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CONTENTS

Industry and agriculture in competition for investment finance
   Hon D.F. Quigley .................................................. 1

Part 1 LAMB MARKETING ............................................... 7
Marketing our lamb in the 1980s
   M.R. Barnett ...................................................... 9
Lamb marketing and the domestic base
   I.H. Jenkinson ................................................... 17
Lamb production and marketing
   P.H. Johnston .................................................... 24
A single company approach for New Zealand marketing
   T.D.C. Cullwick .................................................. 27

Part 2 FERTILISER ..................................................... 39
Development and maintenance fertiliser requirements on hill country
   J.H. Mauger ....................................................... 41
The important mix of fencing and fertiliser
   M.J. Fitzharris & D.F. Wright ................................. 52
Superchoice: a model for calculating superphosphate requirements
   A.G. Sinclair & I.S. Cornforth ................................. 57
Phosphate fertilisers: availability, costs and future developments
   D.J. Higgins ..................................................... 66

Part 3 LUCERNE ........................................................ 73
Chairman's introduction
   G.H. McFadden ................................................... 75
There and back with lucerne: a farmer's viewpoint
   J. Lewthwaite .................................................... 77
Cost savings in lucerne production
   T.P. Palmer & R.B. Wynn-Williams ............................ 80
Lucerne grazing management for the 1980s
   J.G.H. White .................................................... 86
Lucerne for grazing: a farmer's view
   M. Brosnan ........................................................ 93
Best stock performance on lucerne
Sitona weevil and aphids in lucerne
   T.E.T. Trought .................................................. 102
Part 4 FARM LABOUR ........................................ 115
The agricultural workforce and the agricultural industry
B.J. Ross .................................................. 117
The agricultural workforce and the farmer
D.J. Frith ................................................ 122
Farm labour workshops .................................. 126

Part 5 AUTUMN FEEDING OF SHEEP ..................... 129
Planning autumn feed supplies for ewes
K.E. Milligan ............................................ 131
Autumn feeding of sheep under border dyke irrigation
C.R. Dick ................................................ 138
Autumn feeding of sheep under dryland conditions
R.I. Middleton .......................................... 143
Animal health problems associated with grain feeding
A.S. Familton, V.R. Clark & A.M. Nicol ............. 148
Whole flock management
D.R. Macmillan ......................................... 155

Part 6 DAIRY AND PORK .................................. 165
Pre and post calving grazing management
A.M. Bryant ............................................ 167
Dairy shed hygiene and the standard plate count
M.T. Eden ............................................... 172
Parasitism and young stock
A.R. Sykes ................................................ 177
Big bale silage: balage
J.S. Dunn ................................................ 180
Quality silage from the new techniques
T.P. Hughes ............................................. 183
Sow productivity and its improvement
W.C. Smith ............................................. 187
Pig breeding research in New Zealand
N.H.J. Stables .......................................... 197
Formulation of feed rations for the modern pig
O.P. Ryan ................................................ 200
Dairy industry marketing in the 80s
J.S. Parker .............................................. 205
Industry and agriculture in competition for investment finance

Hon. D.F. Quigley, Minister of Housing.

In election year it is usual for politicians to pat farmers on the back and tell them what a good job they (the farmers) are doing. However, I am not going to do that today, because you know how important agriculture is to the New Zealand economy and, as a result of the Agrow Campaign and the drama of the foot and mouth scare, so does most of the New Zealand population. Nor am I going to enunciate government policy. I want to adopt what I hope may be regarded as a different approach to the topic of finance for agriculture and hopefully what I have to say may generate some meaningful discussion.

I was born the son of a North Canterbury farmer and worked on and later purchased my father's Waipara farm. I learnt something about the diversity of United Kingdom farming during the course of a Meat and Wool Board Scholarship in the mid 1950's, and later I gave legal advice to many of my North Canterbury clients after I had completed my law degree which I started while I was farming. I consequently have some understanding of the problems of estate planning, financing farm purchases and more recently, because I have gone back to farming, the problems of a severe drought and rising on and off farm costs.

As a politician I also know that it is invariably easier to state the problem than it is to find an acceptable solution. I am also conscious that the taxpayers of New Zealand (who are too often referred to as "the government") are not going to fund all the demands placed on them - nor should they attempt to do so. In fact I believe the government is already far too involved in both a regulatory and a financial sense.
in peoples' lives. We would all be far better off if the government were to withdraw from a whole range of activities. However, I am the first to concede that we are living in an imperfect society.

When I started to prepare these notes I asked myself, why the topic finance for agriculture? Was it because past methods of funding have been unsatisfactory in either quantity or quality, or has the money which has been available been allocated inappropriately? Clearly we have produced some peculiar results.

For instance, with the average meat and wool farm currently selling for at least $400,000 it is most unlikely that the return on capital would be much more than reasonable wages of management plus a return for risk, let alone the extra $48,000 which you could expect to earn if you invested that sum at conservative government stock interest rates. Either there is something seriously wrong with farming's earning capacity, or farmers are prepared to pay a very high price for "a way of life".

The way in which our agricultural industry has developed in the past may well be responsible for its present unsatisfactory performance from the point of view of return on capital investment. We originally developed as a large farm in the South Pacific to satisfy the demands of the United Kingdom market. Initially, virtually all our surplus produce was sent there and we excelled in specialization. Specialization has been to our advantage we are told.

We are supposed to produce what we do produce extremely well, but this narrow range of products has made us vulnerable to price fluctuations, market protectionism, and the risk of potential disasters such as foot and mouth disease. Indeed, had those Pirbright tests proved positive, we could have lost overnight most of our meat export income which, incidentally, accounts for more than 25 per cent of our total export earnings.

Specialization, far from being our great strength is also, I would suggest, a potential weakness. But specialization has not just been confined to a range of farm products. Our whole economy has been and still is dominated by farming and the export earning capacity of that major industry. Many people now believe that the heady days of the 1960s and earlier eras when it was thought that our farms could provide all our export income and our city manufacturing sector the jobs for our growing labour force, provided those industries were sufficiently protected, are gone forever. Indeed the years from the late 1960s to the late 1970s fortified that belief, because during that time mutton and lamb tonnages rose on average by only 3 per cent, wool production by a mere 1 per cent and dairy production actually fell by 1 per cent.

It has been suggested that that disappointing performance was the result of growing agricultural protectionism and a dramatic increase in the price of imported fuel oils, and that together these added up to a down-turn in our terms of trade, an economic recession, unemployment, inflation, and a reduction in profitability.

Certainly, oil prices have increased dramatically in dollar terms, and even more relative to the price of some of our exports. For instance what cost 20 per cent of our meat export income to purchase in 1972/73, last year required 100 per cent, and many of what we regarded as our traditional markets are becoming harder and harder to sell in.

However, farm production has started to increase again over the past two or three years and there is now what the Meat and Wool Board's Economic Service sees as a "measure of the hopes for the next decade" in its estimates of a cumulative 29 per cent increase in production to the year 1990 at the present growth rate and a massive 51 per cent jump for the whole industry at the higher rate "considered feasible". (Agrow, pp. 20 & 27)
But the obvious question has to be asked: Is either the present or the projected growth rate likely to be achieved in view of the difficulties agriculture suffers from, what actually happened during the 1970s, and the present structure of the New Zealand economy? Or indeed, is it wise to take the risk in view of the fact "that a farmer's efforts can be eroded by forces outside his control. The weather, political decisions at home and abroad, industrial problems and rising costs (which) can all conspire to upset his plans"? (Agrow, p.20)

A comparison of New Zealand's performance with that of some of our fellow OECD members helps us to answer that question and I use as my source an article in the Dominion (4 May 1981) by Mr J.V. White entitled "How New Zealand's living standard measures up". The article suggests that our problems are not just associated with fuel price increases or agricultural protectionism.

In a comparison the following points stand out. Since 1961 New Zealand's standard of living has lagged behind all of the following countries: The United States of America, Japan, France, West Germany, Australia, Demark, Finland, The Netherlands, and Sweden.

All of those countries depend on imported oil except the United States and Australia which is each about 50 per cent self sufficient. Britain has been self sufficient in oil for the last two years. Most of the countries mentioned require large oil imports for heating and, sometimes, power generation, as well as for transport. This is not a problem shared by New Zealand.

The growth in all of the other countries has been almost entirely in industrial products, or, in the case of Australia, in mineral ores. Only Denmark has anything like the same degree of dependence on exported farm products, but she is exposed to strong manufacturing competition as a member of the European Economic Community. The outstanding feature of the policies of the countries that I have mentioned with high growth rates, is that they have maintained relatively open and competitive economies (except for some agricultural products).

There are clearly a number of differences: the New Zealand economy is dominated by agriculture and agricultural exports. We produce and sell overseas a limited range of products and are dependent on selling them well. For instance meat accounts for over 25 per cent of our total export earnings, wool 16.6 per cent and dairy produce 18.1 per cent.

We do not as yet have a strong industrial base to our economy. Because of the narrow base of our economy, our dependence on a limited range of export commodities, and our high capital investment in the agricultural sector, adjustments are often slow and difficult.

This leads me back to the reason for the selection of the topic I have been asked to discuss - the finance available for agriculture. Could it be that some new phenomenon has either developed or is in the process of development which will require a new approach in this area?

The answer may well be yes, because the series of investment decisions which have been taken over the past four or five years, particularly associated with the development of our energy and energy intensive industries, will inevitable lead to new initiatives in numerous sectors of our economy. What will the effect of these new initiatives be on agriculture, or indeed on existing business generally?

The fact is that agriculture will benefit and will benefit very substantially from the new phase now taking place in New Zealand's economic development. It is simply not a case of either agricultural development or industrial development, or one proceeding to the detriment of the other.

For instance, the net foreign exchange earning capacity of new energy and energy intensive projects will not eventuate until the mid 1980s. This means that in
the initial years the significance of our traditional export industries as earners of foreign exchange will be accentuated. This requirement will virtually guarantee that agriculture will have the resources it needs to keep it performing profitably. Secondly, there will be a spin-off effect for agriculture and the existing infra-structure as a result of the renewed life the new projects will give to the construction and engineering industries. On-site and off-site employment will pick up, and with a more active economy there will be less pressure on what are now a limited number of profitable sectors.

Probably the greatest contribution to agriculture will flow from the improved efficiency of the non-farm sector - the new industries which will be based on the development of natural resources will be more internationally competitive than in the past, and will consequently require less support in the market-place to make their own way profitably. As a more balanced economy develops the new growth areas will have the capacity to moderate the impact of agriculture's periodic highs and lows. This in turn will mean less pressure on the farming sector to produce more and more regardless of marketing difficulties, adverse climatic conditions, changes in the terms of trade or declining profitability.

Also, as a more open and more free market economy develops agriculture will, I believe, become less susceptible to political pressures. This will be to the industry's advantage because the ball is invariably kicked around hard in most football games and as a result often loses its shape. In economic terms that is called a distortion, and agriculture is full of distortions. For instance at least one political party is advocating a compulsory residential clause for farm purchasers. That was tried and failed 30 years ago. The same party has promised finance for small businesses at 5 per cent but expect farmers to pay double that rate. There is equity for you; but whose money is it anyway, because farmers pay tax too? We have supplementary minimum prices for some products and not for others; special development concessions that are not available to those who have already, at their own expense, improved their farms; livestock incentive schemes which are not appropriate for those who are already stocked up, and grants for certain types of irrigation and not for others. The anomalies are endless.

The point I am making is that our present production patterns throughout our whole economy are so distorted by what our urban cousins term "subsidies" or farmers call "export incentives" when they are applied to manufacturers, that individual decisions are invariably made not from a point of view of maximising the return on the capital involved, but because of the tag that is associated with investment in that particular area.

Professor Bruce Ross summed up the situation on page 16 of the Agrow booklet when he said: "...any comparative productivity measures which indicate that the returns to resources employed in agriculture are low compared with what can be obtained elsewhere probably reflect distortions in our levels of relative prices more than the true situation".

No wonder many sectors of our economy perform so poorly! But poor performance in itself, at least in theoretical terms, is no justification for special treatment.

Mr R. Johnson summed it up in his reported comment in Agrow page 16 when he said: "I would not argue a case for special treatment vis a vis other exporters - all I suggest is that the export sector as a whole get the same treatment". In other words, no special deals for agriculture; no special deals for other export earners. Shades of Milton Friedman!

The fact is, that agriculture does not necessarily need more finance. It certainly
does, however, need to be able to use what is available to it to best advantage. It is neither in the interests of the farming community nor in the interest of the economy generally for farmers' wealth to be measured in terms of capital gain as opposed to a satisfactory annual income.

These are challenging times, but we are responding to these challenges. We have changed the forms of protection to encourage the growth of internationally competitive industries, and we have removed many of the barriers which were holding our export sectors back.

Much has already been achieved and more benefits will flow from the following policy initiatives:
* A new export incentive package
* A new exchange rate regime
* Changes in the administration of import licensing
* Increases in the pace of industry studies
* Liberalisation of foreign investment criteria
* A more flexible monetary policy
* A more liberal approach to weekend trading
* A freeing up of the regulations associated with meat processing
* The easing of controls on prices and wages, and
* Our positive approach to negotiation with Australia on the topic of closer economic relations

There are however no soft options available to us whether in the form of free lunches, offers of subsidised interest rates, unlimited development finance or the promise of the gold at the end of the rainbow.
Part 1

LAMB MARKETING
Marketing our lamb in the 1980s

M.R. Barnett, member, New Zealand Meat Producers’ Board

"It is not farm production that is sick and ailing. It is not the markets or the marketing that is sick and ailing. It is the New Zealand economy and the low level of productivity being achieved in our processing, manufacturing and transport sectors. The loss of farmer confidence is caused by the burgeoning Government sector, by successive wage and salary increases based on relativity and the cost of living rather than productivity, and by sheer inefficiency in the use of labour".

A.M. Begg, Chairman, N.Z.M.P.B.

A lot of figures could be produced to support those points but I don’t want this paper to turn into a procession of statistics, so I will use only one. It is this: in the last seven years prices for PM lambs at Smithfield market, London, increased at a compounded annual rate of 16.75 per cent. Smithfield of course is indicative of the whole UK market which in turn is still the base market for our international lamb pricing.

We’d be happy with that kind of increase in our lamb returns if that was actually what came back into our hands. The fact that we producers haven’t had the full benefit from the bare meat return is not the market’s fault, and we should be clear as well that it is not entirely the fault of the present marketing system.

Whatever the reason, I sense there is a mood for change in New Zealand; a disenchantment with traditional ways and a degree of public scrutiny and enquiry more intense than ever before. In this environment the meat export industry, which in earning power is by far New Zealand’s most important business, is highly visible, especially the lamb production and marketing side which is widely regarded as our national speciality. Our very involvement in discussing this proposition today is a reflection of that situation.
The other three speakers and I haven't compared notes, yet I imagine that in our independent analyses of lamb marketing we will have come to similar conclusions on a number of points. The most important of these centre on that word "change" because there can be no argument that, compared with 10 years ago, five years ago, or even just one year ago, we are confronted with new forces demanding different responses in our marketing approach. There can be no hope for a strong industry, no hope even for its economic survival, unless we are prepared and able to be flexible in our marketing. The differences between the four of us are most likely to be related to the methods by which we demonstrate our flexibility and the rate at which we go about it.

This underlines what I consider to be the real issue which has been posed for us: is there a need for New Zealand’s international lamb marketing to be harnessed, co-ordinated, reshaped, revitalised, controlled?.....If so, how and by whom?

My main advocacy is that the pace of change is accelerating so quickly that we cannot afford the luxury of response by evolution on a wait-and-see basis or, at the other extreme, a transformation by revolution. On that last point, I simply don't go along with some of those people on the sidelines who want us to chuck out the methods developed over nearly a century and suddenly bring in a monolithic single-seller under Meat Board or Government control.

The solution is somewhere in the middle; let's say evolution galvanised by a good crack on the tail. The trends and changes in lamb markets and marketing over recent years have been carefully monitored by the Meat Board and the meat exporters; they have been coped with effectively, and within quite a short period of years there has been a transformation in the methods and direction of New Zealand marketing.

I've no intention of dwelling on historical aspects but a few critical points need to be set out as it seems to me our lamb trade has been subject to four distinct phases which fit together like an arrow to point in a definite direction.

Phase One: From 1882 (the advent of refrigerated shipping in our trade) to the middle 1950s when all our surplus lamb and most of our other meats as well went to the UK. There were no sophisticated words like 'marketing' used in those days. Lamb went to the British butchers and that was that. The Board's annual reports of the time referred to the trading simply as 'disposals'.

Phase Two: Let's call it the Age of Awareness, for suddenly the point struck home that the cosy arrangement with Britain could not last forever. This roughly followed the decade of the 1960s when terms like the "EEC" and "supermarkets" came into our vocabulary and we had to get out and sell, to find new markets which had large populations, affluence and - hopefully - a taste for sheepmeats. The chief targets were Western Europe, Japan, Canada and the US - the latter being the responsibility of Devco, the Development Company, which is a subject I'll return to later.

Phase Three: As the 1960s closed, the UK was still taking nearly 90 per cent of all the New Zealand lamb exported, but the momentum really came in the 1970s. There was a commitment to diversify, and look what happened: although the decade was virtually stagnant in the production sense, diversification took off like a rocket. 20 per cent diversification was exceeded in 1973, 30 per cent in 1975, and 40 per cent in 1979. Remarkable progress? Well wait till this year's diversification figure is established. I estimate it will be about 60 per cent.

