possible instance.

Big bale silage may have considerable growth potential in New Zealand for smaller farms, where farmers are faced with replacing the silage wagon, tractor and building new pits.

The high losses in small pits is also a factor for consideration. As NZ farmers become more aware of the true pit losses that are probably occurring in NZ, big bale silage popularity may grow.

The ease of carting big bales from runoffs and the attractiveness of self-feeding big bale silage to lactating cows are also factors in its favour.

An early spring a short term feed deficit could be addressed by self-feeding of silage from feeding areas near the cowshed and eliminating the cost and damage associated with running silage onto wet pastures.

The costs of making big bale silage compared with clamp silage or hay are likely to be higher in most NZ situations. Savings in capital out lay of pits, and a feed out wagon and its maintenance, may substantially offset baling and wrapping costs. Silage loss data for "NZ style" silage is needed to assess the true costs of silage losses, as this factor is likely to determine the true costs and benefits of each system.

The limited NZ data available suggest big bale silage losses may be surprisingly low, in line with UK experiences. I suspect pit losses in NZ style clamp silage, in our warm temperate climate may be somewhat less comforting. It may be a " bacterial growth industry" of under rated proportions, and one farmers deserve to know about.

CLAMP SILAGE

The Crop

The most appropriate topic to begin the review of high quality UK silage making with is the grass crop. The stage of maturity at harvest has a direct effect on energy value of the silage when fed to the cows, with the feeding value of silage, largely reflecting the feed value of grass at cutting. The grass digestibility sets the upper limit of silage quality.

As the crop matures the digestibility (D Value) falls from a value of over 70 to 60 or less (Figure 7). This corresponds to the metabolisable energy content (ME in MJ per kg dry matter) of over 11.5 for leafy herbage down to 9 for very mature grass. Farmers can have ADAS advisors monitor the herbage quality during the spring to give a guide to the lateness of the season, and asses the effects of the weather conditions. Analysis of farm herbage is recommended to give farmers an indication of the quality of individual farms crops. Regrowth cuts at around six weekly intervals typically results in silage with a ME level of 10.5 MJ per kg dry matter.

Farmers differ in their preference for silage digestibility. Some farmers prefer taking a lighter crop of 70% digestible high quality leafy silage. Many, however, prefer to wait a few days longer for bulk to increase and the digestibility to fall to near 65% - 67% to achieve a compromise between bulk and silage quality. Silage at this digestibility is still very leafy and of much higher digestibility than a large percentage of New Zealand's silage crop.

Measurement of the rate of change of digestibility at the 65% - 70% mark suggest that a 1% - 3% drop in digestibility occurs per week is likely to occur. Harvest timing is crucial in determining silage quality.

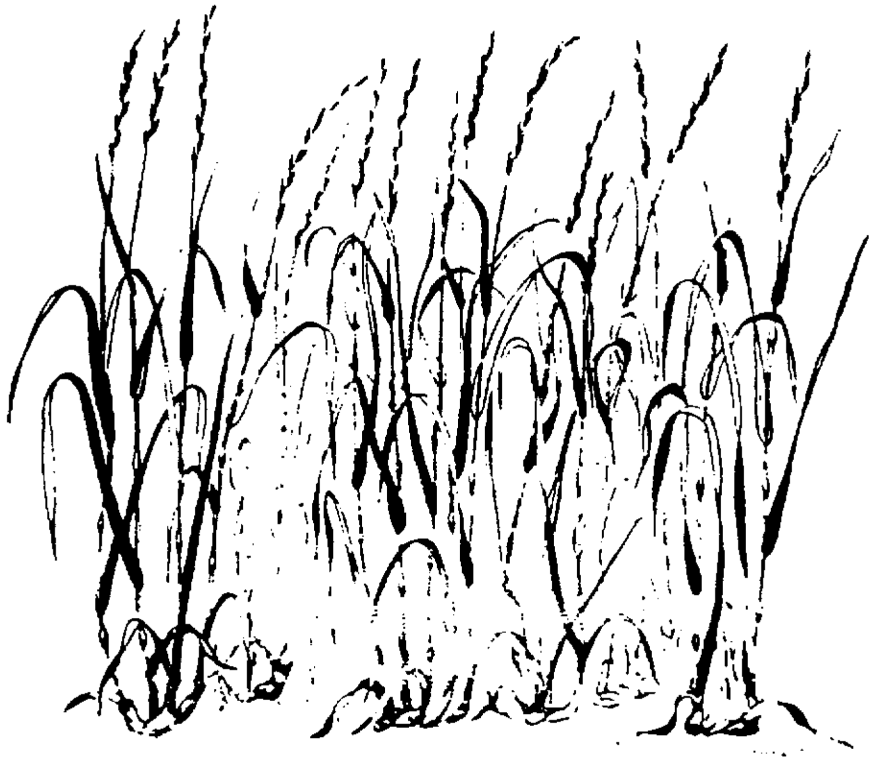
I suspect that a lot of silage made in NZ is of low digestibility as a result of the quality of feed ensiled. While this may not be a problem for a maintenance feed for wintering, it will not be suitable for filling a feed deficit in milking feed . Farmers could plan a portion of the silage to be of high quality if some silage was to be feed to milking cows.

Figure 7. Leaf and seed head present in pastures of four grass swards at different intervals without cutting or grazing:
1) Early and leafy growth (D-value 70), 2) Lengthening of stems(D-value 67), 3) Flower heads emerged (D-value 64), 4) Mature crop (D-value 61).
(From Milk From Grass by Thomas and Young).

Early and leafy growth (D-value 70)

Lengthening of stems (D-value 67)

Flowering heads emerged (D-value 64)



Mature crop (D-value 61)

Ensiling Methods

Recommendations on silage wilting and chopping length and method vary from institution to institution within the United Kingdom. Gordon's (1986) work in Northern Ireland has produced some impressive data when comparing a direct cut flail system, with a precision chop unwilted system, and with a precision chop wilted silage. He found that compared with the precision chop wilted silage, precision chop unwilted system gave a 30% increase in animal production. The direct flail system gave a 20% increase in output compared with the wilting system.

The conclusion from many trials in Northern Ireland is that wilting of silage prior to ensiling, whilst enhancing the dry matter adlib intake by cattle, is more likely to decrease rather than increase animal performance. The evidence would suggest that wilting has no effect on the efficiency of the energy utilisation by either growing or lactating cows, but the greatest yield losses result from the depression of animal production of around 13% following wilting with further improvements in efficiency possible by the use of a simple flail harvesting system.

Data from the UK suggests that sheep intakes would be increased markedly through offering a wilted silage product, but that generally cattle prefer wetter silage. Higher milk yields by up to 20% have been achieved, by ad lib feeding of non-wilted material.

Some of the work in Wales would suggest that wilted silage has a higher temperature after ensiling because of the air trapped in the stack. Temperatures may be 3° or 4°C lower in a no wilt situation because of the lower air content.

In many parts of England a short wilt of less than 24 hours is considered desirable as this limits field losses and significantly reduces effluent. A short wilt will also increase the likelihood of a good fermentation. It is recognised that even once in the silo the grass continues to respire for some time, which can cause significant losses of sugars, particularly when chopping has been inadequate and has been followed by poor consolidation over a long period with defective sealing. Under these circumstances a higher temperature occurs and the ME can be depressed by 0.3 - 1 MJ per kg dry matter.

Pit Filling

It is important to ensure that the grass is harvested as cleanly and quickly as possible, as soil contamination will result in pockets of badly fermented silage within a silo.

During silo filling, the silo should be covered with a polythene sheet at night in order to exclude as much air as possible from the silage. The final sealing of the silo must be made airtight in order to prevent air getting in during storage. Air tight sealing is often achieved by farmers in the UK by using two layers of polythene sheeting, weighted down over the complete surface by either tyres or sandbags.

Silage Additives

Silage additives are recommended in many situations where silage is made in the United Kingdom. A good silage has a low ammonia nitrogen content (less than 10% of the total nitrogen broken down to ammonia) and a low pH (less than 4.2 if the dry matter content is less than 20%).

In well fermented silage, sufficient lactic acid is produced by the bacterial breakdown of sugars, to lower the pH to a level that will provide effective preservation. It is considered that a sugar content of at least 3% in the grass is required to ensure that a good fermentation is achieved.

There are many instances where the sugar content is less than this. For example during periods of dull damp weather during the spring/autumn or where the grass is very wet. In these situations it can be beneficial to use a silage additive in order to ensure that good fermentation will be achieved.

There is a multitude of silage additives on the market in the UK. They can be classified into the following categories of; strong acids, molasses, inoculants, enzymes and adsorbents.

Currently strong acids are the most widely used additive. They cause a rapid reduction in the pH of the grass in ensiling, which inhibits undesirable bacteria therefore leaving more of the grass sugars available for use by the desirable lactic acid producing bacteria. Formic acid and sulphuric acid are the most commonly used acids. Trial results suggest that formic acid treated silage will give higher milk yields when fed than good untreated silage.

There is an increasing interest in the use of inoculants as silage additives as they are much safer to handle than acids. A high concentration of desirable lactic acid producing bacteria added to the crop at the stage of ensiling will improve favourable fermentation. Trial results suggest that higher milk yields can be obtained when cows are offered inoculant treated silage compared with untreated silage, suggesting an enhancing ability of inoculants. Inoculants appear to have a silage sparing effect by increasing the efficiency of the fermentation.

Silage additives are a costly addition to conservation. Acids typically cost in excess of $4 per tonne in solid material. One acid treatment "MaxGrass" gives a very high level of preservation with increased sugars available to stock, but costs $10 - $12 per tonne in solid material.

It is doubtful whether the benefits derived from these additives could be justified in the New Zealand context as the cost is 1 - 3 cents per kg dry matter respectively. Furthermore, the high sugar content in our grasses may reduce potential benefit from the inoculant and mixed grass treatments.

A new approach to silage inoculants is the "Live System" (LS), (Beever 1990) being marketed by the Milk Marketing Board. This inoculant is approximately half the cost of other inoculants at approximately $2 per tonne of silage.

Unlike other inoculations which are sold as solids or suspensions which are diluted and spread on to the silage or the grass as it is ensiled, the LS is based on a preparation of bacteria lactobacillus plantarum, that is brewed by the farmer to make his own inoculant. A kit is provided to incubate the bacteria and with the doubling the numbers of bacteria every 20 minutes, the farmer by the end of 24 hours will have billions of life bacteria. These can either be used immediately or stored in the fridge for up to a month.

This low cost home grown system may have appeal to New Zealand situations. It offers the enhancing value of inoculants but at a very much lower cost than traditional silage additives. The improvement in the efficiency of silage production is achieved by a more rapid drop in pH and reduction in the loss of the sugar content in the ensiling process.

The recommendations for live system inoculant use include that there is an adequate supply of soluble sugar levels. It is likely that sugar levels in New Zealand crops would be adequate for the inoculant.

A benefit that could occur in New Zealand is that it should counter pH buffering effect that clovers have in the ensiling process and result in a quicker lowering of the pH giving a better fermentation.

Silage Losses

The silage research literature has a multitude of silage trial work and loss data. Reviews of this work suggest that typical figures for losses in the conservation process for wilted silage at 28% dry matter, and a 24 hour wilt are approximately a 10% field loss and typically a 20% clamp losses, giving a 30% overall loss.

In the no wilt situation with 19% dry matter silage, 20% overall loss could be expected from a 1% field loss with typically a 19% clamp loss, with good pit management. These are largely invisible respiration losses.

In the NZ context , I believe that losses are likely to be higher than these in most situations as sealing of pit over night while filling and after the pit is full is generally of a much lower standard.

Furthermore additives are rarely used, and the warmer NZ climate would tend to lead to higher pit losses, particularly at the time of silage removal where an aerated exposed face is left without the sealing effect of a silage grab.

Silage Effluent Losses and Pollution

Effluent losses are much higher in unwilted material, however, typically only 3% - 4% of the dry matter content is in the silage effluent and in the unwilted silage clamp, 1% of clamp losses are likely to be from effluent losses. This is because of the very low dry matter content of the silage effluent. Acid additives dramatically increase the amount of silage effluent.

The polluting value of the effluent is extremely high. It has been calculated that a 1,000 tonne clamp of 20% unwilted silage can give the same pollutant effluent as the sewerage from a major city. A large proportion of the prosecutions of farmers for pollution are from silage effluent reaching water ways. While the effluent losses in dry matter are not significant in unwilted silage, the potential for pollution is often a major consideration in a farmer opting for a short wilt.

In February 1991 , regulations were put in place in the UK on silage storage facilities. All new silage pits must have an impermeable base surrounded by a system to collect any effluent and take it to a storage tank. Tank capacity must be at least 3 cubic metres for each 100 tonnes of silo capacity. Silage pit wall strengths are specified and earth baked silos and silos cut into hillsides are effectively banned. The construction standards required are effectively beyond most do it yourself farmers.

In New Zealand silage effluent is not regarded as a major pollutant, however, it is likely in the future that greater awareness of the potential polluting values will be recognised and farmers may be well advised to place their silage pits away from water courses in anticipation of a requirement for improved pollution controls. There are minimum distances, for all silage storage facilities, from waterways in the UK.

Shear Grabs

The shear grabs have dramatically been adopted in the United Kingdom for feeding out silage from the clamps. It is recognised that the deterioration of up to 1 metre into the face can occur. The shear grab seals the face as it removes silage from the clamp and largely prevents this source of loss.

There would appear to be considerable scope in New Zealand for The manufacture and marketing of a cheaper shear grab for silage removal from our New Zealand clamps, as the importation to New Zealand is at a substantial cost.

SUPPLEMENTARY FEEDING OF COWS WITH CONCENTRATES

The standard relationship between concentrates fed and extra milk produced on an energy basis is 0.4kg meal / litre of milk.
This assumes a 12 ME MJ/kg meal is fed providing 0.48 MJ, approximately the energy value of 1 litre of milk of 3.8% fat and 3.3% protein.

The substitution effect of cows eating less silage or pasture when more concentrates are offered means that the response will often differ from that theoretically determined. Furthermore at higher levels of concentrate feeding more energy tends to be put into liveweight rather than milk production.

Typically with reasonably well fed cows producing around 5000 l per cow, a ratio of 0.8 kg to 1 kg of concentrates required for each additional litre of milk occurs (Thomas and Young). These results are largely from indoor feeding trials and are used for winter feed formulation calculations, with silage making up the balance of the diet.

The Relevance to NZ

The most relevant data to NZ conditions, on responses to diet supplementation with concentrates is probably that obtained in The Republic of Ireland, as grazing systems are nearer to those found in NZ. In a review of a large number of trials (Stakelum etal. 1988), results ranged from less than 1 to 6 kg, with an average of around 2 kg concentrate per additional litre of milk produced. Under grazing the substitution effects are likely to be much greater if adequate pasture is available.

Unlike either of these situations NZ cows are only likely to be supplemented in times of feed shortage, where there will be limited scope for feed substitution. A response of between 0.4 and 1 kg concentrate per litre would seem likely.

The economics of concentrate feeding in NZ would only be attractive under a high dairy payout, as meal at $500/tonne (50c / kg DM) with a conversion efficiency of 0.6 kg conc/litre of milk, requires a milk price of 30c / litre or approximately $6.00 / kg of milkfat to break even. The comparatively low milk prices (approx. 50% lower) and higher meal prices (approx. 30% higher) are in contrast to the European situation.

FERTILISER NITROGEN IN UK FARMING

Nitrogen Fertiliser Use on Dairy Farms

Traditionally United Kingdom dairy farmers have mainly used ammonium nitrate for nitrogen fertiliser, with ammonium phosphate being used where phosphate was also required. This would often be applied in the first spring fertiliser application to pasture after the winter period.

Recommendations are for the first spring fertiliser to be applied approximately seven weeks prior to the cows being turned out on to the pasture, at the rate of 250 kg per ha which with a 25% N content, provides 62 kg of N per hectare. This would be applied approximately seven weeks before the first grazing.

The next application of nitrogen would normally follow five weeks later, approximately two weeks before the first grazing, and would typically be ammonium nitrate, applied at 250 kg per ha and with an N content of 34% this gives a further 82 kg of N per ha.

Fertiliser N would again be applied in early May and early June at similar rates. If potassium was deficient in June a potassium containing fertiliser could be used at this stage.

In July and August rates of nitrogen applied as ammonium nitrate would be lowered to 180 and 125 kg of ammonium nitrate per ha respectively. These applications would give 60 and 42 kg of N per ha. Applications after these, in late autumn, are not recommended as responses are poorer and prone to large leaching losses.

Separate nitrogen recommendations are given for areas to be cut for silage. These would generally have heavier rates of nitrogen and with a greater potassium input.

The Role of Urea

In recent times an excess of urea on the world market has lowered it's price per kilogram of nitrogen below that of ammonium nitrate. The effectiveness of urea is dependant upon having favourable soil and weather conditions. Yield results on grasslands have been more variable than with ammonium nitrate. Urea is rarely better and some times inferior to ammonium nitrate fertiliser. It is generally recommended that to be regarded as an alternative to ammonium nitrate, urea should be at least 10% cheaper per kilogram N when used in late spring or summer (Swift 1988). It would appear that urea is suitable for silage crops.

It is recognised that particular conditions encourage high volatilisation losses of urea. At higher temperatures, on recently limed soils of high pH, soils of low organic matter content, and on dry soils, especially in windy conditions ammonia volatilisation losses are likely to be high and urea is not recommended.

Many farmers have substituted urea for early spring applications of nitrogen but prefer ammonium nitrate from the summer period onwards because of the losses that may potentially occur from the urea applications. The greater resistance of urea against leaching losses also favours this strategy as ammonium nitrate can be prone to major leaching losses under wet conditions in early spring especially in light soils.

The current costs of urea is 116 to 124 pounds per tonne, while ammonia nitrate is around 110 pound per tonne. Urea therefore costs 26 pence per kilogram and ammonium nitrate 32 pence per kilogram. These prices for urea are approximately 30% below the current New Zealand price.

Despite these costs differences and the findings of a considerable volume of research on fertiliser types in the UK, there are still a large number of farmers that are reluctant to use the cheaper urea, many feel that is too severe on the pasture and the pastures tend to burn out with it. Scientists often reply that because of the higher content of N in urea, farmers inadvertently apply it at a high effective N rate and therefore note the slow recovery of the pastures as a result of the difference in application rates.

Nitrate Pollution from Nitrogenous Fertilisers

It is now recognised that the nitrate from nitrogenous fertilizers applied to agricultural land can harm the environment, by increasing soil water nitrate concentration. Fertiliser recommendations are now accompanied with advice on how these losses can be minimised. These include reducing late season fertiliser rates, and accurately applying fertilisers at rates that make allowance for organic slurries applied to the land. The severity of the nitrate problem will determine the extent of measures required in the farming region.

NITRATES IN GROUND WATERS

Nitrates are naturally occurring compounds of nitrogen. They are very soluble in soils and are the most usable form of nitrogen for plants. Modern agricultural methods have been used to increase amounts so that higher growth rates and therefore higher production can be achieved. Use of nitrogen containing fertilisers together with improvements in selective breeding of crop types has lead to the food in the western world being plentiful and cheap.

The benefits of the intensification of agriculture has unfortunately brought health and environmental problems. Water with high nitrate contents can cause illness and fatalities in young bottle-fed babies. High nitrate concentrations in water supplies have also being linked to incidence of stomach cancer although the evidence is somewhat inconclusive. Eutrophication of fresh and sea water is becoming a problem. Nitrate in water appears to be contributing to algae growth, particularly in coastal areas of the North Sea.

Nitrates are washed or leached from the soil into ditches and water courses because they are so soluble. Some of them get washed below the soil layer and into the underlying rocks. Nitrates washed from the soil infiltrate very slowly into the aquifer until they reach the water table. It may take many years or even decades for the ground water to be affected significantly. Nitrates move down at the rate of around only two metres each year in the case of some sand stones. In other aquifers such as limestones, water moves through cracks and fissures.

Many of the contaminated water courses in Britain are now being attributed to ploughing of a substantial portion of land during the Second World War to increase cereal production. Because of the long term nature of the potential contaminating influence in nitrate, there is strong environmental pressure from the EC for action to be taken now to protect future ground water quality.

In 1985 the European commissions drinking water directive set a new limit of 50 milligrams per litre for nitrates in drinking water. Before this accepted limit had been 100 milligrams per litre set by the World Health Organization.

This new maximum meant that several sources which were previously acceptable were now over the 50 milligrams per litre limit, and many water authorities had to either abandon water sources or put in blending mains to reduce concentrations in water supply.

Examination of the historic trends in nitrate levels suggests that a large number of other sources currently low in nitrate would in time exceed the maximum level in the future. A new EC directive is being introduced to protect future water quality, as it is now recognised that present agricultural practices will in part determine future water quality.

The Development of the Nitrate Problem

A number of factors have accentuated the release of nitrates into ground waters.

The ploughing of grasslands leads to organic matter turnover and releases large quantities of nitrate, which were previously locked up in the soil organic matter. Large leaching losses occur particularly if the land is left bare after ploughing (Ryden 1984). Cropping areas have increased since the war, and this is thought to be a significant factor increasing the amount of nitrate released to ground water.

Intensification of live-stock farming is also regarded as adding to the nitrate leakage problem. Fertiliser nitrogen applications have increased, as stocking rates have been raised.

Animal urination and the large quantities of slurry applied to limited land areas accentuate nitrate leaching. This effect is illustrated (Figure 8) from work at Hurley (Ryden 1984) where nitrate concentrations were measured in the soil profile under cut and grazed ryegrass pastures.

More recent data from North Wyke Research Station where drainage water has been monitored shows there was a marked increase in autumn/ early winter (October / November) nitrate concentrations under 200kg N/ ha and 400 kg N/ ha fertilised and grazed grassland treatments, compared to unfertilised and grass/clover areas. The EC nitrate limit was markedly exceeded in the heavily N fertilised plots, over this period.