Phase Four: There are a number of aspects involved in this phase which somewhat arbitrarily we can say began in the middle 1970s and whose effects are still very much with us today. The Board has found itself overseeing an export lamb industry rapidly being reshaped by at least four major forces.

International trade protectionism. There are few markets now open to us that do
not have restrictions in one form or another. They range from the serious (like the EEC double-banger, a quota and a levy) to minimal constraints. More than 80 per cent of our lamb exports are to these markets or to markets whose imports are controlled by Government or by state agencies.

Inflation and cost escalations. Here in New Zealand we face an uninhibited financial free-for-all with the unions getting just about everything they demand regardless of the product’s ability to carry the costs. Killing and processing costs for lambs have increased at a compounded rate of 23.4 per cent in the last seven years. As Adam Begg pointed out recently, that figure projected to 1990 produces a killing and processing cost of $52.02 per lamb. Marketing techniques, no matter how clever or skilled, won’t keep us in a viable business if we don’t win the cost battle. In countries like the UK the cost of finance has got so far out of line as the result of inflation that there is a growing reluctance by importers to buy far in advance.

Changing consumer requirements. These are caused by things like cholesterol scares about red meats, the swing from butcher shops to supermarkets with their bigger range of foods, and the availability of other cheaper protein foods. The sharp expansion of the Middle East market. Just a few years ago the Middle East was a minor market region somewhere in the direction of Mecca. This year it will take more than one third of all the lamb we export. Its mushroom growth and the reasonable prices that are negotiated have been the salvation of the New Zealand lamb industry this year.

In the face of these forces the Board at times has been obliged to act quickly and decisively, and its actions have not always had enthusiastic support from the trade. For example, it has set its own lamb schedule, it has insisted on controlled storage in the UK and it has become the prime contractor to Iran. It has exercised more discipline on levels of supply through shipping programming. It established the Meatmark operation in the UK and it has stabilised producers’ incomes through a market-related price-smoothing scheme. Some of those people on the sidelines might say the Board’s moves at times have virtually been reflex responses to sudden emergencies. I would agree with that in part. A lot that happens overseas is beyond our control, often is not predictable, but still requires counter moves.

What you have been seeing in recent years, I suggest, is the Board being pulled by events into a greater involvement in marketing. Why the Board? The reason is straightforward: the Board’s historical claim to industry leadership, as manifested in the Meat Export Control Act, rests on the principle of producer control, the Board being directly accountable to the people who make the industry possible. In that role the Board has the ability to look beyond short-term commercial expediency to longer-term objectives, and it has the responsibility to do so in the producers’ and New Zealand’s best interests.

How much further must the Board become involved in marketing? Must it move towards a dominant role, or are there other effective options? This is an important point because the future methods of marketing cannot be established before the lines of authority are defined. I would like to tidy up the point so that there are no misunderstandings. Events have changed the nature of the Board’s involvement and they continue to do so. Although the following facts have been publicised, it appears there is still not widespread knowledge of them.

The Board, through a trust, will shortly own half Devco’s share holding. This has already been agreed to by Devco’s present shareholders, the freezing companies. The effect will be that the Board, representing producer interests, has direct involvement in a fully-fledged lamb marketing organisation.

The Board and the Meat Exporters’ Council are currently considering a joint or
unified approach in a number of areas. They include contingency plans in the event of a major market dislocation, the development of non-traditional markets, product development, the supervision of the important lamb contracts and possibly the establishment and administration of storage in key regions. It is possible that a new partnership between the Board and the MEC will eventuate. It may not go as far as some people might want - it may be too far for some - but I believe it is a necessary move.

What these moves emphasise is that both organisations recognise the new problems. Events have given them a unity of purpose that could have far-reaching effects on lamb marketing in several parts of the world.

That is the organisational side. What about the markets themselves? Here is my view of the line-up and the prospects for New Zealand lamb.

The United Kingdom: This is still our biggest single market and likely to be for some years. It is confused by the likely effects of the EEC Sheepmeats Regulations which, when introduced last October, badly distorted selling patterns and may do so again as payments to farmers are set at politically determined rates which have little relevance to what the marketplace is paying. At present the UK market is sluggish due to a troubled economy. It is also subject to weak and sometimes panic selling of New Zealand lamb at unnecessarily low prices. It is taking diminishing quantities - possibly as low as 150,000 tonnes of New Zealand lamb this year, compared with the record 287,000 tonnes ten years ago.

Despite those current negatives, the UK will remain a very important market for us and, once the dust from the Sheepmeats Regulation clears and the economy picks up, then hopefully one in which we should rebuild our volume towards the 300,000 tonne mark.

Continental Europe: A reduction in the exports of British lamb caused by the "clawback" of subsidies paid under the Sheepmeats Regulation heightens New Zealand’s prospects. With less British lamb going into the Continental EEC, New Zealand stands to gain. A doubling of sales over the next few seasons to about 40,000 tonnes is possible.

Greece: Variable, but still a useful market with sales up to 15,000 tonnes likely.

North America: The markets serviced by Devco in the US and Canada have the potential to grow steadily but they could be endangered by unreasonably high processing costs in New Zealand and the competition of cheap pork and poultry. Lamb in North America is already at prices that make it a luxury food. There is still unwarranted pressure for import protection being applied by American producers.

Japan: In my estimation, a very big potential indeed but requiring a dedicated development approach. I'll return to that point.

North Africa: Possibilities because of the natural liking for sheepmeats. Price could be the sticking issue in some countries.

The Middle East: There are more people in the area than in the UK and they are all sheepmeat eaters. More than 90 per cent of them live in Iran and Iraq. If natural market forces are permitted to prevail the Middle East would soon be taking half to two-thirds of all our lamb exports. The issue that arises is the spread of risk. Can we afford to be so heavily reliant on such a volatile region?
not have restrictions in one form or another. They range from the serious (like the EEC double-banger, a quota and a levy) to minimal constraints. More than 80 per cent of our lamb exports are to these markets or to markets whose imports are controlled by Government or by state agencies.

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What these moves emphasise is that both organisations recognise the new problems. Events have given them a unity of purpose that could have far-reaching effects on lamb marketing in several parts of the world. That is the organisational side. What about the markets themselves? Here is my view of the line-up and the prospects for New Zealand lamb.

The United Kingdom: This is still our biggest single market and likely to be for some years. It is confused by the likely effects of the EEC Sheepmeats Regulations which, when introduced last October, badly distorted selling patterns and may do so again as payments to farmers are set at politically determined rates which have little relevance to what the marketplace is paying. At present the UK market is sluggish due to a troubled economy. It is also subject to weak and sometimes panic selling of New Zealand lamb at unnecessarily low prices. It is taking diminishing quantities - possibly as low as 150,000 tonnes of New Zealand lamb this year, compared with the record 287,000 tonnes ten years ago.

Despite those current negatives, the UK will remain a very important market for us and, once the dust from the Sheepmeats Regulation clears and the economy picks up, then hopefully one in which we should rebuild our volume towards the 300,000 tonne mark.

Continental Europe: A reduction in the exports of British lamb caused by the "clawback" of subsidies paid under the Sheepmeats Regulation heightens New Zealand's prospects. With less British lamb going into the Continental EEC, New Zealand stands to gain. A doubling of sales over the next few seasons to about 40,000 tonnes is possible.

Greece: Variable, but still a useful market with sales up to 15,000 tonnes likely.

North America: The markets serviced by Devco in the US and Canada have the potential to grow steadily but they could be endangered by unreasonably high processing costs in New Zealand and the competition of cheap pork and poultry. Lamb in North America is already at prices that make it a luxury food. There is still unwarranted pressure for import protection being applied by American producers.

Japan: In my estimation, a very big potential indeed but requiring a dedicated development approach. I'll return to that point.

North Africa: Possibilities because of the natural liking for sheepmeats. Price could be the sticking issue in some countries.

The Middle East: There are more people in the area than in the UK and they are all sheepmeat eaters. More than 90 per cent of them live in Iran and Iraq. If natural market forces are permitted to prevail the Middle East would soon be taking half to two-thirds of all our lamb exports. The issue that arises is the spread of risk. Can we afford to be so heavily reliant on such a volatile region?
emphasis on convenience foods. According to researches the Board has done, the enemy is excess fat and our grading system must continue to absorb the whole carcase (fores in Japan's case) to be boned and disassembled into cuts (bone-in and boneless). They are different in appearance, in the cut surfaces because the packaging for frozen lamb at present available is far from perfect. The unions have built heavy incentive payments into cutting and processing, and New Zealand lamb in markets like Canada and the US often is the most expensive red meat in the wholesaler's hands. In the US recently, the wholesale range per pound was 55 cents for chicken, 90 cents for pork loins, 102 cents for choice beef, 110 cents for US lamb carcases, and 140 cents for New Zealand lamb cuts.

However, despite the difficulties involving high costs, the risk of dessication and so on, there are clearly advantages in processing lamb into cuts in New Zealand as well as overseas. The fact is often overlooked that "lamb" is not a single product and that we are, ultimately, a disassembly industry. Lamb is many products - legs, shoulders, chops, racks, loins, flaps, necks etc. They are different in appearance, they are different in price and they are prepared and cooked in different ways. Those countries that handle all of the cuts within their own markets usually prefer to buy carcases. Iran, Iraq and Greece come into this category. Those who can't absorb the whole range so easily generally prefer primal's or subprimals from New Zealand, packaged and ready for the retail shelves. The United States and Canada are examples. There is a third type of enquiry, mainly from Japan for specific parts of the carcase (fores in Japan's case) to be boned and rolled in Japanese plants.

In each of these countries there are also sectors of the market willing and able to buy well-presented cuts (bone-in and boneless) prepared in New Zealand. Because of the high prices, there is considerable emphasis on quality. Lamb leaving New Zealand in other than whole carcase form at present amounts to about 19 per cent or about 60,000 tonnes a year. The growth of further processing in New Zealand therefore depends largely on which countries will be our biggest customers in future. My own thought on this is that the right balance of markets would be about a third of our total lamb going to Europe (Britain included), a third to the Middle East and the balance to the rest of the world. That would provide a good marketing mix of carcases and cuts.

It is also clear in many of our markets that consumer preferences are changing and we have to adjust our product presentation accordingly. The number one enemy is excess fat and our grading system must continue to penalise it. The consumers of the world are refusing to buy overweight pieces of meat for health reasons as well as wastefulness. Many of these consumers, and especially the younger housewives, are adopting cooking and eating habits different from their parents. They are putting greater emphasis on convenience foods. According to researches the Board has done, "convenience" food is something that can be prepared while vegetables are being washed and cooked or while chips are being deep fried. That means a time scale of about 15 to 30 minutes, and the traditional roast leg or roast shoulder of lamb doesn't fit.

I'm not suggesting that roasts are going to go the way of the dinosaur, but the future marketing of New Zealand lamb, in Europe and North America particularly,
will undoubtedly give more attention to smaller portions. Lamb happily is a versatile product, and the primals such as the legs and shoulders can easily be reduced by a skilled bandsaw operator into slices, chops and steaks.

Again, the Board has researched consumer attitudes to these cuts in the UK and found that there is a remarkable level of interest and acceptance. The promotion campaign which is now in full swing in the UK is almost wholly geared to this concept of versatility and convenience, and I venture to say that this is the way much of our lamb will be marketed in these countries in the future.

My reference to a "dedicated development approach" in relation to Japan: North America has become a useful market and Devco has become a successful company only because the Board and the industry took on a long-term commitment to development and stuck to the task. My personal opinion is that the same approach is required in Japan: a commitment over a period, and the development of the market according to the quality and product forms acceptable to the Japanese.

A third reference was to "price being the sticking issue." The point here is that we can't expect to receive top world prices from some markets in the early stages of development. If we accept that lamb production will continue to grow apace over the next few years, as indeed it has done over the last three seasons, then in looking at the various issues we have discussed we find ourselves confronted with a number of questions. Who decides what the spread of markets should be next year and, say, five years hence? Who decides what the spread of risk should be? Who decides what markets (other than those in the volatile Middle East) should be maintained or developed, to what levels and through what price mechanisms? Implicit in these questions is the assumption of a sort of corporate plan, the greater direction or allocation of New Zealand lamb, and the averaging of returns from global marketing.

Historically, that averaging has been done through the lamb schedule with each grade being rewarded according to the international demand for it at any given time. A difficulty now becoming apparent is that the schedule system is being weakened as increasing volumes of lamb are sold outside it. Recently-formed farm groupings and the co-operatives, plus the products sold through company pools, now account for more than 40 per cent of the ownership of lambs at the time of slaughter. This is a quickly expanding trend and it must be taken into consideration when the options for the future are examined.

I believe that the lamb export industry has managed reasonably well up to now, that it has coped with some alarming situations not of its own creation, and that returns in most recent years have been fairly good. It has been something of a juggling act with the Meat Board at times having to come on stage.

But I would also point out that New Zealand has had some lucky breaks during the last few years with its lamb marketing. Among them were the sharp upward movement of lamb prices in sympathy with beef prices when Britain joined the EEC, the sharp improvement in the pound against the New Zealand dollar - a 53 per cent rise in six years - and the emergence of the Middle East as a major buyer. Rather than rely on further lucky breaks in future, I think we must do more to create our own opportunities.

I think that can be done through a combination of approaches, but mainly through a partnership of the Board and the MEC to look after those matters I listed previously...that is, long-term contracts, the development of non-traditional markets, storage, product development and so on.

This would not be a single marketing organisation, a monolith. But it would be a marketing organisation with authority in specific regions whose collective volume in future could account for more than 40 per cent of New Zealand's total lamb sales.
This way the private enterprise system would be given the chance of robust survival in a world where situations of crisis more and more are leading to Government intervention and takeovers.

An example are the supplementary minimum prices that will apply next season. Unless there is a market upturn of unexpected dimensions, or unless New Zealand devalues, those SMPs are unlikely to have any relevance to what is actually happening in the market place. It is appreciated that the SMPs are an endeavour by Government to restore farmer confidence and permit producers to plan their programmes, and there is no doubt they will be successful in that respect as a short-term measure. The danger is that they will divorce farmers from the realities of the marketplace and cost escalations within the industry. With the Government paying producers 145 cents a kilo for lamb regardless of what the price is at, say, Smithfield there will not be the same pressure on markets to perform.

Next, I believe we have to ensure there is greater discipline in the UK lamb marketing. We already control the level of supplies through shipping allotments and by regulating sailing as best we can. But New Zealand is let down at times by consignment sellers and by companies whose own cash-flow situations occasionally make them weak sellers. These are not necessarily small companies either.

The market is so sensitive that even small quantities of lower-price lamb can deflate it. The Board was faced with such a circumstance in the UK recently. Domestic beef and lamb prices were high, imported frozen lamb stocks were low so that our prices should have been strengthening, but there was evidence of some traders bailing out at ridiculously low prices for New Zealand produce that was threatening the whole tone of the market. The Board made some stern statements in the right quarters and the problem was quickly and successfully rectified.

In this case it required persuasion to reverse the negative thinking of some traders. Their agreement to put the plug in, probably meant that direct intervention by the Board was avoided. Let's be clear on this point. The Board has intervened in the UK market with Meatmark. The intervention naturally brought protests from the trade but the simple fact is that the Board cannot stand by and be a passive witness to unnecessarily low prices or a market collapse that could have devastating effects internationally. The trade may claim the market will bottom out naturally. What we have to ask ourselves is how deep is the bottom?

There are a number of approaches available to the Board to protect prices in the British market and they can be implemented whatever the market circumstances are. They can also be implemented at either end - in New Zealand through a minimum Board schedule, for instance. I see this as a continuing role for the Board....the close monitoring of the markets, the elimination of weakness where possible, and protective moves in times of crisis. To intervene massively in the UK would, in my view, lead us straight into a global single-selling organisation.

On the other hand, my personal preference would be to see the Japanese market given the special attention it needs to fulfill its potential. I see no conflict here. The UK is our base market developed over a century. Japan is at the primary stage of development with most of its people not yet knowing what lamb is. The Board over a long period of years has sunk a large amount of money into Japan, yet there have been variable volumes of lamb in the last few years, variable according to what other markets are paying. Quality has sometimes been less than desirable and there has been too little follow-through by New Zealand exporters.

The development of Japan need not be through a Devco-type approach, though I do not rule it out. It could be a market exercise limited to those companies with a solid history in Japan and possibly even jointly with the Board and Japanese partners.

My recommendations therefore are consistent with a policy of prodded evolution
and in part they are in line with initiatives already taken by the Board. They are aimed at preserving the present strengths of the industry but at the same time creating a global strategy for lamb marketing that retains a strong competitive element and is capable of meeting the changes and crises that will come in inevitable procession. I believe the combination of the Board and the MEC would be the springboard for all sorts of developments.

These recommendations do mean greater discipline of the industry but, in the changing circumstances, that is an unavoidable response. I conclude by pointing out that my recommendations still leave room for flexibility in the future and for additional responses according to the needs of the times.
Lamb marketing and the domestic base

I.H. Jenkinson, Chief Executive, Primary Producers' Co-operative Society

The views I have on marketing will probably appear to be more conservative than progressive, but I am going to caution against some current thinking regarding marketing. My ideas attempt to accept the internal New Zealand political constraints that have the effect of destroying most progressive marketing policies within the South Island meat industry as it exists today. I must confine my remarks to the South Island meat industry, because it is a very different industry in my opinion to that in the North Island.