Climate is also recognised as a major factor determining the severity of the nitrate problem, as in the dry areas nitrate concentrations tend to be higher through a lack of dilution of soil water nitrates. The low rainfall in the eastern parts of England, means that the nitrate concentrations of the water filtering through to the water table are therefore much higher in the these areas. There is also a higher proportion of arable land in the East, these two factors combine to make the situation much worse in East Anglia and East Midlands.

It is predicted that nitrates will continue to rise in ground water unless farming practices change. Changes in farm practices are needed to meet EC nitrate requirements.

Figure 8. **Nitrate content of soil and chalk removed from depths to 8 metres below grazed or cut ryegrass swards receiving 420 kg N per ha per year. (From Ryden 1984).**

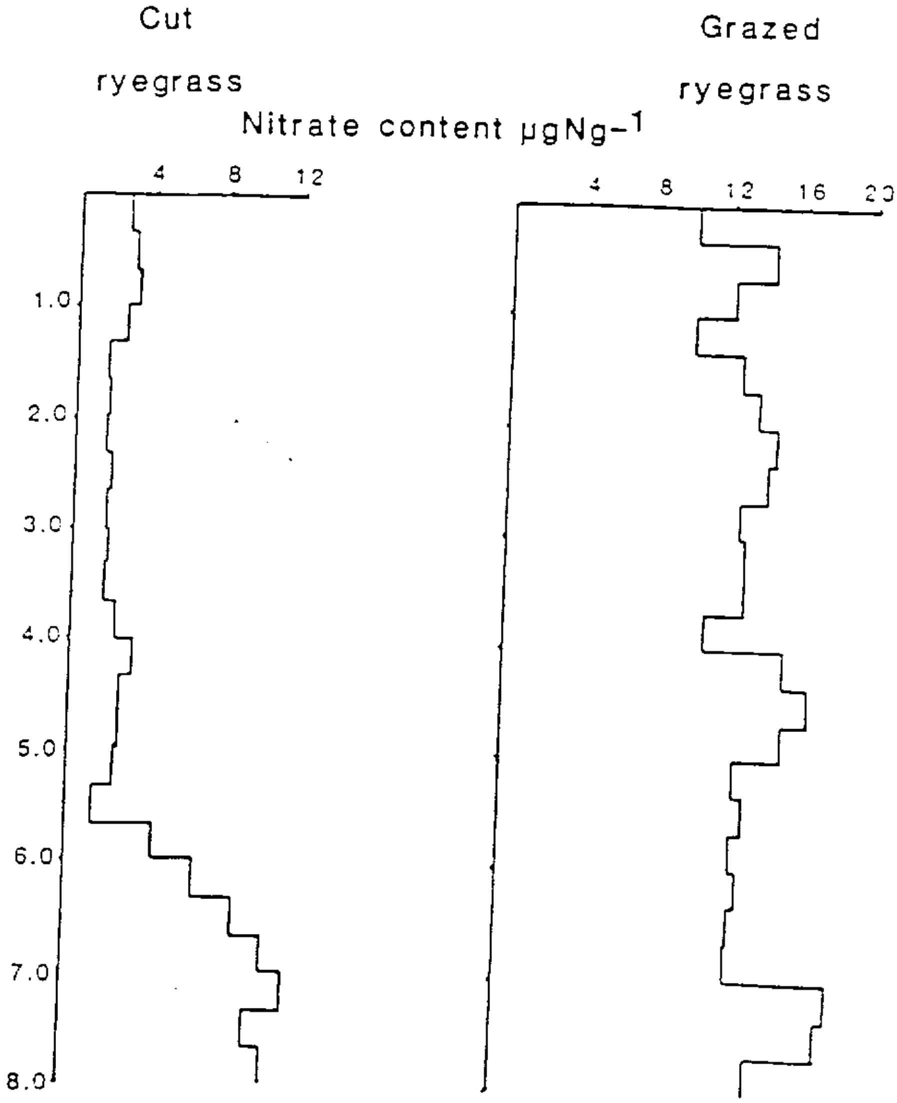


Fig 7.

The Options

Problems can sometimes be cured by laying new mains and building treatment plants. Water companies are now able to blend high nitrate water with low nitrate water, however where the low nitrate water is many miles away, treatment may be a much more economic option. These solutions however are very expensive and become increasingly so as nitrate continues to build up in ground water. The cost of water treatment can be several times the agricultural benefit of fertiliser application.

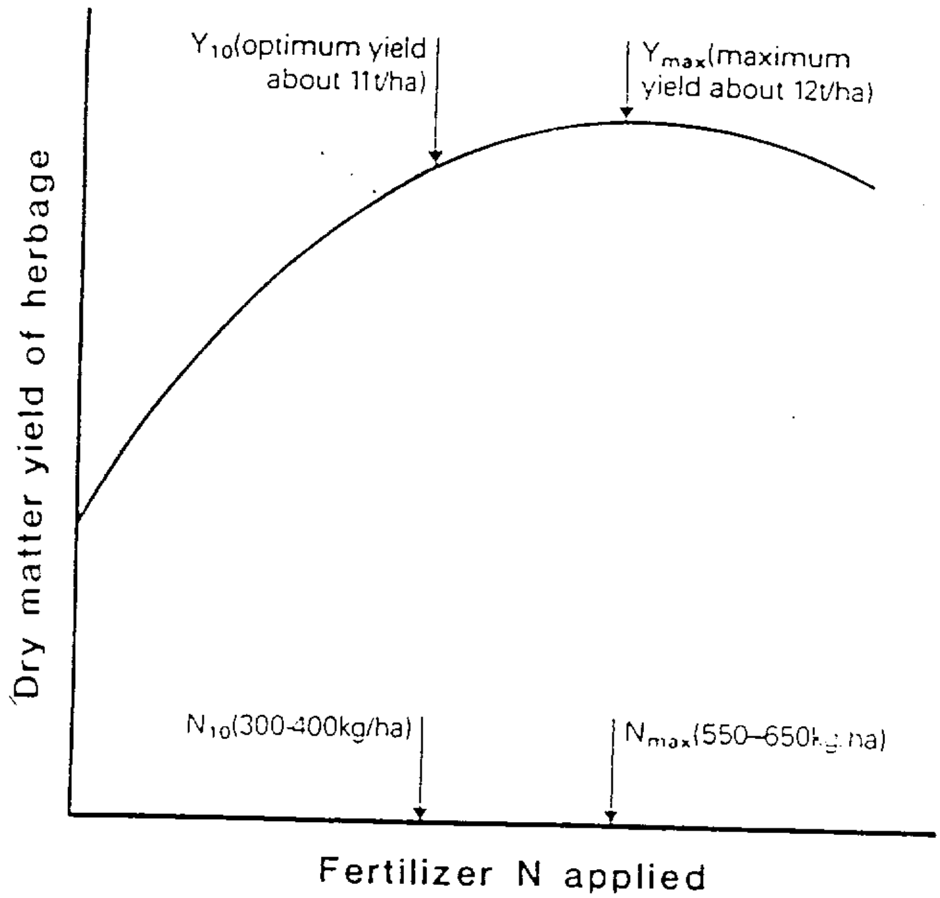
The amount of nitrate leaching to ground water can be minimised by changing land usage, or modifying of cultural practices.

Low intensity grasslands and broad leafed woodlands are both known from extensive research to leach very low amounts of nitrate. Juggling from arable cropping to either of these over a specific area around a bore hole would reduce the nitrate concentration in the long term.

Reducing nitrogen fertiliser applications, and using split dressings are obvious changes to farm practices. With Europe having an abundance of food, and the environment under threat there is support for the concept of reducing fertiliser inputs as the marginal return from N use is small at high rate of application (Ryden 1984). This is illustrated in Figure 9.

Other changes, include maintaining cover crops on arable land in winter, and controlling applications of slurry, along with minimising the amount of grass for ploughing must also help. These practices will need to be applied over a wide area and would therefore affect large numbers of farmers, potentially reducing their incomes as a result of reduced farming intensity.

Figure 9. **The typical response in dry matter yields of grass to fertiliser N, with an initial linear response, a phase of sharply diminishing response, and a point of maximum yield. (From Ryden 1984).**



THE UK NITRATE SENSITIVE AREA SCHEME

It is against this background that the Nitrate Sensitive Area (NSA) scheme has been set-up. The NSA scheme will implement changes to agricultural practices and the effectiveness of agricultural measures in reducing nitrate leaching into water sources assessed. Even where changes to agricultural practices alone will not lower nitrate water concentrations, the NSA scheme will be of value to endeavour to stabilise nitrate levels in order that long term planning for water treatment can be made.

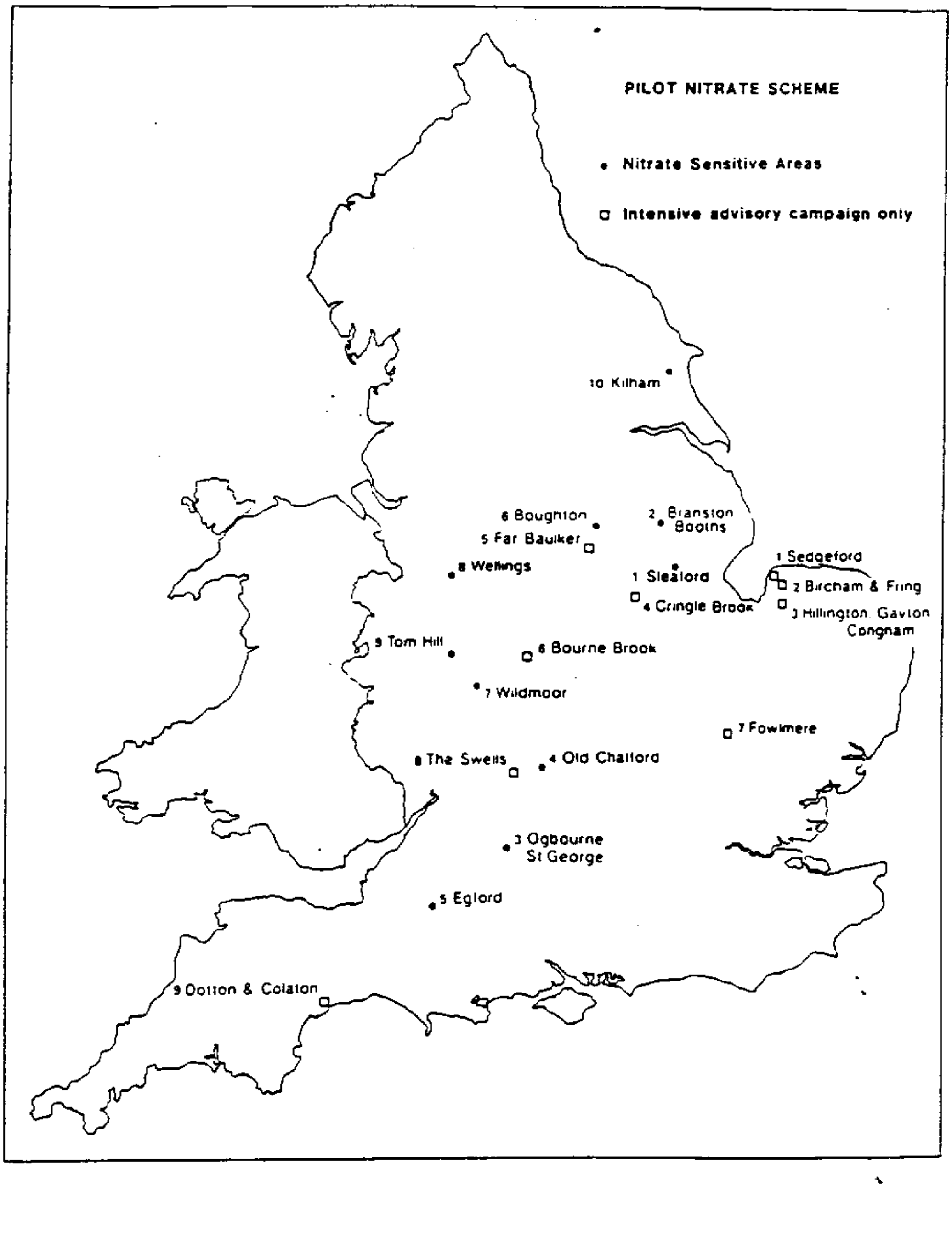
Powers are incorporated in the Water Act 1989 for areas to be designated, where land use controls could be compulsory imposed. The scheme is essentially a pilot one to assess the levels of voluntary participation by farmers and includes compensation for farmers who suffer loss of income.