The export meat industry in the North Island has a much stronger domestic base due to the extra population. In the Auckland provincial area and the Wellington provincial area, there is a very great degree of control of the domestic meat industry by meat processing and export companies. The North Island also, because of its climate, can produce export livestock for a much longer portion of the year, which allows the development of some sophisticated markets, such as that for chilled beef, on a twelve months' supply basis. Some areas of the North Island do not have the intense labour problems that cause the freezing works in the South Island to be out of action many more times than the casual reader of the newspaper would be aware of. In some areas, this industrial peace has been bought at what will, long term, be a very high cost to New Zealand. But, in other areas, it appears to be a genuine reflection of the attitude of the workers towards their work place. In certain areas, such as the Hawkes Bay, it appears to be basically an intangible attribute resulting in industrial peace in both large and small operating plants.

Reverting to the situation in the South Island, it always appears to be something of a problem that governments and statutory boards, set up to perform certain functions, rapidly discover that the basic functions and election promises are
almost impossible to carry out, so that other opportunities that give people or organisations the chance to criticise an industry, will be used to take the minds of the average observer away from what the elected body should be really doing. I would suggest that if governments governed, we would find lamb marketing and lamb trading a lot easier. Similarly, if the New Zealand Meat Producers Board concentrated its undoubted talents on the problems of overseas freights and product grading, just to mention two of its important statutory responsibilities, the return to you, the farmer, from the trading opportunities existing at the present time would be greater.

Therefore, my first recommendation to you farmers would be: we can sell all the lamb that New Zealand can economically produce at profitable prices, when the government either holds our inflation rate to equal or below that of our major markets, or consistently devalues our currency and controls the subsequent economy to bring about the same result.

My second recommendation would be regarding labour costs and labour attitudes in the New Zealand Meat Industry. One hundred years of the Meat Industry has given labour and management a great deal to answer for. Short-sighted policies by boards and management and short-sighted policies by Government have all formed a rigid structure which does not appear to have the ability to change to new technologies, new market requirements, and the product development necessary for New Zealand to maintain a place in existing and new markets. There is no doubt, if an export meat industry was as important to the economies of Germany, Japan or France for instance, as their existing major export industries are, we would now see in existence, an almost completely automated slaughter line similar to that available in chicken factories. Undoubtedly, this automated slaughter line would employ highly paid operators, which is right and proper, but they would be very few in number to cope with very large kills.

The economic difficulties of farmers are not caused by problems directly related to the people who are attempting to sell meat on overseas markets. The frustration of farmers, in relation to returns from their produce, seeks some natural outlet and this natural desire is to attempt to change the only economic sector that appears to be easily manipulated - the marketing sector. Farmers know that the New Zealand style of democratic Government cannot control absurd wage demands by civil servants or key unions. The farmers know that New Zealand democratic government shrinks from controlling inflation, because it is politically inexpedient to do so. The farmer knows that costs will be uncontrolled in most domestic sectors affecting farmers.

Farmers then look at the residue from exporting meat paid to them by the exporter and fix irrationally, but understandably, on this section of their income as providing the faults and the potential cure of their financial problem. Everybody - the government, the unions, politicians - wants pressure taken over their own irresponsibility as far as governing New Zealand is concerned and what better target than the export section of the meat industry.

In a free market situation some blame can be sheeted home from time to time to the errors of judgement made by individual meat exporters, but the marketplace takes care of such commercial errors quickly enough to have little direct effect on farmers as a whole. How more dramatic would be the effect of a single seller organisation. Farmers must realise that they cannot even control governments; how much less a monolithic meat export organisation, regardless of how it was tied in to a free enterprise system. Unfortunately, proponents of such organisations find considerable enthusiasm in governments for such attractions in marketing conceptions, because such proposals do not find fault with the various economic problems existing within New Zealand.
The idea of a single marketing authority as a panacea for your internally generated problems would be ludicrous, if not taken so seriously by various interested parties. Nobody, except perhaps the politbureau in public statements, accepts that any economic or political system is perfect. Thoughtful people within the meat industry know full well that under the present private enterprise system of meat trading there are substantial stresses. Some of the most aggressive proponents of free enterprise, once having developed into large and powerful organisations, immediately commence producing excellent arguments to allow a semi- or complete monopoly situation to come into being.

This, in my opinion, is one of the worst aspects of free enterprise, needing to be vigorously controlled. Because an organisation has performed in the past, there is no guarantee it will perform in the future, or has any special privileges or reasons for consideration in the marketplace, but only the marketplace can take care of this.

The New Zealand meat industry, both as far as New Zealand and overseas owned and operated companies are concerned, mainly grew up and concentrated on the processing elements of the business. The marketing element was not required, being simply a matter of consignment of product to the overseas principal major agent or market. In the early stages of development of other markets outside the major meat markets, the companies relied on F.O.B. selling of their product to entrepreneurs developing such markets. Many small aggressive meat processing and marketing companies now exist. In many cases they now show the way towards specific markets and specific techniques, to the benefit of their suppliers and the meat trade generally.

Just how the balance of enthusiastic growth of new marketing companies, or a change in direction of existing companies can best be encouraged is, I think, the most important problem we should put our minds to. Regulation of markets has not done this. To a considerable degree, we have already seen the concept of a single controlling marketing organisation, in the activities of the New Zealand Meat Producers Board in relation to the North American market, the Peruvian and Chilean markets, the French and West German markets. Regardless of how much propaganda has poured out about Devco, in relation to North America, the market penetration in relation to the North American market has been pitiful. We all know the United States market is a demanding market. We also know how well, we are told, our product is presented and marketed within the United States. Why then, is the amount of lamb product going to America failing miserably to keep pace with the increase of lamb product being produced in New Zealand?

Reverting to Chile and Peru, both these are single seller markets and are disastrous. Chile, unfortunately, is a Federation of Labour nightmare, but nothing has been done in Peru for a large number of years, in spite of the fact that it was handed over to one company to develop. The West German situation was developed on a limited number of sellers being allowed to develop the market. In the majority of cases, the firms involved were overseas companies, something which never ceased to amaze P.P.C.S. West Germany has now reverted to a semi-controlled market which is basically almost uncontrollable under the general E.E.C. regulations.

West Germany will now become an important market for New Zealand. In France we have a slightly different situation, in that New Zealand has agreed to limit exports to France as a sensitive market. However, the product mix which has been insisted upon by economists and other non-marketing people into the French markets, is going to kill that market completely during early 1981. One of the fundamental problems with controlled markets, is that one cannot control the attitudes of the importers or distributors. Nobody in Europe really needs New Zealand lamb. The total product mix could be manipulated to allow other meats available, which at the present time go into intervention, to more than fill any
shortfall or banning of New Zealand lamb. In Europe New Zealand lamb tends to be a luxury item and therefore a high margin item for wholesalers, distributors and retail outlets.

A great deal is made by concerned New Zealanders and politicians about further processing in New Zealand. We have seen some constant improvement in lamb cut tonnages in recent years. A minority of the production has been from an assessment of what the market wants while a majority has been because of the construction of the export tax incentives. My argument here is that there are a number of physical limits to New Zealand technology and New Zealand freezing works labour allowing a rapid increase in the further processing of lamb within New Zealand. Farmers keep on saying "Give us sufficient price encouragement and we will produce the right sort of lamb for the market." There is no right sort of lamb for all markets. Similarly, external forces, such as the relative value of wool and meat and, above all, the weather, are two of the most important factors deciding the type of lamb that you, the farmer, have produced over the last few years.

I am afraid that we are going to see more and more of this type of restraint, based on the pragmatic attitude of farmers towards well-meaning efforts on the part of government and other bodies to increase production of various different products such as wool and beef, with everybody failing to realise that the spin-off from some of these emphases may upset a product's suitability for a market. One serious spin-off is the deterioration in carcase quality as far as meat/bone/fat ratio is concerned. We are lucky the Middle East market has not access to European lambs as a comparison.

This year has seen a substantial increase in the number of Y Grade lambs produced within New Zealand. This is undoubtedly due to, firstly, the swing towards wool-type sheep and secondly, the lack of feed during the early part of the fattening season. Markets have been found for these products in the Middle East, so their sale has been no problem, but, unfortunately, the lighter end of the Y Grades tend to be a particularly expensive lamb for the processing companies to handle and, therefore, the margins returned from overseas on these lambs, when they are in very large quantities, tend to diminish, not because of overseas prices, but because of the high production costs in New Zealand. We have, therefore, a situation that, whereas a lamb may be sought after as a marketing entity by companies such as P.P.C.S., it is certainly not sought after as a processing entity by the processing companies. Only one thing matters to a processing company and that is poundage of product through the works.

Similarly, next year if we have a growth year, we could see ourselves with a substantial swing back to heavy P grade lambs, lambs which will be completely unsatisfactory for the markets which we have so carefully developed during 1981. The farmer says "Give us the price and we will sell the lambs as Y grades rather than P grades." With the greatest respect, this will not happen if a farmer is looking at a sea of grass.

Reverting to the concept of commodity markets and specialist markets, A.E. Frazer of the New Zealand Meat Producers Board in an article in the *New Zealand Meat Producer* (April, 1981) spells out a way in which New Zealand must go, in the European market, with a heavy lean lamb, producing quality cuts at retail. However, this is not going to replace the necessity for New Zealand putting large quantities of frozen carcase lambs into the United Kingdom for some years. Unfortunately, this necessity is more New Zealand's than the United Kingdom's. The production in New Zealand of quality cuts is not possible within the constraints of the freezing industry. Far too much lamb cutting in New Zealand is now decided on what the maximum tax incentive is, rather than whether the product suits the market's
requirements. And yet, it is difficult to see profitable cutting on any sort of scale, without substantially increased incentives, because of the cost structure within the freezing industry. P.P.C.S. itself cuts substantial quantities of lamb overseas, because the type of cut best taken from frozen lamb does not lend itself to maximising the export tax incentives and, of course, one also has the great advantage of a lower priced carcase product when assessing import tariffs.

We can now turn to our responsibility of P.P.C.S. as a trading organisation and discuss what steps we might be able to take to help the farmers' returns, completely ignoring the problems we have already mentioned because, politically, P.P.C.S. does not consider that anybody is going to do anything about them. You might immediately say "What can P.P.C.S. do about the export market?" By being a segment of the free enterprise meat trading arrangements that New Zealand has agreed so far to maintain, we must encourage a system which, with all its warts and problems, still, in my opinion, returns to New Zealand the best possible price year-in and year-out.

Firstly, we must define our lamb markets. It is here that I want to introduce a simple concept regarding our lamb markets. Other people appear to have more complex assessments of our lamb markets than P.P.C.S. suggests. There are two major types of lamb market. Both markets exist in some countries, only one market type in others. P.P.C.S. feels it is not necessary to complicate the New Zealand export lamb markets situation, as some people appear to have done in recent publications. The market concept divides lamb markets into commodity markets and specialist markets. It is hard to see any of the specialist markets developing into volume markets in the short term. We are therefore going to need all our commodity markets as well as all the existing specialty markets, more specialty markets and, of course, more commodity markets. The commodity market in most cases consists mostly of carcases, but could also involve, in some cases, cuts, because the lamb cuts are competing with carcases in those particular markets. In the case of most commodity markets, price is the most important factor and, usually, use must be made of existing distribution networks to compete effectively against other imported foods and locally produced competing products. We forget at our peril that we in New Zealand are not in the export meat business, but in the food production business so that our products compete on each overseas local market with a greater or lesser range of food products.

Historically, the United Kingdom has been, and remains, a commodity market. This situation stretches back over 100 years to when the United Kingdom started to take pragmatic decisions regarding a basic free trade philosophy to import basic raw materials, including foodstuffs, and export manufactured goods. This situation has been under some pressure during the twentieth century and is now changing dramatically under the pressure of EEC membership. We could suggest that the entire imported meat trade in the United Kingdom, and the attitude of everybody involved in imported meat, has grown up under this laissez-faire arrangement.

We have, therefore, as far as the old school of meat importers in the United Kingdom are concerned, what we could call the "Smithfield mentality" of an ordered mediaeval society still having a remarkable degree of influence because of tradition. This Smithfield mentality still seems to control the United Kingdom lamb trade, even though Smithfield Market itself is no longer an important market force as far as imported New Zealand lamb is concerned. The cut lamb trade to the United Kingdom still fits into this general commodity trade, although some degree of sophistication is even entering into this sector under the influence of some supermarket chains.
Most European markets, on the other hand, have always been oriented to internal production of most of their meat requirements. This suggests that most European markets could still be developed as speciality markets. Unfortunately, the example of the United Kingdom’s lamb market trading policies have been noted by all European countries. Pricing of lamb into a particular market is very quickly known in another market, and Europe also has had to contend with a large sector of the imported meat trade being controlled, up to recently, by United Kingdom companies with branches in most European countries. This has further tightened the relationship between what is happening in the United Kingdom and what might happen in Europe. I think it is fair to say that we have seen from time to time in Europe, prices unnecessarily reduced by such international operators for their own good purposes. We look forward, therefore, to the development of stronger indigenous importers of meat in most European countries, to combat this commodity attitude. P.P.C.S. has suggested that the handing over of the West German market to a preponderance of United Kingdom based firms only exacerbated the position that has just been described.

P.P.C.S. feels that the markets in Europe can be developed as high class cut and carcase markets with the occasional hiccup as some E.E.C. or New Zealand based meat operator dumps some product on to one of these markets and puts our marketing plans back for a few months. We have, therefore, to encourage these markets to become specialist markets and free enterprise can do just that.

The Middle East is also a price conscious commodity market in most volume areas - with in many cases suspicious traders who have certainly been treated quite irresponsibly by some brokers and other parties in the past. In many cases the importers do not understand their own customs and tariff barriers or their veterinary regulations. The Middle East, however, is also partly a speciality market requiring multi-product deliveries to the more sophisticated shopping complexes being developed. These two markets must be separately assessed and supplied.

Japan is a curious mixture of commodity lamb trading as a hangover from the large mutton purchases made in previous years. With care it can be developed into a speciality market relying almost entirely on processed lamb products from New Zealand, once again with hiccups caused by the dumping of various products onto the market, mainly caused by the effects of taxation incentives. P.P.C.S. sees Japan as a market to persevere with, supplying high quality chilled and frozen cuts to the restaurant trade, especially those specialising in French dishes, and a market which will develop even further, requiring large quantities of boneless lamb to compete with pork and a carcase trade just big enough to allow some on-processing in Japan. As far as the competition with pork products is concerned, the Japanese government will never allow it to get out of hand, because the production of most Japanese pork is strongly protected. However, there are massive importations of pork into Japan and some of these, we hope, can be replaced by boneless lamb products.

Other speciality markets exist in large numbers. They are all being regularly developed by various sectors of the private enterprise meat export business. From time to time one does lose one of these markets on a pricing basis, but usually the product supplied by a competitor is not the quality required by this particular speciality market and the market can be retained by someone willing to produce a quality market.

A major point I wish to get across is that the present aggressive competitive market forces working for you in the international marketing field can maximise New Zealand’s returns if given some sort of reasonable cost structure within New Zealand.
For some years now, there has been a trend for greater involvement of New Zealand owned companies in the export lamb field. Actually we feel that this trend has just started its second purge of overseas involvement. The first purge was when the American companies departed, almost unnoticed, the Swifts and Armours, more latterly the International Packers, leaving, as far as I can ascertain, one very small American remnant to remind us of the heyday of the American meat barons in the New Zealand export lamb trade. We now see the start of the British companies under the E.E.C. influence departing quite quickly, where their New Zealand investments can be liquidated. We have seen the latest arrival, F.M.C., depart first, but over the next few years you will see a substantial reduction in the involvement of other large British companies in the New Zealand processing and exporting scene. I would like to remind you that some of these changes will not be to New Zealand’s advantage, because they will reduce the political clout that New Zealand has had through British investment in the Freezing Industry in New Zealand. The companies concerned, however, are completely pragmatic and realise that there are more opportunities within Europe than being involved as international traders.

What I have endeavoured to show is that the present free enterprise system has so much going for New Zealand and the New Zealand farmer that radical change to controlled markets is going to lessen farmer returns - we need a better internal structure to take advantage of export opportunities.
Lamb production and marketing

LAMB

P.H. Johnston, General Manager, W. & R. Fletcher Ltd., Wellington

With the two primary concerns of supply and demand, it is healthy that the prospects of supply should trail the potential demand. Demand can fluctuate because of economic factors or other circumstances, so if the supply and demand equated precisely, you would inevitably be in continuous trouble.

However, the figures say actual sales performance of recent times to some 84 countries, who have an acceptance of lamb and can pay a reasonable price, encompasses some 435,000 tonnes on an annual basis, and can be seen to offer potential of a further 155,000 tonnes. Those figures demonstrate what is a fact - that this year we are slightly short of lambs with an estimated close to 400,000 tonne production or 30 million lambs, and that there is a possibility within the decade of production disposal of up to 590,000 tonnes, which equates with an additional kill of 14 million lambs.

Frankly, availability of a further 14 million is stretching it a bit - hence the comment that the problem is not availability of customers nor the ability of current exporters to sell. Where there is a problem, and one on which all seem to agree, is in New Zealand’s inflation rate performance vis-a-vis its customer countries, which progressively worsens terms of trade. You cannot - as you are competing with local foods and meats - expect to close the gap with ever increasing prices to solve our own intrinsic cost problems.

Other attendant problems are high interest rates and tight availability of finance, both of which are costly for responsible marketing. New Zealand’s internal performance is a problem for marketing in returning an acceptable farm gate price. It is not the sale prices or marketing efficiencies which are creating the problem.

Hence to select marketing as a point of attack is to worry about the symptoms and not the disease - akin to taking a cow with mastitis and chopping its head off. You have quietened the complaint without attacking the true source and in the process you have killed the production machine.
It is reasonable, however, to pull out sacred cows every now and again and look them over in the light of proposition and comment. The main critics of, or concerned parties in, the free enterprise system at present operating seem to have similar statements of concern, really similar ideas of solutions, differently expressed, and an identical preference for "order" and "control". Basically the criticisms, or concerns, appear to be the difficulty in the quota market in E.E.C., and a foreseen growth of protectionism. Areas are unspecified, although the phrase "most lamb markets" often appears; the appearance of some and the possibility of more single-buyer government type purchasers, and increasingly complex demands and changing circumstances.

When one looks at the history since the mid-50's one is bound to say - "So what's new?" Quotas have been a fact of life for years for beef in the USA and Canada, and the formulae used have not prevented market development, entry of new entrepreneurial companies, or the fulfilling of the quota. Single buyers are not new either. Many in the Communist bloc countries are opportunist outlets rather than long-term marketing prospects, and important ones such as Iran and Iraq have not been easy but they have been dealt with effectively.

As to complexity increasing, if actual sales to something like 84 countries of widely different ethnic types does not demonstrate that that is being dealt with every day, what does? I believe very strongly and put to you that you must make your mind up and declare yourself on the question of free enterprise versus monopoly control, as nothing can be more destructive of investment of money, time, and organisation than a constant threat of loss of ownership - and the question of SMP's looms large here.

I have already sketched out how free enterprise marketing has demonstrated amazing versatility in finding markets for lamb in an increasing diversity of form - and been flexible enough to combine and co-operate nationally when a particular circumstance has required it. Implicit in the free enterprise system is constant and unrelenting competition between upwards of 80 exporters, which obviously involves a considerable array of talent, and diversity of expertise. Some succeed, some fail and are replaced, but to succeed and obtain the base supplies they have to match it with the others and take some pretty big risks in the process.

Against that, the main propositions basically speak of a "controlled" marketing really under one monopoly set-up. Whether it be a corporate NZMPB/MEX set-up or whatever, it will say who can have what and what they can do with it. Ultimately, I must say, there will be a temptation - because monopolies have to be orderly - to dictate to livestock supply as well. Competition must be minimised and there cannot be room for the spread of competitive entrepreneurial talent. If you can think of a set-up more likely to antagonise major trading partners such as United States and E.E.C., I invite you to try.

The only premise which would justify something other than the present system would be to obtain prices for lamb which override pro tem competition - in short to assume we have a monopoly position. We have not got a monopoly position because lamb is meat and must compete with other forms of meat largely produced and marketed in a free enterprise way. In those circumstances a monopolist approach will lose.

All of which will be considered in some quarters as a dinosaur-like defense of that dreaded term, the "status quo". With the history of the last two decades one could well ask - "What status quo?" - change has been vast and continuous, and adaption likewise. Free enterprise is the only way to cope with the inexorable law of supply and demand. The comfortable "controls" of the uncontrollable will lead you down the wrong road.
The foregoing claims the present system to be perfect - and it is, in principle. There are, however, improvements which can be recommended, some within the powers of the exporter, some not.

In the first category comes presentation, and it is noteworthy that industry is working on many improvements here. For example, shrink wrapping must improve bloom at delivery and - more obviously important from the monetary point of view - it reduces weight loss in transit and in store.

A growth of chilled product is a long-term desirable, say in the Middle East where frozen product is at the bottom of the preference list. A number of companies are working on this, and it is not easy because the chemistry of lamb is more prone to deterioration than beef.

Water is thrown at our product in the cause of hygiene, and the present regulations dictate a “final wash” after the lamb has passed inspection and the scale. This causes problems of cost in subsequent handling and loss of bloom. We are looking at the necessity and we should have the co-operation of MAF, not a blind insistence on regulation.

In the second category are some problems which derive from the intrusion of politics instead of pragmatism into the industry.

Export licences are awarded after recommendations on the applications from MEX and NZMPB to the Minister of Agriculture who is not, however, obliged to follow the advice offered. He very often has not done so, and a proliferation of licences has resulted along with a proliferation of small in and out “sellers” with no marketing expertise, intention, or responsibility. That can result in “price taking” as opposed to marketing. I am not suggesting a restricted licence system, but if we have to have one at all some dispassionate criteria on organisation, commitment to facilities, and representation seems sensible.

A third category is basically one of information, and a difficult one to pin down. That is the quality of production which seems to me currently to be in danger of going off the rails. A demonstrable value in larger lean well-muscled animals and an enforced change in the schedule structure led to the popular cry that “One more kilo per lamb means $60 million more revenue.” It has also led to what seems an increasing trend for large lambs with an appalling eye of meat and some guidance is needed here.

The final improvement - or necessity really - is the need to deliberately foster promising smaller markets at some initial disadvantage to the best return. This is a strategy the MEX is fully aware of as necessary, and is well able to handle - perhaps in conjunction with NZMPB - and in any case there is evidence this is already occurring. Such an approach, however, does not alter the fact that some 30-35 per cent of our product will land in the Middle East where the wealth seems likely to be for the next twenty years.

Smaller market development cannot obviate the risk of that market - it is as well to remember people at war eat as much or more as in peace. Risk, however, is what this business has - and will always be - about.
A single company approach for New Zealand marketing: the key to the future

T.D.C. Cullwick, Professor of Marketing, Department of Business Administration, Victoria University

Recently Federated Farmers commended the Government's announcement of increases in the Supplementary Minimum Prices (SMP) for lamb from the 1980/81 level for PM grade lambs of 110 cents per kg to 145 cents per kg for 1981/82. Farmer concern at the rapid escalation in on-farm costs and associated liquidity problems no doubt prompted the early announcement. Nevertheless it is also considered that the SMP scheme plus good climatic conditions has assisted the increase in export lamb production from 303,504 tonnes in 1977/78 to the 350,138 tonnes of 1978/79 and the estimate of 395,000 tonnes for this year.

Ironically, however, it is my belief that these recent increases in SMP levels will be a major catalyst for challenging the status quo of the present export marketing system for lamb. In brief, I refer to their apparent lack of relationship with expected market realisations which means that exporters will have difficulty offering a schedule which will be acceptable to either the Meat Board or Government. I would remind you that it was only last October that the Meat Board threatened to take over the marketing of lamb from exporters! In my view this latest SMP move clearly signals a Government push on two critical groups in the industry - namely the Meat Producers Board and the meat exporters.

There are however two other areas in which major changes are occurring, and which are themselves challenging the appropriateness of the traditional export selling system for lamb for the future. These two areas are (a) a changing production and processing situation in New Zealand and (b) a changing international market situation for lamb.
PRODUCTION AND PROCESSING SITUATION

Let us initially consider the production and processing situation. Firstly, lamb export production has increased sharply in the last three years and the industry is currently estimating levels of 432,000 tonnes in 1984/85 and 541,000 tonnes for 1989/90. These are substantial increases for which profitable markets must be obtained. Secondly, on-farm and processing costs have been increasing rapidly in the last two years or so, e.g. on-farm costs increased by 22 per cent in the last year, when annual inflation was approximately 16 per cent. This means that better market realisations and processing efficiencies are required to offset this situation. Thirdly, the delicensing of the industry at the processing level allows open entry at the processing level. Over the decade it is predicted that up to 24 additional processing chains will be required and I believe that these will increasingly involve local ownership. Hence the overseas companies’ control of lamb at time of processing could decline from around 50 per cent of 1979/80 to perhaps only one-third by 1989/90. A fourth factor is that farmers are concerned at the decreasing proportion of the market realisation they are obtaining with increased freight and processing costs. More farmers will seek to sell on an own account or pool system basis to endeavour to maximise their returns. For this year the Meat Board indicates 40 per cent of all lamb being sold through these systems.

INTERNATIONAL MARKET SITUATION

Let us now consider the international market situation for lamb. Firstly is the need to recognise the changing nature and role of the United Kingdom market. In 1969/70 that country accounted for sales of 289,805 tonnes (or 84.6 per cent of lamb exports). In 1979/80, ten years later, it accounted for sales of only 180,661 tonnes (or 48.4 per cent). This year that figure could be as low as 150,000 tonnes, a figure which could be the target in the years ahead. Increasingly it is a market which is very fragile in respect of demand and pricing even though it continues to act as reference point for price levels negotiated in other countries. Secondly, the expected increases in production means that profitable markets must be found for up to 280,000 tonnes in other countries by 1984/85, and 390,000 tonnes by 1989/90. While there may be some debate about the figures I suggest, to me there is a need for substantial market development beyond the progress currently made in the Middle East, in North America; or in Continental Europe. Recent lamb sales patterns are outlined in Table 1. Recent FAO estimates are very optimistic, however, for lamb consumption in the next decade or so with Africa, Middle East, Asia, North America, East Europe, and Japan being identified as major areas for potential consumption.

Other market situation factors include the increased control on market access in different countries, either through a single buyer situation as in Iran or through tariff/quota barriers, e.g. EEC. Including the Devco situation, approximately 85 per cent of lamb sales are achieved in controlled market situations. Increasingly too, is a differential pricing being achieved between countries. The majority of lamb exports are made in carcase form (80 per cent) with Devco requirements for USA/Canada being the largest purchaser of primal cuts. Exporters indicate that “further processed” products will be more important in the future but product development progress to date has been very limited. Greater progress in this vital area will be required as the industry seeks to develop specialist metropolitan markets, including retail, catering, or hotel/restaurant segments.

It is my belief that the production, processing, and marketing changes I have outlined will seriously challenge the appropriateness of the existing export lamb
**TABLE 1**  
**LAMB SALES PATTERN AND 1980/81 ESTIMATES**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>United Kingdom</strong></td>
<td>210,067</td>
<td>179,925</td>
<td>205,378</td>
<td>180,661</td>
<td>180,000</td>
</tr>
<tr>
<td><strong>Other EEC</strong></td>
<td>11,338</td>
<td>20,493</td>
<td>18,084</td>
<td>12,747</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Greece</strong></td>
<td>4,399</td>
<td>14,894</td>
<td>14,267</td>
<td>4,667</td>
<td>10,000</td>
</tr>
<tr>
<td><strong>Other W. Europe</strong></td>
<td>3,707</td>
<td>3,577</td>
<td>4,377</td>
<td>3,530</td>
<td>(a)</td>
</tr>
<tr>
<td><strong>Canada</strong></td>
<td>7,105</td>
<td>9,114</td>
<td>8,597</td>
<td>9,976</td>
<td></td>
</tr>
<tr>
<td><strong>USA</strong></td>
<td>7,328</td>
<td>12,477</td>
<td>14,187</td>
<td>10,928</td>
<td>25,000</td>
</tr>
<tr>
<td><strong>Hawaii/Mexico</strong></td>
<td>296</td>
<td>533</td>
<td>973</td>
<td>934</td>
<td>(b)</td>
</tr>
<tr>
<td><strong>Caribbean</strong></td>
<td>2,088</td>
<td>2,339</td>
<td>1,889</td>
<td>2,384</td>
<td>(c)</td>
</tr>
<tr>
<td><strong>South America</strong></td>
<td>29</td>
<td>88</td>
<td>42</td>
<td>176</td>
<td>(d)</td>
</tr>
<tr>
<td><strong>Iran</strong></td>
<td>27,384</td>
<td>27,145</td>
<td>3,668</td>
<td>64,632</td>
<td></td>
</tr>
<tr>
<td><strong>Iraq</strong></td>
<td>9,051</td>
<td>2,733</td>
<td>13,111</td>
<td>11,665</td>
<td>105,000</td>
</tr>
<tr>
<td><strong>Other Middle East</strong></td>
<td>3,241</td>
<td>2,852</td>
<td>3,716</td>
<td>20,742</td>
<td></td>
</tr>
<tr>
<td><strong>Africa</strong></td>
<td>1,199</td>
<td>1,012</td>
<td>921</td>
<td>828</td>
<td>(e)</td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td>14,305</td>
<td>15,279</td>
<td>18,243</td>
<td>12,666</td>
<td></td>
</tr>
<tr>
<td><strong>Other Asia</strong></td>
<td>2,915</td>
<td>2,535</td>
<td>2,347</td>
<td>2,217</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Pacific</strong></td>
<td>6,925</td>
<td>8,501</td>
<td>10,016</td>
<td>11,388</td>
<td>10,000</td>
</tr>
</tbody>
</table>

**TOTAL EXPORTS**

|                  | 311,277 | 303,504 | 319,816 | 350,138 | 378,000       |

**NOTE:** Meat exports by shipment for 12 months ending September of each year.

*An estimate for the small markets (a, b, c, d, e).*

marketing system. Concern for change has increased substantially in the last year with the continued impact of high levels of inflation, along with the substantial increases in export production. From a farmer viewpoint a critical question is whether he obtains a sufficient return from the market realisations to make lamb production profitable over time. Processors and exporters too are concerned about their profitability over time. Despite the farmer belief that someone else is making most of the money, there seems little evidence to indicate that the companies are highly profitable after payment of hygiene expenditure and marketing costs!

In this regard it is interesting to reflect on estimates of market realisations and schedule estimates for lamb. In table 2, volume and price estimates are made for different markets which gives an average FOB return of 188.4 cents per kg. The works/FOB charge of 68.2 cents refers to a PM grade lamb processed at a works in Hawkes Bay, and the 2 per cent commission is an allowance for marketing effort for the exporter. The nett figure of 116.4 cents per kg relates closely with the intial schedule and minimum price of 113 cents per kg and the SMP level of 110 cents per kg.

Where then is this vital industry going? Are changes necessary in the marketing system? I believe a basic change is required - that the industry change to a single company approach for lamb marketing.

A SINGLE COMPANY APPROACH

My proposal is for the formation of New Zealand Lamb Marketing Company Limited which would involve equity participation by the Meat Producers Board and individual exporters. It would be responsible for the marketing of New Zealand lamb on a world-wide basis through the appointment of agent(s) for specific markets. Where appropriate the Company could establish subsidiary companies or itself directly act as the sole agent for a selected country, eg Iran.

The company would have four directors nominated by meat exporters, four by the Meat Producers Board, and two by the Government. It would have the right to take over ownership of lamb exports at FOB, except where being sold by exporting companies which had been approved as selling agents in specific markets.

The marketing responsibility of the Company would include product quality and packaging; product development; pricing and promotion policy; shipping and distribution, and marketing research. It would develop marketing plans for different regions and markets. In addition it would balance the returns from different markets with the investment expenditure required in product and market development to sell expected levels of lamb exports at profitable levels.

The establishment of this single lamb marketing company is an approach which will combine global marketing management, product and market development, and production/selling co-ordination, which are vital factors for effectively marketing lamb in the 1980’s. Key marketing objectives of the Company will be:

• To develop an agressive and unified approach to marketing in the United Kingdom to revitalise demand at realistic price levels. The number of exporters able to sell to that market would be reduced from 33 to five.
TABLE 2

AVERAGE MARKET REALISATIONS FOR LAMB
Estimates for 1980/81

Estimates made in October 1980.

<table>
<thead>
<tr>
<th>MARKETS</th>
<th>TONNES $FOB/TONNE</th>
<th>REVENUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>180,000</td>
<td>1,750 $315 Million</td>
</tr>
<tr>
<td>Middle East</td>
<td>105,000</td>
<td>2,400 $252 Million</td>
</tr>
<tr>
<td>EEC (Excluding UK)</td>
<td>20,000</td>
<td>2,000 $40 Million</td>
</tr>
<tr>
<td>Greece</td>
<td>10,000</td>
<td>1,600 $16 Million</td>
</tr>
<tr>
<td>Canada/USA</td>
<td>25,000</td>
<td>1,750 $44 Million</td>
</tr>
<tr>
<td>Japan</td>
<td>20,000</td>
<td>900 $18 Million</td>
</tr>
<tr>
<td>Pacific</td>
<td>18,000</td>
<td>1,500 $27 Million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>378,000 Tonnes</td>
</tr>
</tbody>
</table>

ie. Average FOB Price = 188.4 cents/kg
Less Works/FOB = 68.2 cents/kg

Less 2% Commission = 3.8 cents/kg (of FOB value)
Nett Realisation = 116.4 cents/kg

Note: Minimum Price = 113 cents/kg
SMP = 110 cents/kg
UK price of $1,750 is equivalent to 50 pence/lb (Smithfield)
• To be the principal agent in selling to the Middle East single-buyer countries and to develop a policy in respect of the proportion of New Zealand lamb sales that should be made to that region in a given year.

• To establish market development plans for medium sized specialist markets such as Continental EEC countries, USA/Canada, and Japan. The relative role of private exporter agents or a company subsidiary for developing these markets would have to be determined. It is envisaged that Devco would come under the direction of the New Zealand Lamb Marketing Company.

• To establish a market and product development plan for small sized specialist market segments for semi-processed or processed products. It is envisaged that these will often be associated with food consumption in the retail or catering sectors of metropolitan communities. Many of these markets may represent demand levels of 500 to 1,000 tonnes.

The marketing strategy that the Company would likely follow would involve a market development approach which would vary between the trading approach for the Middle East to product marketing in the United Kingdom and specialist marketing in other countries as appropriate. A key perspective would be a unified approach to marketing by a company which controlled all elements of the marketing mix, ie, product, pricing, promotion, distribution.