The scheme is administered by MAFF and the National Rivers Authority advises on the location and extent of catchment areas to the bore holes. Ten pilot areas have been set up in different parts of the country with a wide spread of geological and soil types, farming practice and climatic differences (Figure 10).

Monitoring of ground water, surface water and water leached from the soil is being undertaken for a five year period to allow a full assessment of how effective the measures have been. Farmers who joined the schemes are tied to the changes for the five year period.

Discussions were held in 1989 to finalise details of the nitrate sensitive area N.S.A. scheme. By April 1990 the proposal details were finalised, ready for implementation on 1 June 1990. Each countries proposals for dealing with nitrates were submitted to the E.C. for approval. In addition to the ten areas designated as nitrate sensitive areas, a further nine areas were designated for intensive advisory campaigns to reduce nitrates.

Figure 10. **The location of nitrate sensitive areas, and areas for intensive advisory campaign only.**



The Nitrate Sensitive Area Scheme Details

The advisory areas comprise areas of 800 hectares in size to 7,400 hectares. All of the nine areas designated are catchments in which the drinking water level is above or near the E.C. drinking limit of 50 milligrams per litre of nitrate. In each area farmers of the land in the catchment are offered a free advisory visit. The aim of the advisory campaign is to find out how much scope there is to modify current practise and thereby reduce nitrate leaching at little or no cost to the industry. In some cases better practises may well reduce costs.

The modifications to the farming system which are covered in the advice, include such matters as accurate and timely applications of fertiliser, taking account of the nitrogen already available in the soil. The avoidance of bare soil, for example by bringing forward planting times of crops and the control of other factors which might lead to nitrate leaching such as sound irrigation, ploughing up grass, and Autumn manure spreading. Success of the campaign depends partly on tailoring the advice to individual farm circumstances.

On grazed pastures fertiliser recommendation advice will include full allowance for organic manure spreading and be aimed at reducing total inorganic fertiliser inputs.

Recommendations are for lower individual applications of fertiliser and for the elimination of Autumn nitrogen fertiliser. Autumn ploughing up of long-term grassland will be discouraged and surface cultivation techniques for grass re-seeding will be recommended were practicable. Other areas of advice could include avoiding excessive amounts and minimising Autumn spreading of organic manure and slurry application.

Payments are made to those farmers in nitrogen sensitive areas who voluntarily undertake to observe restrictions on their agricultural practises. Payments are made for restrictions on all the NSA land which will substantially enable them to broadly continue to maintain their current farming practices. The payments will vary according to the circumstances of the NSA, in line with overall differences in the costs of compliance between the different areas. The basic rates of payment range from 55 pound to 95 pound per ha in the various nitrogen sensitive areas. The nitrogen sensitive areas range in size from 490 ha to 3,300 ha.

The Basic Scheme

The conditions for the basic NSA scheme include; not exceeding the economic optimum nitrogen fertiliser applied each year, including full allowance for organic manures used, and applying less than the economic optimum amount of nitrogen fertiliser for yield on crops. This reduction is 25 to 50 kg per ha N below the optimum.

On grazed areas nitrogen fertiliser must not be applied between the 1st of September and the following 1st of February, and individual applications of more than 120 kg per ha of N of inorganic fertiliser are not permitted. Controls on organic manure limit annual applications to no greater than 175 kg per ha of total N.

Where grasslands are cultivated or re-seeded, the following crop must be sown as soon as soil conditions allow and no later than the 1st of October in the same year. There can be no grass cultivation between October and February in the following year.

There are a wide range of regulations covering proper practices, such as sowing times allowed when the soil is out of a crop, and the use of cover crops. Also restrictions on slurry application to fields, irrigation practices and conversion of grass to arable areas. The application of organic manures to this area of land must not be increased by more than 25% of its current application. There are also conditions that hedge rows and woodland areas must not be removed unless replaced by an equivalent area.

Another important aspect of the NSA regulations is that records of applications of organic and inorganic nitrogen fertilisers in terms of quantity and timing in the areas must be kept. This data is essential for the pilot nitrate scheme's success to be determined. There are comprehensive regulations for pig and poultry manure spreading and other forms of farming, to ensure they all meet criteria which will reduce nitrate leaching.

The initial proposal for the NSA scheme limited nitrogen application on grassland to 250 kg of N per ha. This requirement would have reduced pasture productivity in some areas, however the requirement was dropped in the final NSA scheme form and replaced with the criteria that organic and inorganic N rates must not exceed the optimum economic rate.

The Premium Scheme

An alternative to the basic NSA scheme is the premium scheme. In the premium scheme additional annual payment is made on any land that is agreed to be placed in the premium scheme. The premium scheme is designed to retire arable land into grassland. The farmer has a choice of putting the land into unfertilized un-grazed grass, onto unfertilized grass that has limited grazing, or to convert arable land into grass with applications of up to 150 kg per ha of N fertiliser per year. The alternative is the conversion of arable land to grass with tree planting.

The payment per ha varies on the percentage of his total holding that he puts under the premium scheme. The higher rates - up to 380 pounds per ha per year, offered for up to 25% of the land holding to be entered in the premium scheme. The lowest payment rates are where 75% to 100% of the total area is entered in the scheme, and these range from 200 pound per ha per annum, down to 90 pound per ha per annum. The lowest rate is offered where arable land is converted to grassland and grazed with up to 150 kilograms per hectare per annum of nitrogen. These payments are in addition to the basic NSA scheme payments. There are stringent management criteria for all land entered in the premium scheme. Managements for each category are designed to minimise nitrogen loss and include such criteria as the timing of grazings, limitations on stocking rates, no irrigation and the use of seed mixtures without clovers.

Future EC Nitrate Requirements

An E.C. " Proposal for a Council Directive concerning the protection of fresh, coastal ,and marine waters against pollution cased by nitrates from diffuse sources "(EC 1989) is under consideration.

In essence the directive requires: Member states to designate as "vulnerable zones" areas of land draining directly or indirectly;

a) into drinking water sources (both ground and surface water) which contain or could contain more than 50mg/l nitrate and

b) into waters levels which are or may become eutrophic (with nitrogen as a limiting factor).

Within the vulnerable zones, the draft directive lays down various agricultural measures that must be introduced. These include:

a) Quantitative limits on the amount of manure that may be spread either in terms of livestock units or nitrogen per ha (170 kg nitrogen per ha proposed or equivalent of two dairy cows per ha of land available for manure spreading).

b) A closed season for manure application and restrictions on applications to frozen, snow covered, water logged or sloping ground.

c) Minimum storage requirements for animal manures. The details of all safe manure limits would be specified by individual member countries. Already new regulations have been introduced for slurry storage in the UK, generally requiring a minimum of four months storage capacity and high standards of construction.

d) Quantitative and timing limits on chemical fertilisers based on good agricultural practice.

The second range of proposed measures would be far more reaching and would have to be implemented if the changes in agricultural practise (above)were insufficient to rectify the problem. These include those where land use changes for example cover crops or set aside afforestation.

The E.C. directive would require Member States to take preventative measures outside vulnerable zones including introducing a code of good agricultural practice.

The directive would allow Member States two years to designate the zones and a further two years to implement the necessary measures.

The Implications

The areas receiving debate include the broad nature of the proposal which currently includes both surface and ground water and nitrification of service. estuary, coastal and marine waters.

The implications and extent of affected water in the UK could be immense. The provisions of the directive include restricting the number of animals according to the land available for manure spreading, using figures laid down by the commission. In nitrogen sensitive areas availability of land for manure spreading may mean a reduction in stocking rate is necessary.

A provision of the EC directive causing some concern is that areas of land feeding ground waters must be designated if the waters are intended for drinking water and contain 50 milligrams of nitrate per litre or could contain this level if protective action is not taken. Vast areas of land will need to be designated as levels could rise in the future if action is not taken now.

The most important issues facing dairy farmers are the extent of nitrate areas. For the farms in these areas, the intensity of the enterprise may be limited by the area available for disposal of effluent, and limitations on nitrogen fertiliser rates that can be applied. As much of the nitrate leaching can come from grassland ploughing, this may markedly affect farmers ability to plant crops through a cropping rotation.

The water authorities association estimate that vulnerable zones designated respect of ground water would cover about 300,000 ha mostly in East Anglia in the Midlands, and that a further 4,000,000 ha would have to be designated in respect to surface waters on a worse possible interpretation of the directive.It will be sometime before the severity of the problem will be determined.

From a NZ perspective, we should be pleased that our low cost agricultural systems have lower nitrogen fertiliser inputs. Most N applied in NZ to grasslands is spring applied, rather than later in the season. The higher stocking rates in NZ will however result in greater animal N return and associated leaching, while higher rainfall in many areas will favour a lower concentration of nitrate in soil water.

An awareness of the European situation should prompt monitoring in NZ of trends in nitrate concentrations, and ensure our reputation for environmentally friendly agriculture, and a supplier of healthy food continues.

DEVELOPMENTS IN ANIMAL BREEDING

The UK Dairy Herd

There are approximately 2.9 million cows in the U.K. with approximately 65 cows being the average herd size in England and Wales. Friesians. Holsteins and their crosses constitute 92% of all dairy cows in the U.K. While the majority of these are classified as Friesian, many contain a proportion of Holstein genetics.

In 1987, 50% of dairy cows in England and Wales and 39% of producers were enroled in national milk records. Between 65 and 70% of calves born to dairy cows in England or Wales are estimated to be conceived by artificial insemination, and currently slightly over half of the Milk Marketing Board inseminations are to dairy breed bulls.

Genetic improvement for the dairy industry has until now been based on progeny testing. By far the largest testing scheme in the U.K. is the dairy progeny testing scheme, operated by the Milk Marketing Board for Holsteins and Friesians.