Larger companies would have an important role in relation to the new company through their major involvement in such markets as the United Kingdom. Nevertheless it is important to recognise that medium and smaller sized companies would be actively encouraged to participate in the product development, packaging, and marketing associated with specialist market segments, or as agents in countries with small demand. A number of these companies have been most active in this kind of development work.

Within the overall marketing approach of the Company it is envisaged that on a national basis there would be two distinctive directions. The first would involve a change in the selling options available to the farmer. The second would involve a major commitment by the Company to the development of value-added lamb products.

SELLING OPTIONS FOR THE FARMER

Under the single company system, the present schedule selling option would be deleted. This would leave the farmer with the option of selling on the farm, or under the pool system approaches presently available, or in a National Pool administered by the Company. However, the realisations of any of the pools would involve a deduction of a levy by the Company which would be decided after assessment of the marketing development expenditure requirements of the Company on a global basis. This development fund would also be used to (a) offset reduced returns that might be achieved in developing priority markets, eg, Japan or as in the critical period of developing the North American market, or (b) to encourage specific types of product development either in New Zealand or overseas.

Overall the Marketing Company would be required to balance the expenditure,
the returns, and the risks associated with marketing lamb and lamb products in markets in a variety of countries. In this global context, it is my view that the schedule selling system which was developed for the United Kingdom market has now become redundant. Specifically the comparison the farmer makes between his returns from the "open door" pool selling system and schedule used to be based on an assessment of the British market at some reasonable predictable time in the future. The comparison emphasised a short-term viewpoint with no concern for the development requirements of multiple markets which is now the sales situation for lamb. For the future, however, farmers must be concerned with the development of profitable markets for the increased quantities of lamb that they will produce in the next decade.

The schedule selling option and its link with the United Kingdom has a long standing tradition in lamb marketing from this country and I now wish to illustrate why I believe it is redundant as a selling option. Firstly, let us consider the mid-month quoted Smithfield prices for PM grade lamb (as presented in the New Zealand Meat Producer) - Figure 1. One can readily identify an upper and lower trend line which are shown and extrapolated to 1982. This trends assessment would be substantially more valuable if quantities sold on a month to month basis were known but they are useful as a starting point. From this graph it could be argued that a Smithfield price of 50 cents per kg for PM grade lamb was a fair starting point for schedule in this season (ie 113 cents per kg), but that the schedule for April selling could well have been bases on a United Kingdom price of 55 pence per lb. This would have given a schedule of 124 cents per kg.

Nevertheless if I was confident in my market realisation assessment I would of course be operating as an exporter and not in a university! Accordingly, let us make some estimates for the 1981/82 year for which SMP levels for PM grade lambs have been set at 145 cents per kg. (Note: PM grade lamb only represent approximately one-third of lambs exported and in 1980/81 there appears to be a higher proportion of YL grade lambs).

Specific estimates are presented in Table 3 and are based on three major market groupings - the United Kingdom at 150,000 tonnes only, 135,000 tonnes for the Middle East and other countries taking 150,000 tonnes. The United Kingdom realisation is based on an average Smithfield price of 57 pence per lb. Overall prices are based on a 5 per cent devaluation plus a 10 per cent increase in the market price in the United Kingdom and the Middle East, and 5 per cent increase in the market price in other countries. On this basis I estimate a nett return of 128.1 cents per kg which is substantially lower than the SMP level of 145 cents per kg!

Clearly the changing market destinations for lamb and the level of the SMP for 1981/82 challenge the role of the schedule selling option in the industry. However, the increased needs for market and product development to handle the substantial increases in quantities of export lamb production means that farmers must support a philosophy of longer term commitment to marketing and one in which they pay their way. The deletion of the schedule system would be one step in that direction. Farmers would then be able to evaluate their pool return in respect of the SMP or the Danks Committee Minimum Price level. Individual exporter or processor competition for stock would still exist on a local or regional basis with the payment of premiums in some areas. Also there would be competition between the returns that might be achieved through pools run by different companies, and the National Pool operated by the New Zealand Lamb Marketing Company.

Let us now consider the second key activity which results from the formation of this Company - namely that of increased product and market development.
Figure 1: New Zealand Lamb Wholesale Prices at Smithfield (U.K.)
(Price for PM Grade Lamb)

- Higher Trend Line
- Mid April
- Mid July
- Mid January
- Mid October
- Lower Trend Line

Mid January Price
Mid April Price
Mid July Price
Mid October Price

Sources: New Zealand Meat Producers' monthly reports
### TABLE 3

**AVERAGE MARKET REALISATIONS FOR LAMB**

**Estimates for 1981/82**

<table>
<thead>
<tr>
<th>MARKETS</th>
<th>TONNES</th>
<th>$FOB/TONNE</th>
<th>REVENUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>150,000</td>
<td>2,010</td>
<td>$302 Million</td>
</tr>
<tr>
<td>Middle East</td>
<td>135,000</td>
<td>2,760</td>
<td>$373 Million</td>
</tr>
<tr>
<td>Other Countries</td>
<td>150,000</td>
<td>1,710</td>
<td>$257 Million</td>
</tr>
</tbody>
</table>

---

435,000 Tonnes

\[
\text{ie. Average FOB Price} = 214.2 \text{ cents/kg} \\
\text{Less Works/FOB} = 81.8 \\
\hline
132.4 \\
\text{Less 2\% Commission} = 4.3 \\
\hline
128.1 \text{ cents/kg}
\]

**Note:**
- SMP = 145 cents/kg
- UK Price = 57 pence/lb
- If UK Price = 60 pence/lb  Nett = 133.9 cents/kg
- 54 pence/lb  cents/kg

1981/82 returns are based on 5\% devaluation, plus 10\% increase in market price - UK/Middle East, plus 5\% increase in markets price - Other Countries.
PRODUCTION AND MARKET DEVELOPMENT

Market development in lamb marketing traditionally meant finding new markets for the lamb carcase product. Such effort required selling to new countries and meeting specific requirements, e.g., killing procedures for Iran contract. Major progress was made in this direction so that the relative importance of the British market has declined substantially. There will continue to be such efforts in the future in Africa and in Eastern Europe.

Nevertheless for the future, market development will increasingly involve developing specific products for specialist market segments. For example, it could involve portion control products for the food service or catering market in Belgium or Britain; or smoked lamb rashers in America or Germany.

At present some 20 per cent of lamb exports are sold in other than carcase form. These are mainly primal cuts which were initiated under Devco specifications, although other cuts are being sold in Japan and in Continental EEC countries. For the future, market requirements and the impact of freight costs will put emphasis on developing "value-added" products. Exporters themselves indicate growth potential but report a variety of difficulties. These include difficulty in identification of specific customers and their requirements; shortage of working capital; limited quality standards; limited commitment by management; difficulty of access to competitively priced raw materials; and limited profitability.

The existence of progressive management and export incentives to improve profitability have encouraged a few companies to seek to make progress. Successful developments appear to be associated with companies which undertake the marketing and technical development work themselves.

The Lamb Marketing Company will have a vital role in assisting market opportunity identification through research, and then in working directly in a commercial sense to develop and market these products. Internationally, specialist packing houses often operate on a contract basis in such developments. Such an approach in New Zealand or overseas appears feasible.

Within the context of requiring a professionally oriented approach for new product development, there is also the need for adequate funding. At present the industry is only spending small amounts on product development work. To me it appears reasonable for an industry of this size to initiate a new product development budget of $5 million per year - or 0.5 per cent of the FOB sales value. Clearly there would be an experience curve for getting the programme underway. However, a much higher level of effort is required in terms of both market research and technical development work.

The market development requirements for lamb marketing could include retail or trade promotion expenditure of approximately $10 million. The level of operating and administrative costs would depend on the extent the Company operated subsidiary companies for specific markets, and was involved in specific product procurement. General marketing and administration on a global basis could represent an additional $10 million. In total these development expenditures account for approximately $25 million, or 2.5 per cent of the FOB sales value.

CONCLUSION

The present system of selling, including the "pool" system were developed when almost all lamb was sold in the United Kingdom. Lamb is now sold in many countries with markedly different market characteristics and selling situations. The production estimate of 541,000 tonnes of export lamb by 1989/90 represents an
increase of 37 per cent and is based on high levels of farmer confidence. This confidence will only be maintained if profitable returns can be achieved for this production.

The national importance of the lamb export industry means that the industry must pay its way on a year to year basis. Anything less than that for lamb and increasingly for other export sectors means that in the long-term we are all losers. Looking ahead in this market and production environment for the 1980's, it is my view that the industry would be well served by the establishment of a single company to market New Zealand lamb overseas.

There will be many who will resist the adoption of this proposal. In closing might I remind you that the single company proposal I have suggested is based on a private enterprise philosophy. I believe the Government is looking closely at a more centralised approach to lamb marketing. In this respect I view the latest SMP figures as being a signal in that direction. My preference is for the Meat Board and the meat exporters to make a decisive move before the Government seeks to impose its views.

Note: A further analysis of the international market situation for lamb is presented by the author as "The Need for a Global Marketing Strategy for Lamb and Lamb Products" in Proceedings of a Seminar in Future Directions for New Zealand Lamb Marketing, Lincoln College, AERU Discussion Paper No 52 (December 1980), pp 108.
Part 2

FERTILISER
Development and maintenance fertiliser requirements on hill country

J.H. Mauger, East Coast Farmers Fertiliser Company Limited, Napier

THE LAND RESOURCE

Hill and high country dominate New Zealand pastoral agriculture in both area and stock carrying capacity. 50 per cent of occupied land in New Zealand is steepland, 20 per cent moderate hill, 30 per cent rolling or flat (Aglink 1/4000/5/78 NZA17). The actual areas involved in hill and high country are North Island, 3.5m. ha; South Island high 3.0m. ha; South Island hill 1.9m. ha. Fifty one per cent of New Zealand's total sheep and beef cattle are carried on hill and high country. North Island hills alone carry 40 per cent of total NZ stock units and 72 per cent of the North Island's total. Twenty five per cent of the South Island's sheep and beef cattle are carried on hill and high country. Of the national flocks and beef herds carried on hill and high country the South carry 21.3 per cent and the North 78.7 per cent. These proportions have remained constant for some years, at least up to 1979 (the latest figures available). N.Z. leads the world on hill country utilization with exotic afforestation and domestic grazing of sheep, cattle, deer and more recently goats. (Statistics from M.A.F., D.S.I.R., T.G.M.L.I., N.Z.M.W.B.E.S.)

The known potential of our pastoral systems is high. Double on flats and downs, greater than three-fold on hills in the short term (by removing phosphate limitations) and more long term; four to five-fold on high country and three to four times in warm· temperate regions (Brougham 1973). The current livestock population of New Zealand is 107m stock units. It was assessed in the early 1960's that given certain criteria 150m stock units were attainable by 1980, (Gibbs 1963). This figure has not been reached. Hill country alone could readily carry the
projected total livestock increases. North Island hill country is theoretically capable of carrying sheep and beef numbers equivalent to the current N.Z. figures (Mauger 1977b).

Hill and high country is capable of attaining a 100 per cent increase in livestock over a given decade from an 85 per cent lambing (Mauger 1975a). Practically, however, the 50 per cent national growth with a 100 per cent increase on the wetter and higher fertility areas is acceptable (Hight 1979).

The latest potentials of South Island hill and high country are similarly dramatic. A T.G.M.L.I. pilot survey indicates there are many examples of terrion on one run, or on one part of a run, supporting ten to twenty times the stocking load carried on similar terrain nearby (O'Connor 1977).

Despite the considerable number of variables affecting hill pasture production, especially slope and aspect, on the best and most developed hill country, stocking rates comparable to downlands are being achieved. In Wairarapa and Hawkes Bay whole farm stocking rates of 18-20 stock units/ha are known with many paddocks within properties contributing up to 25 well fed and high producing stock units (Mauger 1975a & 1977a).

SOIL FERTILITY

It is still not sufficiently appreciated after 100 years of fertiliser manufacture and 32 years of aerial topdressing in New Zealand, that soil fertility is the major determinant of pastoral productivity in N.Z. hill and high country. Work on significant hill sites in the southern North Island indicates the interdependence and complexity of variable plant nutritional requirements. Individual and cumulative responses have occurred to P, S, Mo, and Lime. The importance to animal productivity is also being noted. Whilst the main response is to P, the loss of productivity from inadequate inputs of the other elements is marked (J.K. Syers, pers comm., Lambert & Grant 1980). There is a real need for a much wider appreciation of the fertility cycle, (soil-plant-animal) and pasture utilisation matters generally, in back and developing areas (Grant et al 1978).

Adequate profitability in the export sector, particularly within the pastoral sphere is seen as a fundamental prerequisite to New Zealand's economic recovery. The North Island hill country survey (Class 4 N.Z.M.W.B.E.S.) divided into two groups, for high and low stock performance provided a comparison of similar properties as to both physical factors and stocking rates. But the high performance farms showed a nett profit some 83 per cent higher than the low performance group. Of interest is the comment "It is possibly very significant that expenditure on fertiliser per hectare and per stock unit is low in the low performance group" (Taylor 1979).

(Note: Class 4 is easier hill country held in smaller parcels than the Class 3 referred to earlier).

The syndrome that hill country can be fully productive at a significantly lower fertility status than its flat counterpart remains without foundation.

N.Z.M.W.B.E.S. data (Table 1) indicates the dramatic fluctuations that have occurred in some years particularly in hill country topdressing. For example, between 1974-75, kg-fertiliser per effective ha was reduced by 52 per cent on N.I.H.H., 44 per cent on N.I.H. and only 32 per cent on N.I. intensive fattening. There are equally productively disturbing features about S.I. hill and high country top dressing records.

Figure 1 portrays actual fertiliser usage per livestock unit in the Eastland region, 1961-62 to 1979-80 (Rodgers 1981). The usage is appreciably lower than that indicated by the national surveys of the N.Z.M.&W. Board Economic Service, and
# TABLE 1

**EXTRACT FROM “SUPPLEMENT TO SHEEP & BEEF FARM SURVEY (N.Z.M.W.B.E.S.)”**

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<tr>
<th>Class of Farm:</th>
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<td>kg/SU (fertiliser)</td>
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<td>kg/effective ha</td>
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<tr>
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<td>4.2</td>
<td>16</td>
<td>42.1</td>
<td>54.5</td>
</tr>
<tr>
<td>kg/SU</td>
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<td>12.9</td>
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<tr>
<td>kg/effective ha</td>
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<td>147.0</td>
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<td>3.8</td>
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<td>58.2</td>
<td>76.8</td>
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<td>kg/SU</td>
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Figure 1: Quantity of Fertiliser Demanded per Stock Unit.

![Graph showing quantity of fertiliser demanded per stock unit from 1961 to 1979.](image)

... obviously the adverse effects of costs and prices is greatest in remote hill country areas, the very resource in greatest need of consistent fertiliser inputs. In monetary terms, recent applied cost increases for fertiliser are horrific. But relative to other farm inputs, the real 1981 costs are on a par with those ruling in 1962; the dip from the mid 60s-mid70s being a reflection of subsidy (Rodgers 1981). Despite the cash inputs from incentive schemes the current season is experiencing a reduction of 30 per cent in aerial topdressing in many hill districts. The effects of this - lower ewe body weights in districts experiencing droughts, higher stocking numbers and the ravages of facial eczema - must inevitably lead to lower lambing percentages in most North Island hill areas this spring.
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Figure 2: Fertiliser Prices 1962 - 1980

- Applied price of superphosphate, monetary terms.
- Applied price of superphosphate, real terms.
Pasture production losses from withholding or stopping fertiliser use can be severe. The development phase of most hill soils makes them productively very sensitive to erratic topdressing practices. Production losses vary according to soil phosphate retention factors and the state of fertility. They are more severe in the autumn-winter period.

Production losses of 15-25 per cent have been recorded on low rainfall adequately topdressed soils by the second autumn, and similarly, higher rainfall ones have shown losses of up to 30 or 40 per cent. With developing soils, losses of 50 per cent have been noted in the first year.

Recovery of full pasture productivity on recommencing and reinstating topdressing occurs only where original soil phosphorus levels were adequate, due to plant mortality and weed ingress during the intervening time. Where fertiliser sulphur and potash are required, non use can rapidly precipitate pasture collapse (Saunders 1969; R.S. Scott 1971; During & O'Connor 1975).

It is of interest that the degree of competition of browntop with white clover for available phosphate is double that of improved grass species. Suitable topdressing and grazing management to promote the better pasture species is therefore critical for efficient use of resources. (Jackman & Mouat 1972). Animal influences on pasture components can be profound (Radcliffe 1973).

The significant feature to date, of the management systems work at Ballantrae, is the dominating influence of soil fertility. Irrespective of the management system imposed, the higher fertility treatments are showing significant pasture and animal responses, compared to the low fertility treatments. Indications are that grazing methods should not be regimented but adapted to the variable requirements of a given developing state of fertility (M.G. Lambert pers comm., Lambert & Grant 1980). Recent work at Whatawhata confirms the Ballantrae experience (A.G. Gillingham pers comm.).

Fertility transfer uphill and to camping sites by grazing animals, mainly from the lower two thirds to the upper third, can have a withholding effect on the lower portions of hill paddocks (Gillingham & During 1973). Studies on this most important facet with its relevant indications are now well advanced (Gillingham 1980). Quantitative work on the amount of P transferred by animals on grazing slopes indicates that on steepland soils of around 25 degree slope, net annual losses of about 22kg P/ha (220kg/ha of Superphosphate) may occur. Obviously this has a direct bearing on P fertiliser requirements (Syers 1977). The use of fertiliser Nitrogen can give managerially important additional pasture growth flexibility, or be used to shorten a development phase (Sherlock & O'Connor 1973, Mauger 1975a, 1978, Ball et al 1976).

Slope is a complicating factor due to depository sites for moisture and nutrition, increased surface area and aspect. One study showed an average slope of 29 degrees had microsites ranging from 0-80 degrees. A further study showed that a 35 degree slope had an actual surface area 30 per cent greater than map area (Grant, et al 1973). This affects aerial distribution of seed and fertiliser (Charlton, Grant 1977).

Camp sites and tracks may be the only hill areas that are developed and in high fertility. Camp sites consistantly produce as much pasture as fertile unirrigated alluvial plains, and flexibility of management may be gained from utilising variable growth patterns of different aspects. Tracks and camps may comprise up to 50 per cent of steeplands and are virtually flat areas (During & Radcliffe 1962). Management techniques involving fencing, stocking systems and fertiliser forms and applications are being developed to capitalise on the potential of hill slopes and their increased surface to map areas.
Indications are available that from improved sub-division and grazing systems, dry matter production can be increased from 8 to 11,000kg/ha and that pasture utilisation can be improved from 60-80 per cent allowing a 30 per cent increase in stocking rate (Hight 1979).

Where such procedures are managerially implemented a 15-20 per cent increase in stocking rate is achieved, with a 10-15 per cent increase in lambing performance, a 40 per cent increase in wool returns per ha and overall a 40 per cent increase in economic terms (K. F. Milligan, M.A.F., Hastings, ers comm.).

The rapid acceptance of Maku Lotus and its adaptability to acid conditions in the South Island (R. S. Scott pers. comm. and the exciting potentialities of the new Grassland Division, D.S.I.R. prostrate white clover bred for moister hill conditions (W. Williams, pers. comm.) will provide a base for increased and sustainable legume contribution, hitherto a difficulty in most hill pastures.

Prior to the 1976 requirement for adequate concrete floored on-farm storage, two thirds of the aerially sown fertiliser in Eastland was ground stored. Migratory capillary action losses of up to 50 per cent of the phosphorus and sulphur in superphosphate were recorded (Mauger 1974, 1975b). The majority of superphosphate historically applied contained substantially less nutrients than purchased. The provision of all weather on airstrip storage facilities are an economic necessity.

Fertiliser aerially spread on to hill country in a maintenance state can give better than 85 per cent (up to 98 per cent) of pasture growth obtainable from perfectly even distribution where advice on recommended swath widths and altitudes is followed. On soils of low fertility, of high P retention or where S or K are limiting, satisfactory distribution is critical if significantly less than the 85 per cent figure is to be avoided (Scott 1971).

The effect of erratic topdressing and other inhibitions to hill pasture production above, may be judged from the progressive Southern Eastland Region, where 90 per cent of soil samples had a quick test Olsen phosphorus value at the very low level of 10 or less (Mauger 1976). Extended enquiry found this position to be prevalent to a greater or less degree in all districts of both Islands. It is accepted that hill and high country fertility is in a low or very low state (N. R. A. C. 1978).

Current fertiliser subsidies continue to favour the intensive areas and revised policies are necessary to redistribute fertiliser to the developing hills at some expense to developed downlands. Failure to do this will inhibit the incentive schemes of 1976-80, or require a significant increase in national fertiliser use.

INTENSIFICATION AND DIVERSIFICATION

The public and many administrators do not comprehend the substantial degree of intensification and diversification that has and is taking place in the uplands.

The dominant move has been to fattening caste stock, particularly lambs. Notably 78 per cent of all sales lambs from hill and high country, including ewe lamb sales, now go for export. No longer should the uplands be considered store country. In the North Island 52 per cent of fat lambs come from the hill country, the national figure being 28 per cent. The rise in the export lamb kill from the South Island hill and high country has been dramatic in recent years (Supp. to the Sheep & Beef Farm Survey, N.Z.M.&W. Bd.Ec.Sc., up to 1979).

Deer, goats, forestry and forest farming and horticulture on minor flat areas are growth areas of diversification. Greater emphasis and perspective is required on productive shelter for preserving pasture already grown, reducing stock losses (Sturrock 1978 & A. Nordmeyer pers. comm.), and providing capital reserves.
Growth in one man forestry in association with soil stock and pasture conservation, and in common with New Zealand's one man farm concept has considerable advantages (Aitken 1979). The prevalent polarisation between forestry and agriculture is inhibiting both industries. Suitable part farm afforestation provides a means of retaining farmland within a family not otherwise available.

THE FUTURE

The direct relationship between farmers' cash liquidity and fertiliser demand is widely recognised. The challenge has to be met of competitively providing fertiliser in forms that meet the specific requirements of hill and high country. The main nutrient requirements are for phosphorus and sulphur with possibly some nitrogen. Potash would be additional in some areas particularly those influenced by volcanic ash.

Reasonable residual values are necessary to cater for alternative years or spasmodic application with plant efficiency irrespective of the time of the year application is made. Strong residual characteristics would assist in negating our most limiting agronomic hill phenomena, that of fertility transfer. More concentrated forms of fertiliser are economically justifiable in reducing transport and application costs particularly were existing subsidies removed. Preferably fertilisers should be capable of efficiency in moderately acid conditions.

By increasing the concentration of phosphorus in fertiliser, say doubling from 10 per cent to 20 per cent, average applied savings to hill farmers in the Eastland region would be 20 per cent, reaching 25 per cent for those at a greater margin, exclusive of subsidy. The percentage difference must increase with escalating energy costs. In the event of existing subsidies remaining the cost benefits would be roughly half those mentioned. Benefits would accrue also to downland farmers at approximately 50 per cent of those applicable to hill country.

Direct application phosphates, known as reactive rocks, or those that are agronomically usable without acidulation are under close scrutiny.

- North Carolina - which requires grinding and hence energy prior to acceptability and in this state is not capable of application unless pelleted or bound with some other product.

- Sechura (Peru) - which is capable of aircraft application in its "as received" form and is very free running. Peru does not have the infrastructure to market large quantities but is anxious to trade bilaterally with New Zealand for dairy products.

- Chatam Rise - which is our indigenous resource, requires mining from considerable ocean depths with techniques yet to be fully developed, but which under trial is giving significantly greater legume responses then either North Carolina or Sechura. This is possibly due to a bound calcium carbonate impurity (K.S. Syers pers comm.).

In all cases the above reactive rocks are performing as well as or better than superphosphate by the second year with differentials becoming greater by the third year or the length of available trial data available (K.S. Syers pers comm.). A desirable advantage with the reactive rocks is their ability to tolerate reasonable acidity or conditions applying to most hill soils. They provide a strong possible
solution to the animal transfer difficulty, meet requirements for acid tolerance as well as intermittent application and consequently hold strong candidacy for capital hill country applications or a realistic way of breaking the soil fertility barrier in hill and high country.

In the majority of upland areas sulphur is as critical an input as phosphorus and this has been a significant factor over the years in the success of single superphosphate. An exception is the inland dry areas of the South Island where sulphur inputs are frequently more critical than phosphorus.

Clearly as the forms of phosphorus in available fertilisers are altered, so will the forms of sulphur. Much knowledge is available on this matter, but more is required. Currently limitations of soil and animal knowledge on sulphur requirements in the North Island is retarding progress on developing alternative phosphorus fertilisers. The future is likely to see sulphur as a fertiliser being developed to specific requirement or prescription demand with appropriate cost efficiencies.

Concern is frequently expressed that pastoral farmers do not appreciate the importance of unitary analysis, or the quantifying of nutrients being purchased and costing this back to provide purchase and application at the most economical rate. Intensive cropping farmers by contrast are very conversant with the simple arithmetic required.

Obviously if phosphorus only is required and the analyses show 0-4-0, 0-8-0, 0-10-0 with similar costs per tonne, the 0-10-0 must be the best buy. With the likely future variations of fertiliser with increasing cost the simple exercise will be mandatory to all farm managers.

**SUMMARY**

The perpetuated history of political exploitation of our hill and high country was only arrested as recently as 1976 by such measures as the Livestock Incentive Scheme. The rapid hill farmer response to such measures in association with the implementation of both developed and developing techniques, unquestionably mark hill farmers as the most efficient of all our pastoralists (Mauger 1979).

The basic fertility difference between down and uplands is inadequately recognised, as is the extreme importance of understanding fertility transfer. Considerable progress in recent years has been made, in association with defining a meaningful grazing system for unploughable country. A greater administrative understanding of these matters is necessary to achieve lower relative costs for substantial inputs, particularly fertiliser.

Development of alternative fertiliser materials is moving reasonable rapidly but greater urgency is required if the gains in livestock numbers made since 1976 are not to be squandered. The current year has not allowed for sustainable inputs and this must lead to depressed production of the delicately poised upland resource.

Whilst nobody denies the difficulties involved, a scheme for selective assistance to upland farms regarding fertiliser is essential to achieve the necessary sustainable management. This is made more difficult with the urban majority being politically dominant.

South Island’s hill and high country in recent years has made vast progress in implementing available techniques, seeding, fencing and grazing in particular. The South Island hill country until recently has been a forgotten resource and did not share the earlier impetus from soil conservators experienced in the lower North
Island or the Southern High Country, as it did not have an inherent erosion problem. Sustainable investment is required in the uplands for some years to come. It is essential that gains made are not reallocated to other community interests if the cyclic severity peculiar to the uplands is to be broken enabling their proper and equitable role to materialise.

REFERENCES


The important mix of fencing and fertiliser – major management factors in Gisborne hill country farms

M.J. Fitzharris, Farm Advisory Officer, MAF, Gisborne.
D.F. Wright, Scientist, MAF, Palmerston North.

Attention needs re-focusing on North Island hill country because of its productive importance, scope for further improvement, and the need to solve current problems. In the past, production increases with increased stocking rates on this type of country, was often applied suddenly, rather than gradually, without essential sub-division or management skill, until the point was reached where per hectare production was reduced, because of poor animal performance.

However, now we have the situation where the basic facts suggest that inflation will continue and that prices for our produce will tend to lag behind increasing costs. This being the case, there is no alternative other than seeking more efficient production - getting value for the increasing amount of money that has to be spent. Something has to be done to counter the movement of rising costs and relative diminishing returns. The only practical way for long term efficiency is increased production - both per head and per hectare - by development through sub-division, superphosphate application, and stock management.
The study related in this paper looks at the roles that fencing and fertiliser have for influencing animal production and profitability on Wairoa, Gisborne, Ruatoria pastoral hill country farms. The initial analysis over the last decade aimed at providing an objective measure of a farm's efficiency in the form of a comparative net income, the economic farm surplus (EFS). This was expressed per ha, per effective ha, and per stock unit (SU). Thus farms of a similar type, but different sizes and different equity situations were compared and the relative efficiency and potential of each farm gauged.

EFS is the money available after subtracting farm working expenses, repairs and maintenance, vehicle, and standing charges expenses, from the gross income. It is the residue left to pay a reward for management, capital expenditure, principle and interest on debt and tax.

Net profit shown in a set of accounts is not a comparative measure of efficiency; neither are the various individual performance and price figures on their own. Net profit, for example, includes profit made for the sale of capital stock. It also uses standard values. In contrast, EFS takes different opening and closing stock numbers into account and fair market values are used for stock values.

The analysis breaks the EFS down into its many components, high-lighting the strengths and weaknesses of present policies and farming systems. It is thus a good starting point for a critical analysis of the farm as a business.

A further Management Study was carried out on eighty to one hundred hill country properties to the north and north-west of Gisborne, more specifically over the five years 1976-1980. Although the criteria examined were constant, their values varied from year to year, and from farm to farm. The results of the analysis indicate what has happened and how. Variations over the years, e.g. in production or profit, can be caused by a large number of factors, some of which are manageable, i.e. can be influenced by man, and some of which cannot be measured, e.g. many of the management skills. Those factors which were investigated were the ones on which some measure could be made, and those discussed are the ones which contributed significantly to that variation.

Results given in the following tables are only those with any major significant statistical effect. (Significant at the 5 per cent, 1 per cent, and 0.1 per cent level).

After capital fertiliser, the effects of the percentage of the farm topdressed each year, and the effects of kg superphosphate per livestock unit are both of interest; which is more important is uncertain, as they are closely correlated. Phosphatic fertiliser is critical to the maintenance and expansion of pastoral output, with the over-riding consideration being the necessity to topdress annually. While fertiliser requirements are determined by the properties of the soil, the nature of the plants, the animals, and the climate, it should be remembered that even under store stock production there is an important and definite drain of fertility.

Farms with 20 paddocks or more had significantly higher production and profitability than those with fewer; it has long been recognised that sub-division is one of the most important factors in any farm programme. It appears that paddock numbers are probably more important than paddock size. A minimum number of paddocks - about 25 - with fencing into sunny and shade faces allows maximum flexibility in the management of different age groups of sheep and cattle.

Superphosphate and sub-division costs are in a continuing state of change, as of course are the products being produced on pastoral hill country farms. Nevertheless, the survey covering the five years from 1976-1980 indicates that these two factors had the key role in influencing overall production and profitability.

Many things in hill country farming can be measured. Other things cannot be. The farmer who can react best to this situation is the farm management expert.
TABLE 1

EFFECTS OF % FARM TOPDRESSED EACH YEAR

<table>
<thead>
<tr>
<th></th>
<th>4 year mean 1976-1979</th>
<th>1978-79 season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Area topdressed</td>
<td>% Area topdressed</td>
</tr>
<tr>
<td></td>
<td>0-25  26-50  51-75  76-100</td>
<td>0-25  26-50  51-75  76-100</td>
</tr>
<tr>
<td>Lambing %</td>
<td>74     84     87     93</td>
<td>68     89     89     99</td>
</tr>
<tr>
<td>Calving %</td>
<td>71     75     75     80</td>
<td>63     66     71     78</td>
</tr>
<tr>
<td>Wool Wt kg/SEE</td>
<td>4.4    4.9    5.0    5.3</td>
<td>4.2    5.1    5.1    5.4</td>
</tr>
<tr>
<td>Sheep Inc/SEE</td>
<td>$ 4.39 $ 5.35 $ 5.66 $ 7.31</td>
<td>$ 4.91 $ 6.54 $ 7.01 $ 9.10</td>
</tr>
<tr>
<td>Wool Inc/SEE</td>
<td>$ 7.82 $ 8.11 $ 8.99 $10.01</td>
<td>$ 8.19 $ 7.90 $10.10 $10.60</td>
</tr>
<tr>
<td>Cattle Inc/SEE</td>
<td>$ 4.26 $ 4.87 $ 5.51 $ 7.70</td>
<td>$ 5.88 $ 6.14 $ 7.83 $11.23</td>
</tr>
<tr>
<td>EFS/SU</td>
<td>$ 2.98 $ 3.34 $ 4.19 $ 5.17</td>
<td>$ 3.26 $ 3.63 $ 6.55 $ 7.61</td>
</tr>
<tr>
<td>EFS/ha</td>
<td>$22.00 $29.00 $36.00 $48.00</td>
<td>$25.00 $36.00 $44.00 $67.00</td>
</tr>
</tbody>
</table>

Sheep INC/SEE is the revenue from the sale of ewes and lambs. Wool INC/SEE is the revenue from wool alone.

TABLE 2

FERTILISER: EFFECTS OF FENCING AND NUMBER OF PADDOCKS

<table>
<thead>
<tr>
<th></th>
<th>4 Year mean 1976-1979</th>
<th>1978-79 Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of paddocks</td>
<td>Number of paddocks</td>
</tr>
<tr>
<td></td>
<td>19 paddocks or less</td>
<td>20 paddocks or more</td>
</tr>
<tr>
<td></td>
<td>19 paddocks or less</td>
<td>20 paddocks or more</td>
</tr>
<tr>
<td>Lambing %</td>
<td>83.0</td>
<td>93.0</td>
</tr>
<tr>
<td>Calving %</td>
<td>69.0</td>
<td>75.0</td>
</tr>
<tr>
<td>Wool wt kg/SEE</td>
<td>4.8</td>
<td>5.4</td>
</tr>
<tr>
<td>Sheep INC/SEE</td>
<td>$ 6.06</td>
<td>$ 6.37</td>
</tr>
<tr>
<td>Wool INC/SEE</td>
<td>$ 8.86</td>
<td>$ 9.26</td>
</tr>
<tr>
<td>Cattle INC/SEE</td>
<td>$ 7.67</td>
<td>$ 7.81</td>
</tr>
<tr>
<td>EFS/SU</td>
<td>$ 3.41</td>
<td>$ 4.35</td>
</tr>
<tr>
<td>EFS/ha</td>
<td>$31.00</td>
<td>$42.00</td>
</tr>
</tbody>
</table>

54
### TABLE 3

**MAJOR MANAGEMENT FACTORS ASSOCIATED WITH PROFIT**

<table>
<thead>
<tr>
<th></th>
<th>YEAR ENDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For increase in Economic Farm Surplus</td>
</tr>
<tr>
<td>Per ha Bigger farms</td>
<td>Fertiliser</td>
</tr>
<tr>
<td>More paddocks</td>
<td>More paddocks</td>
</tr>
<tr>
<td>Per SU More paddocks</td>
<td>Fertiliser</td>
</tr>
<tr>
<td>High sheep</td>
<td>More paddocks</td>
</tr>
<tr>
<td>Low cattle</td>
<td>ratio</td>
</tr>
</tbody>
</table>

Judgement, coupled with knowledge, is what makes a good manager. Factors which the farmer can concentrate on in his management decisions include fertiliser and paddock numbers. The same picture shows up on the basis of economic farm surplus per livestock unit, and economic surplus per hectare. Other factors are involved, but not with the same importance.