The proven bull team consist of between 30 and 40 proven sires, and the Milk Marketing Board also imports Holstein semen from proven bulls from a number of countries, including the United States. Each year between 80 and 100 young bulls are evaluated by the Milk Marketing Board. This number is limited by the relatively low number of cows offered for insemination by young bulls for their evaluation.

The majority of young bulls in the dairy progeny test scheme are obtained through contract matings of cows in the U.K. The cows involved in these contract matings are within the top 1% of the U.K. population on predicted breeding values for combined fat and protein production, as well as being acceptable on type.

The Milk Marketing Board also imports pure breed Holstein embryos to generate young bulls for the dairy progeny test scheme. Semen is currently being collected from the first crop of young Moet bulls for evaluation within the scheme.

Embryo Transfer Technology

Embryo transfer is now universally accepted in the UK. It is the quickest and most cost effective method of increasing the rate of genetic improvement within a herd. It can be a valuable addition to any breeding programme leading to greater efficiency and profitability in both beef and dairy herds.

Embryo transfer offers the chance to produce up to 20 or more progeny per year from the best cows in the herd. Farmers can profit by selling their best genetics in the herd while retaining the family. There is a growing international market in frozen embryos, and now top genetics can be bought into herds from overseas at a fraction of the cost of importing a live animal.

The Milk Marketing Board in England offer an embryo transfer service. They have qualified staff and skills and can either perform the transfers on farm or in their own facilities. The results from the Milk Marketing Board experience, suggests that 90% of reproductively sound healthy cows will produce viable embryos when flushed. 60% of cows with a poor breeding history are unlikely to produce embryos. Super-ovulation of cows is likely to result in the cow giving six viable embryos at collection time.

On average the Milk Marketing Board achieve a pregnancy rate of over 60% following direct non-surgical transfer, and around 50% after freezing and thawing of an egg. These results are based on transfers which include embryos from the very top grade to the poorer grade. Pregnancy rates can be approximately 5% higher when using resident recipient herd stock at the research centre.

Embryo Splitting

An embryo splitting service is available, so that a single egg embryo can be split into two. Embryo splitting will raise the pregnancy rate to over 100% for the whole embryo split. The current minimum age for embryo collection is 15 months. Older cows are less likely to produce the average six embryos per collection.

A cow can be used for embryo collection as long as she responds to super ovulation treatment. This will vary from animal to animal. It is possible for cows to turn good results for up to six or more collections, while others may need a rest between programmes. The rest may involve allowing the cow to cycle naturally two or three times or returning her in calf before embryo collections. Embryos can be collected from a cow approximately every eight weeks.

Super ovulation treatment will not effect the cows future fertility, and she will show normal fertility when next time on heat.

It is possible to sex embryos now but the cost and poor reliability in the technique mean that it is not a commercially viable proposition. Research is continuing to develop new methods and it is hoped that a sexing service will be available within the next year.

The current costs are approximately $500.00 per ET pregnancy. Splitting eggs cost $100.00, in contrast to these prices it would cost up to $5,000.00 per pregnancy if you brought a top egg off a top line sire and dam from the States. It would appear that the cost of embryos and embryo transfer technology is dropping.

Bull Power Master Calf Scheme

It is also interesting to look at work in Ireland where embryo transfer was being used to implant beef breeds into dairy stock, with the embryos having being obtained from slaughtered beef animals. The scheme, called the Bull Power Master Calf Scheme, enables dairy herds to carry beef animals at a comparatively low cost. The frozen embryo from a slaughtered cow was being sold for NZ$75, and would give a three quarter pure breed beef animal of comparatively high market value. Work was also going on in trying to implant a second embryo to give twinning, to increase the value of offspring for beef purposes. This work could have an impact on the beef industry and the role of the dairy industry as a provider of donor stock.

Computers Feed Monitoring and Animal Breeding

The housing and indoor feeding of livestock in Europe has facilitated the use of computer monitoring of animal feed intake in breeding programmes, with objectives of efficient feed conversion in animal production. This new technology has been developed to a high degree and is currently being installed in a number of animal breeding and research establishments in Europe.

Early results from the Langhill research work, in Edinburgh, with the high and low BI cows is highly relevant to the New Zealand scene. Preliminary data indicates that a 40% higher production was being achieved with the high BI stock with an estimated 20% improvement in conversion efficiency.

THE MOET SCHEME

The Genus Moet Nucleus Breeding Programme is owned by the Milk Marketing Board of England and Wales and is a major development in dairy cattle breeding in the United Kingdom. It sets out to establish a UK herd of outstanding genetic merit for commercially efficient milk production based at Baisley Farm in Northumberland. Their 250 cow herd is planned to become a source of top quality genetics for dairy farmers in the UK and for export.

Embryo transfer (ET) has been used commercially in the UK since the 1970's. Estimates of numbers of transfers conducted are around 7,000 per year. ET has been used primarily within the pedigree sector to increase the reproductive potential of superior females, and to facilitate introduction of some of the larger European beef breeds. In addition beef bred embryos also being collected for export in each case the high commercial value of the progeny has justified the expense involved in ET.

The concept of the multiple ovulation and embryo transfer (Moet Technology) was first put forward in 1983, and the present scheme was launched by a private group in 1987. The Moet programme was established after thorough evaluation of both the practical and financial feasibility of such a programme. The decision was taken then to establish a nucleus Moet herd with 250 cows, which has been developed almost entirely from Holstein embryos from the United States and Canada.

Their are a number of factors which lead to the Moet concept. Firstly there were some immediate commercial pressures. In the early 1980's it was generally perceived that the UK Friesian was an old fashioned dual purpose animal and not as well suited to specialised dairy production as the Holsteins in North America. A breeding programme based on North American Holstein genetics seemed a sound approach to international competitiveness and commercial survival.

The Moet technology opened up the possibility of self-sufficient breeding programme based on the relatively small nucleus herd and without the need for involvement in progeny testing. A high degree of operational control could be exerted over the nucleus breeding programme, something which had proved difficult to achieve with progeny testing in the UK. The company Premier Breeders, had already become a major supplier of ET services in the UK and a sales network of semen and embryos.

In 1989 Premier Breeders was taken over by the Milk Marketing Board.

The Moet Herd

The Moet Nucleus Herd is based on 250 cows. The herd was established over a three year period and is the result of the embryo transfer programme which began in 1987, and in which approximately 500 embryos were transferred each year. These embryos all came from North America. Embryos from 60 donor cows and 20 to 25 service sires are used over the three year period. All the service sires have been progeny tested and are placed in the top 5% of the North America Holstein population for combined fat and protein production. Similarly the donor cows had predicted breeding values which placed them in the top 5% for combined fat and protein, as well as excellent type.

In 1987 457 embryos from 19 matings were transferred. The average number of embryos transferred per family was 24. The pregnancy rate from these transfers was 66.4%.

In 1988 513 embryos were transferred, with an overall pregnancy rate of 62.8%. The majority of transfers were made non-surgically as compared with the previous year, when they were made surgically, and gave a slightly higher pregnancy rate.

The Operation Of The Moet Scheme

The 250 cow nucleus herd will have full milk and feed recording measurements and annual selection of the top 32 females and top 8 bulls for embryo production. This elite group were used to generate 500 embryos which were transferred to recipients. The 130 female calves are reared and served to calf at two years old, they will then go into the nucleus herd. The 130 bull calves are taken and the eight best will be selected on ancestors and sibling records, that is to say the sisters production records. This elite group of eight bulls is used as the bulls to go with the 32 females.

Surplus females are taken out of the nucleus herd into industry herds. Surplus bulls are sold and removed from the scheme. It has been decided to operate the Moet scheme as a open nucleus scheme, with the continuing introduction of young females into the herd. They will enter the Moet evaluation programme and the best can then be used to generate new Moet families.

Benefits of Moet

The Moet scheme gives an opportunity to provide standardised conditions of thorough evaluation of this select group of animals. It also allows recording of all characteristics of economic importance to commercial dairying, and not just to production traits, which sometimes is the case in a progeny test scheme. While the overall objective will be to select on index of profitability, taking into account returns from milk production, the scheme will allow production costs to be monitored including feeding during lactation, disease fatality and breeding and replacements.

Since the feed intake is known through computer monitoring of individual cow intake, an estimation of biological efficiency can be obtained, and cows selected for their efficiency of conversion of milk. This objective is not easily achieved with progeny testing. A selection of animals on production and feed intake is likely to be substantially better than selecting on production alone, both in terms of increased profit and biological efficiency.

Cows will be evaluated in the Moet scheme on their performance in the first 90 days lactation, to minimise generation interval lengths. Research suggests that production and intake data from the first three months lactation should give a reliable prediction of whole lactation performance. It is hoped that it will be possible to find suitable selection criteria to improve resistance to mastitis and disease, and to improve fertility within the herd.

The computerisation of measurement and recording of all information on the population is aided by the fact that all data is on site. This is considered a further advantage of a Moet type scheme over a progeny test.

There have been several studies on the expected rate of progress in a selection programme. Initially it is predicted that a gain of 1.7% per year in milk production could be achieved. More recent estimates taking account of new heritability and accuracy assessments, which suggest a gain in yield of 1.2% per year. This figure is considered realistic with regard to the embryo production and operational management of such a scheme.

It is recognised that a Moet scheme assessment of cows in which the breeding merits of bulls are judged on the performance of sisters and half sisters milked in the same herd. It does not provide the reliability of a progeny test based on say 30 to 40 daughters, it is however believed that the benefits of saving three years, that is having a sibling test at the end of four years compared with a progeny test at the end of seven years, effectively doubles the rate of progress and far out ways the loss of accuracy.

Relevance to NZ Industry

It is unknown at this stage as to how acceptable the wide spread use of these bulls will be without a full progeny test. In the New Zealand context, where our bulls have extremely high usage in the national industry, it may be considered too great a risk that families go directly into wide spread industry use without a full progeny test. The benefits of a much higher genetic progress in particular traits must be weighed up against this reliability factor. It is possible that accommodation of the two schemes may give the optimum, where by additional imported blood can be bought into a national herd and screened in a much shorter time to find those families most suited to our diary environment.

The other advantage for the New Zealand conditions of a Moet approach, is that if feed intake could be measured then an efficiency index could be put on the bulls. New developments in Ireland may make measurements of intake in grazing animals a commercial reality in the future.

Doubts about the schemes working in practice have often been put aside by pointing to the poultry and pig industries, where similar schemes have enabled dramatic progress to be made. It is also pointed out that in using Moet bulls it would not be advised to use a single bull as the selection, but to use a group of three or four bulls. As a group these bulls will pass on superior production ability and be ahead of currently progeny tested bulls, even though it will not be possible to be sure which individual of the group is the best.

The Future of Moet Schemes

A reduction in the cost of embryo transfer technology, could increase the benefits of the Moet approach. Moet schemes could be used to select bulls to put into progeny testing as this allows farmers to have the benefit of proven bulls.