The successful man in the hill country is the sheep and cattle man who topdresses to grow the feed, fences to utilize that feed, and employs some sort of rotational grazing, or at least mob stocking, to manage that feed. With hill country improvement as such, the station owner changes from a large scale grazier to a farmer. Blocks become paddocks. Unless he is prepared to accept and make these changes in overall management and way of life, many of the hill country farmer's current problems will not be solved.

To achieve high production from hill country it is necessary to sub-divide adequately, segregating sunny from shady faces, topdress with superphosphate, oversow with clovers, and to utilize fully the resulting extra growth.

---

**Acknowledgements:**

*J. Bell, MAF, Wellington*

*J. Rowland, MAF, Palmerston North.*
### TABLE 4

**MANAGEMENT FACTORS ASSOCIATED WITH HIGHER PRODUCTION**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wool/wgt/sheep EE</td>
<td>Low sheep</td>
<td>Low sheep</td>
<td>Low sheep</td>
<td>Bigger farms</td>
</tr>
<tr>
<td>High cattle ratio</td>
<td>high</td>
<td>high</td>
<td>high</td>
<td>cattle</td>
</tr>
<tr>
<td>Fertiliser</td>
<td></td>
<td></td>
<td></td>
<td>Fertiliser</td>
</tr>
<tr>
<td>Lambing %</td>
<td>More paddocks</td>
<td>Fertiliser</td>
<td>Fertiliser</td>
<td>Fertiliser</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High stocking rate</td>
<td></td>
<td>High stocking rate</td>
</tr>
<tr>
<td>Calving %</td>
<td>More paddocks</td>
<td>Fertiliser</td>
<td>-</td>
<td>More paddocks</td>
</tr>
</tbody>
</table>

Other factors occur but again were not as consistent or as vitally important as fertiliser and number of paddocks. Results showed that average hill farms with extra super or extra paddocks achieved the following:

**Per hectare:**

1976: For every extra paddock an increase of $1.20/ha
Fertiliser had no significant effect

1977: For every extra paddock an increase of $1.20/ha
For every extra kg/SU a gain of $0.70/ha

1978: For every extra paddock an increase of $1.90/ha
For every extra kg/SU a gain of $0.60/ha

1979: Extra paddocks had no significant effect
For every extra kg/SU a gain of $0.60/ha

**Per Stock Unit:**

1976: For every extra paddock an increase of 10 cents/SU
Fertiliser had no significant effect

1977: For every extra paddock an increase of 9 cents/SU
For every extra kg/SU a gain of 8 cents/SU

1978: For every extra paddock an increase of 9 cents/SU
For every extra kg/SU a gain of 6 cents/SU

1979: Extra paddocks had no significant effect
For every extra kg/SU a gain of 17 cents/SU
Superchoice: a model for calculating superphosphate requirements of grazed pastures

A. G. Sinclair, Invermay Agricultural Research Centre
I. S. Cornforth, Ruakura Soil and Plant Research Station

Phosphate (P) is essential for the growth of all plants, and the clovers which are the basis of New Zealand's highly productive pastures are very sensitive to P deficiency. Most New Zealand soils are naturally deficient in P and must receive fertiliser P to achieve desirable levels of pasture production. Once such levels have been achieved, P fertiliser must still be applied regularly (albeit at a lower rate than during the development phase) or both the quantity and quality of pasture soon decline. Although large areas of land still need P for development, the predominant use of P fertiliser is now for maintaining desired levels of production in developed pastures. Experience shows that the quantity of P required to maintain pasture production can differ greatly in different situations. SUPERCHOICE is a way of using relevant experimental information to calculate maintenance P requirements for any pastoral farming situation. This model will allow these calculations to be done simply and quickly by advisers and farmers.

The need for a continued input of P just to maintain a steady level of pasture production arises because there are continuous losses of P from any grazed pasture. A knowledge of these losses allows calculation of maintenance P requirements.
Figure 1: A Simplified Maintenance P Cycle as used in SUPERCHOICE

![Diagram of P Cycle]

**LOSSES THROUGH ANIMALS**

Plants extract P from the soil, and a healthy pasture carrying 20 stock units per hectare would take up about 55 kg P/ha/yr. This is equivalent to 700 kg superphosphate, i.e. more than twice the average maintenance P fertiliser applied. Thus a very large amount of P is removed from the soil by plants. Some of this is returned directly to the soil in the form of uneaten herbage, but most is consumed by grazing animals and is either incorporated into animal products (milk, meat etc) or is excreted in dung. If dung goes back onto the pasture then most of its P content can be used again by plants, as can the P content of uneaten herbage returned to the soil. However, there is often an inefficient return of dung leading to substantial loss of P. On dairy farms there is loss of dung in shed effluents, yards and walk-ways; on rolling land sheep “camp” at night on high ground where they deposit a disproportionately large amount of dung which is therefore effectively lost from the main productive area of the paddock; on irrigated pastures sheep prefer to camp on the dry levees, again giving a P transfer loss; and on steep hill country most of the dung is deposited on the contour tracks while the steep, hard-grazed, inter-track areas receive very little. Transfer losses are probably at a minimum on flat land with intensive rotational grazing to discourage stock camping. In summary, animal P losses depend on the type of farming enterprise (dairy or meat/wool), the topography of the land (steep, rolling, flat or border-dyked) and the grazing management (set-stocked or rotationally grazed).

Table 1 shows the quantity of P lost per standard stock unit (for definition of stock unit see Table 4) in various situations.
### TABLE 1

**ANIMAL P LOSS GROUPS**

<table>
<thead>
<tr>
<th>Stock Type</th>
<th>Land Form</th>
<th>P Loss Group</th>
<th>P Loss kg P/SU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep and beef</td>
<td>Flat to rolling</td>
<td>Low</td>
<td>0.7*</td>
</tr>
<tr>
<td>Sheep</td>
<td>Border dyked</td>
<td>Medium</td>
<td>0.9</td>
</tr>
<tr>
<td>Dairy cows</td>
<td>Flat to rolling</td>
<td>Medium</td>
<td>0.9*</td>
</tr>
<tr>
<td>Sheep and beef</td>
<td>Easy hill country</td>
<td>Medium</td>
<td>0.9*</td>
</tr>
<tr>
<td>Sheep and beef</td>
<td>Steep hill country</td>
<td>High</td>
<td>1.1*</td>
</tr>
</tbody>
</table>


### LOSSES IN SOIL

These occur mainly through P being converted to chemical forms (both organic and inorganic) in the soil from which it cannot be extracted by plants. Leaching losses are significant only on very sandy non-retentive soils under irrigation or high rainfall. It is very difficult to measure soil P losses directly, but they can be estimated indirectly. Consider the simplified P cycle in Figure 1 where Maintenance fertiliser P = Animal P loss + Soil P loss.

By substituting in this equation maintenance P requirements measured in field trials and corresponding animal P loss values from Table 1, the soil P loss can be calculated for each trial soil. When this is done for all maintenance trials in N.Z. it becomes apparent that soil P loss varies widely and is highest on soils of high P retention. On present data we can only allocate soils to three loss groups, low, medium and high in which the average soil P loss in growing sufficient feed for one stock unit under efficient farming is 0.3, 0.7 and 1.1 kg P respectively (Table 2).

We can now construct a table of maintenance P requirements for any combination of animal and soil P loss groups (Table 3). This table applies to efficient cent plant available P the maintenance superphosphate requirements is $19.2 \times 100$ by stock. For that situation the amount of P recommended in Table 3 will maintain pasture yield at about 90 per cent of the maximum achievable with unlimited P, which is near the economic optimum in most situations. Table 3 therefore gives a quick and easy guide to maintenance P requirements for efficient farming. The following examples illustrate its use:

**Example 1:** What is the maintenance superphosphate required on an efficiently grazed sheep farm on a border-dyked irrigated Lismore soil (a drier Yellow-grey earth) with a stocking rate of 16 SU/ha?

From Tables 1 and 2, animal loss is medium, soil loss is low, hence from Table 3 P requirement is 1.2 kg/SU or 19.2 kg/ha. Assuming supershosphate contains 8 per cent plant available P the maintenance superphosphate requirements is $19.2 \times 100 \div 8 = 240$ kg/ha.

59
### TABLE 2

**SOIL P LOSS GROUPS**

<table>
<thead>
<tr>
<th>A. SOUTH ISLAND</th>
<th>P loss</th>
<th>kg P.SU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brown-Grey Earths</strong></td>
<td>Low</td>
<td>0.3</td>
</tr>
<tr>
<td>Drier Yellow-Grey Earths, and recent soils with &lt; 1000 mm rain</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moister Yellow-Grey Earths,</strong> and <strong>Recent soils with &gt; 1000 mm rain</strong></td>
<td>Medium</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Yellow-Brown Earths</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gley Soils, Podzols, Rendzinas, Brown Granular Clays and Loams</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yellow-Brown Loams</strong></td>
<td>High</td>
<td>1.1</td>
</tr>
</tbody>
</table>

| B. NORTH ISLAND | | |
| **Yellow-Grey Earths** | Low | 0.3 |
| **Recent soils, Yellow-Brown Pumice soils, Yellow-Brown Earths, Brown Granular Loams and Clays, Red-Brown Loams, Gley soils** | Medium | 0.7 |
| **Yellow-Brown Loams, Peaty Loams and Peats, Yellow-Grey Earths from Basalt** | High | 1.1 |

---

**Example 2:** What is the maintenance superphosphate requirement for an efficiently grazed dairy farm with three Jersey cows per hectare on a North Island Yellow-brown loam?

Animal loss is medium, soil loss is high, hence P required per stock unit is 2.0 kg. From Table 4 the stocking rate in standard stock units is $6.0 \times 3 = 18$. Maintenance requirement = $18 \times 2.0 \times 100 = 8 \times 450$ kg superphosphate per hectare.

In Figure 2 we have plotted predictions based on Table 3 against maintenance requirements deduced from field trials and observations in 48 situations throughout...
the country. In 24 of these comparisons the predictions are within 2.5 kg P/ha of the observed values, and in 40 cases they are within 5 kg P/ha of the observed value. As some of the observed values are merely best estimates based on limited data we regard the agreement between predicted and observed maintenance P as very satisfactory. It is of interest to note that the average NZ. usage of P, based on total stock numbers and total P used on pastures is 1.5 kg P/SU, i.e. near the centre value in Table 3.

TABLE 3

MAINTENANCE P REQUIREMENT (KG P/SU) FOR 90% OF MAXIMUM PASTURE PRODUCTION WITH 80% PASTURE UTILISATION BY STOCK

<table>
<thead>
<tr>
<th>Soil P Loss</th>
<th>Low (0.3 kg/SU)</th>
<th>Medium (0.7 kg/SU)</th>
<th>High (1.1 kg/SU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.7 kg/SU</td>
<td>1.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Medium</td>
<td>0.9 kg/SU</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>High</td>
<td>1.1 kg/SU</td>
<td>1.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Comparison of Maintenance P Predicted (Table 3) and Observed.
FULL SUPERCHOICE MODEL

Table 3 applies only to 80 per cent pasture utilisation and pasture production maintained at 90 per cent of the maximum possible, which we have equated to good farming practice. With the SUPERCHOICE model, variation can be allowed for in these factors as well.

As yield is pushed nearer and nearer to the maximum possible by increasing maintenance P fertiliser application, P losses increase out of proportion to the extra growth achieved, thus each successive increment in growth requires more P than the previous one; this is the "diminishing returns" effect, and is illustrated in Figure 3. This relationship can be expressed in a mathematical equation (the Mitscherlich equation) and that is how it is allowed for in SUPERCHOICE.

Figure 3: Maintenance P Response Curve

Under poor grazing management a large proportion of pasture produced is not eaten by stock but dies off and is trampled back into the soil. To feed a given number of stock using an inefficient grazing system (e.g. with 60 per cent pasture utilisation), it is necessary to produce more total growth than if grazing were highly efficient (80-90 per cent utilisation). This means operating nearer the potential maximum growth and hence incurring the associated high P losses explained above.
The information required for using SUPERCHOICE includes (a) animal P loss group (Table 1); (b) soil P loss group (Table 2); (c) the carrying capacity of the land, i.e. its ultimate potential (from M.O.W.D. Soil and Water Division Land Use Capability Survey Maps or from local knowledge and experience); (d) the actual stocking rate (use Table 4 if necessary); and (e) the pasture utilisation - the percentage of total pasture grown which is eaten by stock.

TABLE 4

FACTORS FOR CONVERTING STOCK CLASS TO STANDARD STOCK UNITS

<table>
<thead>
<tr>
<th>Stock Type</th>
<th>Weight (kg)</th>
<th>Percent Lambs weaned</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewes</td>
<td>45</td>
<td>100</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>100</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>100</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>120</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>140</td>
<td>1.20</td>
</tr>
<tr>
<td>Hogget Nov-Nov</td>
<td>-</td>
<td>-</td>
<td>0.70</td>
</tr>
<tr>
<td>Hogget Jan-Jan</td>
<td>-</td>
<td>-</td>
<td>0.80</td>
</tr>
<tr>
<td>Angus Beef Cows Hard Conditions</td>
<td>-</td>
<td>-</td>
<td>4.10</td>
</tr>
<tr>
<td></td>
<td>Good Conditions</td>
<td>-</td>
<td>4.80</td>
</tr>
<tr>
<td>Fattening Steer 8-20 months</td>
<td>-</td>
<td>-</td>
<td>3.60</td>
</tr>
<tr>
<td>Jersey Cows</td>
<td>-</td>
<td>-</td>
<td>6.00</td>
</tr>
<tr>
<td>Friesian x Jersey cows</td>
<td>-</td>
<td>-</td>
<td>6.70</td>
</tr>
<tr>
<td>Friesian Cow (Town Milk supply)</td>
<td>-</td>
<td>-</td>
<td>8.00</td>
</tr>
<tr>
<td>Jersey Yearling 0-12 months</td>
<td>-</td>
<td>-</td>
<td>1.80</td>
</tr>
<tr>
<td>Jersey Heifer 12-24 months</td>
<td>-</td>
<td>-</td>
<td>3.00</td>
</tr>
</tbody>
</table>


SUPERCHOICE is used in the form of a set of tables of which Table 5 is an example. Parameters (a), (b), and (c) above indicate the relevant table, while (d) and (e) show the maintenance P required for the specified conditions. Thus where Table 5 applies, then for a stocking rate of 14 and a pasture utilization of 85 per cent, the maintenance requirement is 15 kg P/ha (118 kg/ha superphosphate at eight per cent available P).
TABLE 5
EXAMPLE OF A MAINTENANCE P REQUIREMENT TABLE FROM SUPERCHOICE

Animal Loss: Medium
Soil Loss: Medium
Carrying Capacity: 20 SU/ha

<table>
<thead>
<tr>
<th>% Pasture</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilisation</td>
<td>50</td>
<td>18</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>14</td>
<td>18</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>12</td>
<td>15</td>
<td>19</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>11</td>
<td>13</td>
<td>16</td>
<td>20</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>70</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td>21</td>
<td>27</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>10</td>
<td>11</td>
<td>13</td>
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Note: Numbers within the table are kg P/ha required for various combinations of stocking rate and pasture utilisation. Blanks in the table occur where the corresponding combinations of stocking rate and pasture utilisation would required pasture yield of more than 95% of maximum possible with unlimited phosphate application.

Estimating pasture utilisation is the most difficult operation in using SUPERCHOICE but it can sometimes help to use the model in reverse to evaluate the current situation, thus giving some guide as to what could be achieved in the future. Thus if 14 stock units were being maintained with 21 kg P/hectare current pasture utilisation must be 70 per cent. An increase to 15 SU/ha could be achieved either by applying an extra 6 kg P/ha or by improving pasture utilisation to 76 per cent (a choice between fertiliser to give more growth or fencing to allow more efficient grazing). Stocking rates above 15 cannot be achieved at 70 per cent pasture utilisation, however, much P is applied, and it is a waste to use more than 27 kg P; to reach those higher stocking rate pasture utilisation must be improved.
SOIL TESTING AND SUPERCHOICE

SUPERCHOICE goes beyond merely giving a maintenance P recommendation for a specified set of conditions. It identifies the current position and presents alternative strategies for reaching specific goals. SUPERCHOICE deals only with maintenance P requirements. Soil testing has two roles in relation to the model.

Soil tests show whether the present level of P in the soil is appropriate for the level of production aimed at. If soil P is unnecessarily high then maintenance P can be omitted temporarily, and if soil P is too low then maintenance P will have to be augmented by a corrective P application. Figure 4 is used to decide whether maintenance P as calculated from SUPERCHOICE is appropriate. For example, if 90 per cent of maximum pasture production is required then Figure 4 shows that for Olsen P test levels in the range 10-20 the maintenance P derived from SUPERCHOICE should be applied (Figure 4 may need to be modified for some North Island soils with very high P retention values).

Figure 4: SUPERCHOICE and Soil P Tests

A: Apply maintenance P plus corrective P for one year then retest.