The introduction of commercial embryo cloning is believed by some to be an attainable target. The introduction of animal evaluation procedures based on the individual animal model could lead to dramatic change in operation perception of conventional dairy improvement schemes. Moet breeding schemes may evolve into nucleus herds of high proven genetic merit and production from which embryos could be obtained for evaluation and where appropriate cloning.

The benefits of such a scheme would also be enhanced by identification of useful indicator perimeters in the young bulls, so that the best bull could be selected from the Moet family.

Another possibility in the future is that sexed embryos could be used to ensure a far greater number of female offspring, this would further enhance the potential genetic gain. While sexing of semen is now possible, the rate of production of sex semen was slow and certainly not commercially viable at this point. Embryos could be used to provide a sexed offspring as the costs involved for providing sexed embryos would be much lower through the use of very small amounts of sexed semen. The launching of lower cost sexed embryos would also bring a dramatic change to present concepts of animal breeding in many parts of the world.

Another option is to move from an adult to a juvenile Moet scheme where the juvenile animals could be flushed for eggs, this assumes that adequate embryos could be collected from the heifers.

A paper given to the Massey Dairy Farmers Conference 1991

CONCEPTS IN EUROPEAN GRASSLANDS MANAGEMENT FOR THE NEW ZEALAND DAIRY FARMER

The harsher climate and higher prices paid for milk under the European Community Common Agriculture Policy have meant that major differences exist between New Zealand and European dairy systems. In the United Kingdom, for example, cows are typically housed for five months of the year, during which time the diet is principally silage, with concentrates being fed to increase milk production. The high milk price, in excess of NZ$12 per kg milkfat, gives a profitable return to concentrate feeding at levels in excess of 1000 kg/cow/year. Grasslands have an important role in providing a large amount of silage for the housed winter period.

Given the harsh climate and short growing season, the performance of the UK grazing with winter housing system are impressive. In the six month grass growing season, under a high nitrogen regime (400 kg N/ha), around 10,000 kg of dry matter can be produced. The average UK cow production of approximately 5000 litres milk per cow compares well with the New Zealand average cow production of 3000 litres milk per cow. While some of the additional milk from the UK cow is in undoubtedly attributable to the concentrate feeding, the performance of cows on many farms from pasture grazing is impressive.

While travelling on my Nuffield Scholarship I soon appreciated that the major differences in climate and production system meant it was unlikely that technology could directly be transferred from the Northern Hemisphere to our own systems. However, I believe that the considerable expertise developed in some fields, offer perspectives for the New Zealand dairy industry. Concepts in pasture species, its management, utilisation and conservation are discussed in this paper.

GRASSLANDS SPECIES AND PRODUCTION

As in NZ ,ryegrasses are the main component of grassland seed mixtures. The number and range of ryegrass varieties available to the UK farmer is much greater than that available in NZ, with over 100 varieties of perennial ryegrass on the UK National List. The majority of perennial ryegrass used in NZ are early-flowering types. This is in sharp contrast to the UK where late- and medium -flowering types dominate seed usage.

Italian ryegrasses are usually preferred for short term specialist conservation pastures, while the hybrid ryegrasses are popular components in the medium term pastures (up to 5 years), that are likely to be dual purpose grazing and silage pastures. A tetraploid hybrid ryegrass would often be sown with a diploid perennial variety of intermediate and late heading dates, to give early spring growth,coupled with palatable , high quality summer and autumn production. The use of a tetraploid hybrid is considered to aid clover establishment because of its lower tillering capacity and erect habit. The high production potential off the hybrids may lead to their increased use in NZ permanent pasture mixes.

The recently developed tetraploid perennial ryegrasses are becoming very popular as a component of permanent grazed pastures, and now account for about 30% of seed usage of medium and late perennials in the UK. The tetraploids have higher yield potential, higher moisture and sugar content , and are creating considerable interest at the moment in view of data suggesting higher animal performance from the lasher tetraploid varieties. The feed quality attributes of tetraploid perennials suggests that they could also have an important role in NZ.

GRAZING MANAGEMENT

I encountered a diversity of grazing systems on my European travels. I am left with the impression that the particular grazing system adopted in a region relates largely to historical practice, rather than being based on research technology. For example, in Ireland rotational grazing is very popular, while across the sea in England, set stocking was often preferred in similar climatic and production systems. Grassland researchers and advisors also had their preferred grazing system.

The set stock system for dairy cow management was an interesting concept. The key principles are to intensively set stock pastures, to ensure that leaf height is kept in the 8 - 10 cm height range, considered to maximise animal production (Hodgson,1986). This keeps pastures in a short leafy, densely tillered state.

In spring, seed heads are grazed before elongation of the stem can occur. The flowering tillers die and new vegetative tillers can maintain pasture density and feed quality throughout the growing season. In contrast, rotational grazing with long grazing intervals, allows a greater degree of stem elongation on some pastures in the rotation, requiring greater stock grazing pressure to maintain pasture palatability. The intense spring grazing under set stocking also allows a large proportion (typically 60%) of the farm to be shut for the first cut silage crop.

Over the summer and autumn period. smaller proportions of the farm are out for silage production and much of the area is available for grazing at lower stocking rates than over the spring period. Pasture are maintained at the optimum sward height (8-10 cm), despite varying pasture growth rates and animal pasture requirements by a buffering fencing system, or by buffer feeding supplements. Buffer fencing involves putting an electric wire fence across a paddock and moving it to increase or decrease the area on offer to the stock, according to the height of the pasture. At the end of the grazing season any surplus grass which is accumulated behind the fence is typically conserved for silage for the winter period.

I believe the buffering fencing concept has relevance for NZ grazing systems with a set stocking component. Provision should be made for additional grass to be available in a set stock system to avoid overgrazing, when cow requirements exceed pasture growth, as may often occur in summer. In the New Zealand context this may well be provided by a deferred grazed area which could be brought back into the set stock grazed area in order to optimize leaf height, growth rates and animal performance.

Many British farmers are proponents of the set stock system, and consider animal performance to be higher under set stocking than with rotational grazing. In fact at times I had to defend our typical New Zealand practice as I had been told that rotational grazing is really "controlled starvation."

There is a wide range of preferred grazing systems in the United Kingdom. Some farmers set stock, while others totally rotational graze, but many prefer a combination of the system, often resulting in blocks of the farm being grazed for night and day grazings or the cows being placed in blocks on the farm for several days before being moved on to another area. Many of the higher performing farms that I visited, regarded flexibility in their grazing methods as key ingredients.

The Government Advisory Service offer recommendations for both rotational and set stock systems and do not recommend either system over the other. Recommendations for grazing guidelines are based on tiller height, rather than kg DM/ha, making extension of the concepts widely understood. In NZ pasture cover assessments in kg dry matter per hectare, and the associated feed budgeting practises are valuable management tools. Extension of feed budgeting concepts in NZ may be improved if seasonal relationships between tiller density, height and kg DM were promoted.

There have been many dairy systems experiments comparing set stocking and rotational grazing management systems. From a review of European trials, Ernst et al.(1980) concluded that overall animal performance was similar in European systems. The current Ruakura grazing management trial (Bryant 1991) has highlighted small production differences in a NZ dairy system. The need for detailed pasture, and animal studies for a particular system is highlighted. It would appear that the majority of detailed studies have been under sheep grazing, with even fewer involving systems management.

An important implication is that we may be able to construct a grazing system involving combinations of set stocking, short and long rotations that will give pastures resilient to the outdoor wintering required of them. The requirements of the pasture to withstand a severe winter grazing and treading pressure over the wet New Zealand winter are considerable. More densely tillered pastures, achievable under shorter rotation and set stock systems may offer considerable advantage for the New Zealand early spring growth, as tiller numbers surviving the winter grazing may be greater.

Observations from trial work at Mooreparke Research Station in Ireland, where milk production was higher from set stock pastures in the early part of the season, support this concept. While grazing management may have little effect on milk production over much this season, the high tiller density pasture systems offered advantages in the early part of the lactation grazing.

On arriving back into a wet NZ early spring, after five months of looking down to dense swards, NZ style winter block grazing appeared to be a severe stress to inflict on water logged pasture. I suspect that we are under estimating the impact of winter sward damage, on spring production. Perhaps we could use concrete races and yards during wet spells to a greater degree to avoid damage. I am pleased to see winter grazing options under increasing evaluation.

GRASSLAND NITROGEN STRATEGIES

New Zealand practice of seasonal tactical N use, contrasts with the 300+kg N/ha typically applied to UK dairy land, and perspectives on N use in this paper are limited in view of the limited similarities. The serious environmental problems of nitrate contamination of drinking water that farmers in some regions face has resulted in a big increase in clover based pastures, and a high level of interest in NZ clover pasture technology.

It was interesting to note that the seasonal pattern of pasture nitrogen responses has similarities to the typical NZ response pattern, with largest responses occurring over the spring. Researchers and farmers with N fertilised ryegrass and white clover based pastures not receiving fertiliser N, have observed much lower early spring growth rates from the clover based swards. The NZ practice of early spring tactical N use would appear to be a sensible compromise for many management systems.

PASTURE CONSERVATION

Silage is the major feed component, fed indoors in the housed dairy systems. A cow needs approximately 10 tonnes DM of silage for wintering, which is about 10 times the average feeding level in NZ. There has been a vast amount of research into silage making technology. The farmers have used this technology to make a high quality product, in order that they may minimise the level of concentrate feeding required to their milking cows when housed indoors.

UK farmers has much more attention to detail when making silage, right from shutting of the crop, to harvesting maturity, ensiling procedure, sealing in the pit, and silage quality analysis. It would cost us very little to put a little of the UK pride into our efforts. Minimising dirt contamination and sealing pits properly are examples of basic operations that I suspect frequently not given due attention on some NZ dairy farms.

Shear grabs have become very popular in the UK, and given that pit face losses are likely to be high in our warmer climate, a low cost shear grab should be a winner here.

Typically in the UK, grass would be cut at 65-70% digestibility. At this level of digestibility the seed heads will be very immature. In NZ, silage used for winter feeding does not need to be of especially high digestibility. However we could benefit by making some high digestibility silage when intending to supplement lactating cows spring diet.

The Hillsborough work of Gordon (1987) would suggest that there is no advantage to be gained from wilting grass prior to harvesting, over direct flail cutting and harvesting. Results from silage trials using formic acid as an additive, suggested that wilted silage intake was higher, but that the energy from precision wilted silage was less efficiently utilized for milk production.

I think from a New Zealand prospective it would be dangerous to assume we should direct cut silage in all situations, as in some conditions we would be in risk of having an unsatisfactory fermentation. I think the lesson is that if we are going to wilt at all, we should be aiming for short wilting periods of less than 24 hours. Accumulating field losses make it unlikely to be beneficial waiting for silage to dry beyond this short wilt period.

Acids, or bacterial inoculants are commonly added to silage to ensure a successful ensiling process. The need for an additive relates to the less than desirable weather conditions that silage is frequently made under, and the need for a very high quality product. Silage additives have generally been considered to be unlikely to be cost effective, or necessary in NZ.

An interesting development in the United Kingdom is the low cost "live system inoculant" (Beever,1990). A culture of Lactobacillus plantarum is grown and sprayed onto the silage to provide a desirable fermentation. The live system inoculant is "brewed" by the farmer (in much the same way as we make a home brew). The higher sugar content of New Zealand silage grasses may allow inoculants to lower the pH quicker, resulting in a lower pH silage of higher nutritive value.

Big bale silage is having a big impact in the UK in recent years. It is estimated that up to 30% of all silage may now be going into big bales. Farmers making small amounts of silage may prefer big bale silage as losses from small pits are comparatively large. Farmers can also avoid the capital cost of building pits (which are now required to be effluent proofed), and having to invest in silage choppers and wagons.

In the New Zealand context big bale silage could have an increased role, for farmers in similar situations. While the direct costs for making big bale silage are generally higher than for conventional silage, the lower capital requirement may mean that where little silage is required in a New Zealand dairy system there is little difference in a big bale and conventional system in some instances.

From a review of a number of experiment, Kennedy (1989), concluded that storage dry matter losses were lower in big bale silage than in conventional silage. The mean storage losses from a number of experiments comparing silage systems were 10% for wrapped bale silage and 27% for conventional silage. If in fact it does provide a lower loss more efficient silage process, then its rapid adoption likely to continue. Storage losses in the warmer NZ climate are likely to differ from those recorded in Europe.

Most silage in Europe is fed on concrete or in troughs, rather than on pastures. While most silage in NZ will continue to be fed on pasture, there may be some scope for increased early spring production in feed shortage periods, by ad lib feeding high quality silage to the dairy cows as they leave the shed. In this way silage wastage will be minimized, while offering ad lib intake to the lactating animals. A small amount of high quality big bale silage may well fill this role in the New Zealand context.

THE GRAZING HERD

Perspectives on grazing management would be incomplete without reference to the dairy herd. The cows in the Northern Hemisphere are predominantly Friesian/ Holstein and much larger than their New Zealand counterparts. I had the opportunity to see some New Zealand sired Friesian cows and was surprised at how much larger they were than typically seen in New Zealand.

I was also impressed by the size of the calves and weaners and yearling stock and suspect that higher growth rates are obtained in rearing replacement stock. Target liveweights for dairy replacements are much higher. For example recommendations from one Experimental Research Station were for 90kg at 3 months; 215kg at 9 months; 300kg at 15 months; 465kg at 21 months; and 515kg at 24 months. Average herd dairy cow weight is approximately 600kg. I suspect that NZ heifers target liveweights are too low and that cow production is being adversely affected.

Autumn born calves are reared indoors in well ventilated sheds over the winter period, before moving out onto pasture in spring at an age of about 5 months. Surprisingly milk levels fed to the calves are relatively modest, but calves are often individually penned and reared. With ad lib silage and concentrates, the calves seem to thrive in the indoor rearing systems. Calf health appeared better than seen in many NZ rearing systems, with pens are disinfected between calves, and the provision of adequate ventilation in the sheds being a high priority. Perhaps our warmer NZ spring period contributes to a greater disease susceptibility.

SYSTEMS MONITORING

A large proportion of UK dairy farmers use one of the industry production monitoring systems, to give a monthly and season to date reviews of farm performance. Parameters monitored include; milk production, yields per cow, yields per hectare, profit margins per hectare after feed and fertiliser costs, and Utilized Metabolizable Energy (UME). Data is compared in relation to budget and milk quota.

These data systems are run by the Milk Marketing Board Farm Management Service and the Government advisory service ADAS. The service assists milk quota and farm management, and gives farmers and advisors current data on farm performance compared district trends. Dairy companies moving into the farm production area, could consider this type of monitoring scheme as an extension of their computerised recording system, if there was supplier interest.

The concept of UME/ha enables the energy contribution of grasslands systems to be determined and compared. It has been widely adopted by UK dairy farmers, advisers, and researchers. The calculation of UME in MJ/ha/annum provides data on a farm on the efficiency of use of grassland by subtracting energy from bought in feed from energy leaving the farm in product.

UME is particularly useful, where purchased feed makes an assessment of grassland utilisation complex. It also could have an application in systems development, as a measurement that can integrate differences in milkfat , protein and bodyweight. It focuses on efficient grassland conversion to product, a criteria of management systems likely to become increasingly important when cow efficiency (of conversion of grass to milk) can be better evaluated.

THE GRASSLANDS ENVIRONMENT

In a rapidly greening world, European farmers are been asked to be guardians of the land. Encouragement is given to retire less productive land, and farm some areas less intensively, in a more traditionally manner. I certainly not proposing that we plant our grasslands in wild flowers, as is the case in the UK, but if we were to take the concept on board in New Zealand and accept that we will green with a similar vigour to the rest of the world we probably should be considering retiring less productive areas of land into native bush. An investment of wasteland into trees, while not adding significant value to the farm at this stage, may prove to be a wise investment in future decades.

A paper given to the Large Herds Conference 1991

THE FUTURE OF THE NEW ZEALAND DAIRY INDUSTRY

The Trading Environment

New Zealand dairy farmers have been told repeatedly that our future prosperity will greatly be determined by the success or otherwise of efforts to reduce protectionism in world agricultural trade.

I am heartened by the evidence I saw in Europe of the turning of the tide away from subsidies . A system that taxes consumers by several hundreds of dollars many of whom are far from wealthy ,and then pays farmers to produce food to a level beyond need is doomed for harsh review.

Recent trends of a reduction in total support , and support being targeted to those farmers that can perhaps justify some social support, suggests to me that the bureaucrats in Brussels are having their way in making the CAP a social policy , rather than a political pay off to the strong rural lobbies in European politics. These signals auger well for the New Zealand Industry .

New Zealand's Industry is small compared to the United Kingdom and United States industries (Table 1) . The technology advances in these large wealthy subsidised industries in the last decade has been stunning . Currently the Russian industry produces much less per cow than the European and US industries. If western technology flowing into the Eastern block recently lifts output per cow nearer to European and US levels, the effect on world milk production will be dramatic.

Table 1. Cows, Milk Production, and Production per Cow.
(Provisional figures 1989, based on milk sales to factories and dairies)

	COWS millions	MILK PRODN m.tonnes	PRODN/COW kg milk /cow
NEW ZEALAND	2.3	7.3	3200
EUROPEAN COMMUNITY	23.2	99.0	4300
U S A	10.1	65.9	6500
SOVIET UNION	41.8	77.5	1900

Furthermore, the consumption of milk products in Eastern Europe will not be aided by higher consumer prices , a need for hard currency , and recent reports of orders for a number of margarine plants .

I believe that we must face the reality that in the foreseeable future , the world is awash with technology to produce milk . Our role will continue to be as low cost producers . We can out perform our competitors on cost of production. Furthermore , by keeping our costs of production down , we have the potential to expand into new third world markets.

We have become expert low cost producers by combining the natural grassland resource , a successful herd improvement programme , with management practises that have been fine tuned by researchers , advisers , and farmers. We have two decades of practise at coping with deteriorating terms of trade (Table 2.). Lets take a step backwards , and look forward to how we have coped to date , and will have to farm in the future.

Table 2.
Milkfat Price, Inflation Adjusted Milkfat Price, Herd Size, Production per Cow, and Number of Herds

SEASON	MILKFAT PRICE $/kg mfat	INFLATION ADJUSTED PAYOUT $ Dec 88	HERD SIZE	PRODN/COW kg mfat	HERDS
1974/75	1.36	7.07	112	128	16540
1975/76	1.41	6.77	115	137	16449
1976/77	1.53	6.18	117	143	15986
1977/78	1.67	6.02	120	131	15454
1978/79	1.73	5.73	123	142	15156
1979/80	2.08	5.85	126	151	14962
1980/81	2.65	6.24	129	147	14561
1981/82	3.33	6.93	133	144	14391
1982/83	3.61	6.51	137	143	14455
1983/84	3.50	6.23	140	154	14612
1984/85	3.96	6.35	146	152	14593
1985/86	4.00	5.40	150	157	14499
1986/87	3.31	4.06	151	138	14121
1987/88	3.60	4.26	153	154	13772
1988/89	5.30	5.70	157	143	13593

The statistics show that we have survived by milking more and more cows, in fact about 3 more cows on average more each year. The increase in herd size has more than compensated for the reduction in total herds , as total cow numbers in NZ have increased by 9% over the 15 year period of this data .

We should not forget the social costs , of rural depopulation closed schools, stores and community infrastructure.It may be of some consolation that even in Europe, with the Common Agricultural Policy, in place, to protect traditional rural community structural , massive rural depopulation has still occurred. I do not believe that we can curb the rural exodus . This process of rural depopulation will continue.

The increases in production per cow have been less dramatic as weather conditions have a marked influence on national performance. It appears that production per cow is slowly increasing at about 1 kilogram of milkfat per year.

Stocking rates increased from around 2.1 to 2.4 cows per hectare through the 80's, with national average production per hectare ranging between 330 and 380 kg milkfat /hectare in recent seasons.

Looking back certainly highlights the variation in performance of New Zealand dairy farmers. The comparatively modest stocking rates , per cow performance and per hectare production of a significant percentage of NZ farmers mean that many are likely to have to improve their performance or leave the industry , over the next decade.

Our Ability to Milk More Cows

For many dairy farmers , staying in the industry mean running bigger herds. To date the growth in herd size has often been by the retirement of smaller farms , but with the retention of the family owner operated unit as the mainstay of the industry.

Future growth must increasingly come through the employment of farm workers rather than owner/operators milking more cows.

It must be of grave concern that herd size increase will give reducing benefits to the survival capacity of the industry.

There is little evidence of new milking technology in the last decade to increase the throughput per man in the milking shed.

While I was intrigued by the automatic cup placement technology that a number of European companies are reputedly working on , the players in this field who have gone public , are building one cow milkers , designed to handle 30 to 50 cows , and priced at tens of thousands of pounds.

Perhaps the most relevant European concept that could currently help our shed throughput is the dropping front rail herring bone. An innovative engineer could improve long herring bone throughput by perfecting this concept.

There are a large number of computerised milking systems developed throughout the world . I am impressed with the accuracy of the milk meters and the extensive integration of the milking systems. One European group were keen to sell me their foot attached transponder system . Each milking the walking characteristics of the cow was down loaded onto the shed computer. This data was used for mating management as the transponder could detect a different cow behavioral pattern in the field .

We should not dismiss these high cost , high technology systems , as there is every indication that the cost of electronic computerised systems will fall , and reach much more realistic cost levels in the not to distant future. Stand alone in line electronic mastitis detectors have recently been released in the UK. Electronic herd testing may also be with us if electronic prices begin to tumble. Electronic animal identification will become increasingly of value as herd sizes grow .

Current Technology and Production

I believe researchers and innovative farmers have guided the industry down a path of more efficient low cost production.

Herd improvement has given us cows that are cheaper to run, and probably much more adaptable to large herd operations

The feed budgeting principles, with controlled supplement feeding are also good examples .With reduced milk prices in the United Kingdom , there is increasing interest in efficient grassland use. The industry has not used feed budgeting . It highlighted to me , its benefit in NZ over crucial feed periods.

Spring nitrogen fertiliser use to better match grass growth to animal requirements is another innovation of considerable value to the dairy industry. Indications are that it has become a widely accepted management strategy, and that its use will continue to grow through the next decade. I was frequently told in the UK that while grass/clover swards provided a very high quality feed and were great for keeping soil water nitrate levels down, they were pathetically slow in early spring.

I have no doubts that a grass /clover sward with limited early spring fertiliser nitrogen will serve us well through the next decade. Our position contrast with that in many areas in Europe where nitrate pollution of soil water will force a change in farming practice in the coming decade.

The no conservation farming trails have also broadened our views on effective low cost farming. There has got to be a message here for every farmer , whose serious about reducing costs . We are still making silage in our operation , but we hope to make even less in the future if we can possibly get the feed directly into the cows throat as grass.

Lower Production Costs

As well as milking more and more cows, for more production, we will have to keep cutting on farm costs. The challenge here will be for farmers and staff to sharpen their farm management pencils. We have had a great training run this last season , haven't we!

We have learnt to buy less new machinery; to question the economics of land development programmes, that are great fun to do but cost a heap; perhaps even to leave the tractor and motorbike in the shed; to rediscover the thistle grubber .

Production has not suffered , costs have been cut.

Checking and treating the lame cows foot , instead of calling the vet so he got dirty was a tough decision to make. One day soon , we could consider training the staff a little stockmanship . It may pay big dividends if the scientific evidence linking cow stress and the cows immunity to disease is substantiated. I am sure you will all appreciate the challenge involved in having to lower costs, employ, train, and motivate more staff , and to maintain or increase individual cow attention.

The challenge of the future dairy industry also lies with the wider industry , and depends on the New Zealand economic environment. Dairy farmers provide the raw product for a large portion of the NZ economy. I hope that returns will allow a growth in production , rather than demand a defensive stagnating position.

Future Efficiency Gains

New Zealand dairy farmers are regarded as among the most efficient grassland farmers in the world . Ironically ,only about a third of the energy value of the pasture ends up in the vat . A substantial part of grass energy is required for cow maintenance.

There is general acceptance that gains in total pasture productivity in future years will be modest . The challenge is there for us improve our productivity by improving per cow performance . For the last two decades with have been increasing stocking rates. Heavily stocked farms , stocked with high genetic value stock can theoretically gain a lift in total production by reducing stocking rates and hence the maintenance requirement.

Cow intakes must be increased to realise this production. I believe that this is a realistic objective for the next decade and beyond .More palatable ryegrasses, such as the perennial tetraploids that have become very popular in the UK , must offer great potential. These ryegrasses are lusher than many diploids currently used in NZ . Unfortunately it is not possible to simply import their top lines as the climatic differences require specific breeding programmes. There are other characteristics , such as heading date , leaf morphology, that may offer a more palatable pasture .

New clovers are likely to compete better with ryegrasses and increase their contribution in the sward. An increase in clover content would do great things for cow intake and per cow performance. It is important that we keep our programmes on pasture improvement on target, as there are long lead times in breeding programmes.

Cows selected for their conversion of grass to milk efficiency, are also likely to improve the efficiency of our dairy systems in the next decade. Computerised feed monitoring system are a reality in Europe now . This means that every time a cow takes a bite of a particular ration , a transponder carried by the cow will identify her to the computer and a precise measurement of her dry matter intake will be recorded. While intake measurement and efficiency studies are always going to be much more difficult on grazed pastures, advances are being in this area.

Genetic engineering and animal breeding strategies such as embryo transplants , embryo cloning , embryo and semen sexing the development of the super efficient cow are all out there in front of us.

In the United Kingdom only 3% of the commercial herd are from embryos , but 50% of the sires used where from these technologies. Widely differing opinions exist on how we will use the embryos to accelerate genetic gain. There are so many possible strategies that the only safe bet is that one or more of them will be economically viable in the future.

Embryo based breeding programmes will allow farmers to select both on the sire and dam breeding line . Multiple ovulation will allow our best cows to give many offspring in a breeding season , compared to her having to rare each calf individually herself. The disease risk through importing embryos is much less than with semen . Affordable sexed embryos may be available long before sexed semen is a commercial reality.

There is considerable interest in the United Kingdom in the Multiple Ovulation Embryo Transfer (MOET) scheme being set up in Newcastle by the Milk Marketing Board. This project is based on the formation of an elite 250 cow nucleus herd form the multiple embryo offspring of top line US imported embryos.

The herd is milked and cows evaluated on their production efficiency (milk yield with relation to intake), to determine best performing families. The generation interval is much shorter than with a conventional progeny test. There is considerable interest to see if the potential genetic gain is achievable in practise.

Centralised breeding schemes such as the MOET scheme are ideally suited as elite embryo donors for cloning for widespread us. Speculation is rife as to when we will see reasonably priced clones available . Clones are an attractive proposition in that the animals can be proven in the industry before the technician heads back to the deep freeze to mass produce a particularly fine individual.

There are many novel schemes being researched . One of the more interesting approaches is to have an elite cow inseminated and to abort her to collect the 60 -70 embryos out of the foetus . The number of eggs in a female cow decreases with age . I understand that the technology has been developed to harvest eggs from 7 month foetuses , and the aim is to collect viable eggs from a three month old foetus . This technology would allow the best cows in the herd to provide all replacement stock , without the use of cloning.
The eggs can be fertilised and frozen until required .

I have no doubts that new technologies will allow us to remain the most efficient grassland farmers in the world . Investment in agricultural research is a crucial component to sustain our competitive advantage. It is up to the industry to ensure a "critical input" is maintained to keep a forward thinking team setting up the new technologies that will take us into the 21st century. The funding of agricultural research has become an issue in many countries . The pivotal nature of grassland farming to our economy means that it is imperative that we invest in the future.

I would like to be able to report that we could let other countries pay for the research , and that we could tag along for a free ride . Unfortunately plants and animals proven in other environments will not necessarily be suited to our production systems.

The Greening of Society

It has been said that if the 80's were the decade of genetic engineering , then the 90's will be the decade of the environment. While , there is some doubt as to whether the gains were made in genetic engineering that were hoped for , I have no doubt that environmental concerns will be acted on forcefully at the end of this decade.

The world is greening and we must be prepared to farm in accordance with societies expectations. Environmentally friendly policies are extremely popular in Europe .

We are perceived as a green country , by the densely populated European countries. It is a sentiment we should value , considering the competitive food market in which we must sell.

Our anti nuclear stance enhanced this sentiment. Our trade prospects can only be enhanced We should really get our house in order before we are found wanting.

In practise , this means that green policies ,and political parties, will increasingly gain support. In the European Parliament ,the greens hold the balance of power. It was curious to see conservative parties in Europe promoting liberal green policies , simply I suspect because it would be political suicide to not to be seen as green.

We can expect animal remedies , pesticides , and weedicides to be reexamined for harmful residues. The farmers responsibility for storage , safe handling , chemicals on the farm will become much more important. Safe disposal of unwanted chemicals , and empty chemical containers has become a priority in the UK.

The value of trees and bush could increase markedly as farmers are increasingly seen as having a role of guardians of the countryside. Shelter planting that will make your farm an attractive piece of real estate may be a wise investment .

Farmers polluting water ways will increasingly bear the might of the courts . Most prosecutions for polluting water courses in UK are from silage effluent . Fortunately we have only a fraction of the amounts of silage made here , and much of this is wilted. If any of you feel that the powers of control authorities are severe now , I would suggest that you quickly come to terms with the realisation that the environmental expectations of society are certain to increase.

Animal rights groups are likely to become increasing interested in breeding strategies and farming practises such as tail docking, castration techniques and dehorning practises. Legislation covering the anaesthetic requirements of castration and calf dehorning are currently being reviewed .

I was surprised to learn in the UK that all calf dehorning must be done under a local anaesthetic. Tail docking is illegal in the UK. It may be rather short sighted of us to put our induction slinks in the public eye on the roadside for the slink collector. We must go with and guide this legislation , as we will have few friends if we try and fight the tide.

Future Prosperity

Future prosperity lies within our control. Decisions in NZ will have a much bigger impact than Gatt negotiations.

Dairy farming has been a prosperous NZ industry. The return on investment has been competitive, when capital appreciation of the land resource has been added to balance sheet profitability. We must not forget that capital profits were inflation driven, rather than being based on improved terms of trade or large production increases. Land investment decisions must take into account the lower inflation rate .

New technology potential exists to maintain our competitive advantage as low cost producers. I am concerned that in recent years , we seem to have lost our will to advance , in order to meet rigid budgetary guidelines.

The history of development in the NZ dairy industry has been one of great team work between the farmer, advisor ,and researcher. It is up to you as farmers to ensure that the cost accountants, and politicians trying to siphon income off the industry, don't upset the team work to the extent that the future of the industry is at stake.

CONCLUSIONS

My impressions of NZ's agricultural situation in the world scene are very positive. Prospects for the reduction in protectionism, and more orderly trading of agricultural production are encouraging. The CAP is being changed, in recognition of the need to bring food production in line with consumption.

New Zealand's image as a supplier of healthy food is being enhanced in an ever greening world. The challenges to maintain and build on our reputation as a high quality food producer require an awareness of the environmental expectations of consumers. Competition on the basis of perceived food quality is increasing.

New Zealand farmers should learn from the European nitrogen fertiliser usage. NZ farmers are increasing N use and at the same time Europe is looking for clover based pasture technology as a saviour for a nitrate pollution problem. An awareness in NZ of European environmental pressures that farmers are facing is fundamental to appreciating and protecting our clean green image.

The potential benefits from NZ R&D in the pasture management areas studied would appear to be high. While there may only be potential for small increases in total dry matter yields, the potential to select for desirable characteristics to increase animal production appears to be substantial. We can not rely on European cultivar selections. A long term commitment to plant breeding programmes is required.

The European experiences with varying grazing management strategies, and recent Ruakura trial results give a clear message to agronomists that the potential for increased animal performance from innovative grazing regimes exist. Furthermore a lowering of the cost of production through higher animal performance, lighter stocking rates and reduced winter feed conservation are a realistic and achievable goal.

I strongly suspect feed conservation inefficiencies on NZ farms are generally grossly under estimated. We can all recognise silage compost, but we have little appreciation of invisible respiration losses. The arrival of big bale silage technology in NZ would make a review of the NZ situation timely. The vast amount of European data on feed conservation can probably be extrapolated to our environment with a limited amount of experimental verification. Low cost silage inoculants may have a cost effective role in NZ, in increasing conservation efficiencies.

Agricultural research institutions visited contrasted from progressive, innovative, well funded groups to those under budgetary retrenchment and in a state of slow death. The rationale behind a reduction in government support for agricultural research in some sectors, may sit well with the food over supply situation in Europe. A reduction in pastoral R&D in NZ, cannot be afforded if we are to maintain our cost effectiveness as a quality food producer.

Large budget research projects in animal breeding and other new technologies are likely to have an impact on our animal breeding strategies in the future. While we cannot hope to fund such programmes, it is important that NZ researchers, in all areas of primary production, have sufficient resources to keeping abreast of developments in the Northern hemisphere in order that NZ's entry into a particular field is timely.

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