B: Apply maintenance P as deduced from SUPERCHOICE.

C: Omit P for one year then retest.

Soil tests are used to monitor the effectiveness of the maintenance P programme. This involves testing soils every 2-4 years, and observing trends. A continued rise in soil P above the appropriate level indicated in Figure 4 shows the maintenance treatments to be too high and vice versa.

Farmers and advisers can immediately start using the simple form of SUPERCHOICE given in Table 3, making use of Tables 1, 2, and 4, to decide on input data and following procedures given in the two examples. The full SUPERCHOICE model requires for its application a set of over 100 tables. These will form part of a comprehensive "Fertiliser Recommendation Bulletin" which the MAF plan to have ready to distribute to farmers and advisers in 1982.
Phosphate fertilisers: availability, costs and future developments

D.J. Higgins, Director, New Zealand Fertiliser Manufacturers' Research Association

This year is the centennial year of fertiliser manufacture in New Zealand and for this whole period fertiliser has meant principally phosphates and phosphate has meant superphosphate until "super" has become almost a synonym for fertiliser in this country. My address deals then mainly with phosphates because of their importance.

It is not commonly known that on a per capita basis New Zealand is by far the largest user of phosphates in the world and our dependence on phosphate is correspondingly high. You all know that our phosphate rock raw materials have come for the most part from islands in the Pacific and Indian Oceans and will have read alarming reports on the deteriorating supply situation in these places and even suggestions that we may be deprived of supplies or forced to resort to unusual expedients to retain continuity of supply.

It is true that Makatea and Ocean Islands have been exhausted and that Christmas Island has a few years only of life and even Nauru has a severely limited life. It is not so commonly mentioned, however, that the New Zealand demand for phosphate is only about 1 per cent of world production and that overall world reserves and resources of phosphate are gigantic with no shortages remotely in prospect. The analogies often drawn with the oil situation are quite erroneous.
Some of the major reserves and resources are:

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<td>USA</td>
<td>Egypt</td>
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<tr>
<td>Florida</td>
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<td>Western Fields</td>
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<td>Peru</td>
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<td>Senegal</td>
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This list is by no means complete and resources so exceed demand that many of these major fields are not even in production or close to production. These major deposits are also very well distributed geographically. When it is also remembered that many of these countries are existing or potential trading partners with New Zealand fears of shortages can be laid to rest. It is true, however, that since Nauru has become an independent nation, and because of cost escalation on Christmas Island, we are now paying world prices for phosphate rock and we are going to remain in this situation.

Figure 1:

Typical Ex-works Cost of Superphosphate to the Farmer.
Figure 2: International Price Trends

(July 1979 - January 1981)
This movement in phosphate prices and equally severe price rises for sulphur, the other major raw material for superphosphate, coupled with the depreciation of the New Zealand dollar, rising freight costs and rising manufacturing costs have led to the large superphosphate price rises of recent years.

Scale is also an important factor. Annual tonnage reached one million in 1955, two million in 1972, two and a half million in 1974 and has not since repeated that figure. The cost ameliorating effects of growth have then not been of assistance to prices since 1974. Price increases for superphosphate have been then quite severe as can be seen on Figure 1 showing a typical case. Because of the factors just mentioned and the fact that subsidies have been reduced over the period of this graph these movements have been greater than international price movements, samples of which are given in Figure 2.

For these same reasons however, ignoring subsidies, price increases in future can be expected to be more aligned with world movements and while international demand is currently quite strong, suggesting further price increases, rapid escalation such as has happened in the last few years is not anticipated. In this period of such severe price rises it is not surprising that alternatives to superphosphate (including ground phosphate rock and "biosuper") have received a lot of publicity. There is nothing new about these materials. The history of phosphate rock as a fertiliser is a very extensive one and a huge volume of published work exists. A small volume of the product has always been produced. It has not occupied a significant place in developed Western World agriculture currently amounting to perhaps 0.5 per cent.

The production of granulated phosphate rocks is not technically very difficult but it does involve considerable plant and it is much more energy intensive than superphosphate production. In the absence of granulation, ground phosphate rocks are unsuitable for transport or conventional distribution either by air or ground spreading. Granules can be distributed but in almost all cases are agronomically inferior to dusts which themselves usually give inferior results to soluble phosphates. The performance of these materials is very dependent on soil pH, type of rock, soil conditions, moisture, temperature and intimacy of distribution. The associated uncertainties are the reasons why, internationally, interest in such products is so small and is largely limited to centrally controlled economies or areas of undeveloped agriculture where there is little investment in land and where high production is not the main or even an attainable objective for the farmer.

The concept of attempting the acidulation of phosphate rocks in the soil by means of added sulphur is a very obvious one and also has a long history with the first patent dating from 1877. Many subsequent workers have examined the material but no significant commercial production has ever resulted. The problems of manufacturing granulated mixtures of phosphate rock and sulphur are appreciable and expensive and in some routes hazardous. In some published material this is said to be simple and cheap. In reality it is costly and complex and requires just as much hardware as in the manufacture of soluble phosphates. The raw materials costs are exactly the same as for superphosphate and the processes are much more energy intensive because the energy of oxidation of sulphur, which in the conventional process results in significant electrical power generation, is lost. In recent years this oxidation of sulphur has been equivalent to about 250,000 barrels per year of imported oil. Any hope of price reductions resulting from these materials is likely to be illusory and any realistically achievable economies will be effected only in transport and application costs.

Figure 3 shows some recent determinations of the rate of solution of a typical range of phosphate fertilisers and the very slow rates of availability of the rock
phosphates is very apparent. This is sometimes cited as an advantage but it makes high productivity agriculture out of the question, reduces the dependability of response in various ways and also involves incurring financing costs at an earlier stage than is necessary.

As has always been the case world-wide in fertiliser manufacture future product trends will be determined mainly by cost on the ground and not be variations, probably minor, in agronomic effectiveness. Soluble manufactured phosphates will remain the most effective delivery systems for phosphorus and if changes occur they will be in the direction of triple superphosphate and ammonium phosphates as the need arises and as the economics dictate. It is for this reason that in most industrial countries superphosphate is giving way to triple superphosphate which is in turn under severe competition from ammonium phosphates. These economics are kept under continual review.

Figure 4 shows, in an aerially applied situation, and Figure 5 in a ground spread situation, comparisons of on the ground costs, subsidised at present levels and unsubsidised, at various distances from the point of manufacture, for superphosphate versus triple superphosphate. It should be noted that this is a typical superphosphate and the triple is based on costings of a hypothetically locally manufactured product on a considerable scale, i.e., not the currently available small scale imports.

As can be seen the advantage except in special situations is still with single superphosphate and this is without allowance for the value of the sulphur in the superphosphate. None the less these breakeven distances are diminishing with increasing transport costs, and the examination must continually be upgraded and examined for trends indicative of the need for change.

Similar comparisons of superphosphate and granulated phosphate rock on the
Figure 4: On the Ground Cost for SSP & TSP_L (Aerial Spread).

Figure 5: On the Ground Cost for SSP & TSP_L (Ground Spread).
basis of the phosphorus in the two products show the phosphate rock favourably. Making the comparisons on the basis of the available citric-soluble phosphorus puts the superphosphate at a very strong advantage. If the comparison is extended to a situation where the phosphorus in phosphorus rock is valued at 80 per cent of the soluble phosphate, the advantage is also with the current product. If the value of the sulphur present is also added to the calculations, the phosphate rock is put at a further disadvantage.

Little encouragement can be drawn from these results which favour phosphate rocks only at attributed efficiencies which will be attainable only in the most favoured situations.
Part 3

LUCERNE

Held in association with the Agronomy Society of New Zealand. Technical papers presented at the conference are published separately by the Agronomy Society.
Chairman’s introduction
G.H. McFadden, Senior Advisory Officer, M.A.F., Christchurch.

In view of lucerne’s history in light land development in New Zealand, and in Canterbury in particular, it is appropriate, although perhaps ironic, that we should be reviewing the crop now - when farmers on light land and especially coastal country in mid-central and north Canterbury, are suffering the effects of severe summer drought and are entering the winter with inadequate feed. At the moment local works are killing ewes and lambs to capacity but the stock are in poor condition. Right at this moment farmers from that light land are facing very difficult decisions involving the purchase of expensive dry feed, the disposal of stock at low prices, and the possibility of high winter death rates. The effects will obviously carry on well into next years income.

I’m not for one moment suggesting that lucerne, performing as we know it in the 1960’s could have overcome all of this season’s feed problems. However, it was in just these present circumstances, along with some grassgrub, a great deal of farmer enthusiasm and some hard selling by advisers and scientists, that the crop really came into its own in the 60’s and early 70’s. And, make no mistake, it served many people very well. There are people here today who would feel lucerne has been a key to their personal success.

It is interesting to look at the data on lucerne/pasture dry matter comparisons. On Canterbury light land advantages of 30 per cent to 100 per cent to lucerne along with much less variability, are common. These kinds of major dry matter advantages in seasonally dry climates soon encouraged farmers to develop management systems to take the best advantage of this crop, whether it be as hay or grazing. As a bonus, or perhaps a major feature in encouraging the use of lucerne, it proved to be resistant to serious pasture pests like grass grub and black beetle.

In fact during the 60’s and early 70’s, lucerne was looked on as being pretty well pest and disease free which was a major attraction. The sudden recognition of all
sorts of pests and diseases since then has certainly contributed to farmers' disillusionment with the crop. Now, what are the trends in lucerne use in New Zealand in recent years?

During the 1960's and early 70's there was a rapid growth in area, steadily building up by 1975 to a New Zealand peak of 220,000 ha - a 125 per cent increase from 1960. Since 1977 the area of lucerne has dropped dramatically and it fell by 20,000 ha in each of 1978 and 1979, which is a decline of about 10 per cent each year.

The decline has been reasonably consistent by districts with the exception of South Auckland/Poverty Bay and the Marlborough and Central Otago areas. The slower decline in these latter two traditional lucerne growing areas may in itself be significant. Lucerne is well suited to these seasonably dry areas and in these circumstances has a clear competitive advantage with the ability to withstand varying levels of management. During earlier dryer seasons lucerne has sometimes moved out into wetter areas and heavier soils to which it is not ideally suited.

The extent of farmers' recent loss of confidence in the crop is illustrated by the fact that from 1975 to 1979 there is a recorded reduction of 2,500 farmers who have lucerne on their properties.

However, let's not blame all of this on the lucerne plant itself. Remember that in this period there have been some marked changes in farming trends and conditions. For instance, nationally, there has been a major swing to all-grass farming systems with an emphasis on rotational grazing and a subsequent marked reduction in dependence on hay. In several areas there has been some very rapid irrigation development. Also we have had a series of wet summers. It has also been suggested grass grub problems have declined. I am not too sure about that, and certainly this year there are a lot of grubs about.

Nevertheless, despite these other farming developments, one must admit that last spring it was extremely difficult to find a lucerne stand on the light land in Central Canterbury where one could look over the fence and say "My word that's a vigorous healthy stand".

There have been some dramatic changes in the lucerne story in the last 15 years. There has been a significant loss of farmer confidence in the crop. However, we will see major droughts again and so what place will lucerne play in those circumstances in the future? This is the kind of issue we all want to assess during the papers and discussion at this conference.
My wife and I farm 165 hectares 40 kilometers west of Ashburton and about four 
kilometers from Mt. Somers. The farm is flat, and the soil Ruapuna stony silt loam - 
a free draining fertile soil with scattered boulders. It is 300 metres above sea level 
and has an annual rainfall of approximately 1,000 millimetres. When we took over 
the property 12 years ago, it was running 1,400 Romney ewes and 300 hoggets, with 
24 ha of grain crop.

Why then did I move from grass to lucerne? How did I manage the crop, and why 
did I go back to grass?

In the first two years on the farm three problems became apparent: poor lamb 
thrift, dry summers, and grass grub. Being anxious to make a success of this, our 
first farm, I began looking for answers to these three problems. Lucerne appeared 
to be a possible solution. Initial enquiries brought little encouragement, however.
Lucerne just wasn’t grown successfully in the district. Several paddocks had been 
tried and had failed. I decided in good kiwi fashion to have a go anyway.

The first spring I sowed three hectares, which established successfully. Then in 
conjunction with the Winchmore Irrigation Research Station, trials were carried out 
to determine the carrying capacity of lucerne. It produced sufficient feed to carry 
trial mobs of 30 ewes/ha, with 120 per cent lambs from lambing to drafting. I was 
impressed with this, and sowed another eight hectare under barley the next spring. 
This second paddock was a great success and it convinced me that I should change 
to more lucerne for grazing.

By this time, I had changed over to a straight Coopworth flock, mating all the ewe 
lambs. I had increased the cropping until 50 per cent of the farm was in wheat or
barley. The rotation was from turnips, wheat, autumn green feed, wheat, autumn green feed, through to barley undersown with lucerne. Following this rotation, I had a clean grass-free seedbed for the lucerne, and the lower nitrogen levels were no problem to the vigorous legume. The resulting high quality summer feed met the needs of the increasing number of lambs, and the need for better food for the hoggets also rearing lambs.

Cutting trials showed that, contrary to popular belief, the established lucerne was actually producing more feed than the grass, even in late September - 20 per cent more in fact. My mind was made up. All three of my initial problems had been solved by lucerne. It carried a high stocking rate, right from the first year, even after three straw crops. Lambs were all going away prime, at good weights, and ewe lambs were 36 -45 kilograms at mating. Grass grub problems were a thing of the past.

The next stage was reached when 71 per cent of the grazing area of the farm was in lucerne. Each year, I modified the grazing management as I learnt from current research and my own experience. We wintered on greenfeed, turnips, and hay. Lambing commenced in mid-September, and 10 days before lambing we moved to a slow rotation on autumn saved pasture to spell the lucerne as long as possible. As lambing progressed, lambed ewes were shed off and gradually moved onto lucerne and rotated round the farm. By the third week in September, when lambing was at a peak, the lucerne was up to the ewes’ bellies. I noted that the ewes and lambs stayed together well in this long feed.

Before tailing, we boxed ewes into mobs of 200 and later doubled these again, giving us three mobs of 400 ewes. Each mob then had its own rotation of four five hectare paddocks until weaning at six to eight weeks. At weaning, lambs were drafted into two mobs - ewe lambs and wether lambs. They rotated round their grazing area, followed by ewes cleaning up. The hoggets and their lambs followed the same system. The lucerne was spilled from late autumn until spring, trials having shown that this gave the greatest spring feed.

The only problem of any consequence was redgut. This usually caused 10-20 deaths in the January to March period. Watching lambs closely and shifting them off lucerne at the first sign of the problem made it more of an annoyance than an economic problem, and it was more than offset by other advantages. Ewe fertility was increasing due to careful selection and greatly improved ewe weights. Lambing percentages had slowly climbed to 135 and lamb weight remained constant at around 12.8 kg.

Why then did I go back to grass? Five or six years ago, we noted yellowing in the lucerne in November and December. At first we thought it was a combination of aphids and wet winters and springs we had at the time. The yellowing became worse in subsequent years, and lucerne production dropped during this time of peak feed requirements. The rotation failed when insufficient feed was growing to allow adequate spelling. The snowballing effect of “chasing our tails” resulted in production loss.

Our M.A.F. adviser suspected Sitona weevil from the early stages, and a heavy infestation was later confirmed by Trevor Trought. Because of the dramatic change in production, I stopped sowing lucerne and drilled grass instead, direct drilling Tama into the least affected and Nui into the worst affected lucerne stands. Two years ago I drilled one more paddock of lucerne with all the love and care possible, only to find the same thing happened in its first year. It had the direct drill treatment this autumn.

We have now gone the full circle. We are facing the same problems we had 10-12 years ago, but now we have double the lambs to fatten. Where in 1968 we had 1,400.
lambs from 1,400 ewes, in 1980 we had 2,800 lambs from 1,400 ewes and 580 reared hoggets. This year we have not been able to fatten all these lambs or grow the replacements to satisfactory weights. Grass grub is once again a problem in the autumn.

If the problems with lucerne could be overcome economically, I would give serious consideration to going back to the previous system. I could sustain a high proportion of the farm in profitable cash crops. The lucerne would provide high quality feed, even in dry conditions, for growing lambs and hoggets after weaning their lambs. It could support a high stocking rate from the first year, even after three years in a crop, and it is resistant to grass grub.

With careful use of grass, I believe we could cash in on lucerne to achieve high liveweights before moving stock onto saved grass for flushing and tupping. Thus we could achieve lambing percentages as good, if not better, than on grass alone. But for me, in the meantime, I must stick with grass, with its limitations, while waiting for the scientist to come up with an economic answer.
Cost savings in lucerne production


It is often said that lucerne costs more to establish and maintain than grass/clover pastures because of additional expenditure on seed, herbicides, lime and fertiliser, and because of limited production in the year of sowing. However, research has shown that many of these costs can be reduced, and production in the sowing year increased.

ESTABLISHMENT COSTS

Plant Numbers

There is much evidence from plants ranging in size from sub-clover to pine trees, that as the number of plants per hectare increases, the size and yield of each plant goes down, so that increasing the number of plants above a certain figure does not give any increase in yield (White 1980). Farmers will be more used to this idea in relation to animal stocking rates. It is illustrated in Figure 1.
Figure 1: Plants per Hectare and Yield

Figure 2: Growth of Biomass per Hectare from Various Sowing Rates
This curve is arrived at by growth from sowing time as illustrated in Figure 2 with results from a subterranean clover trial (Donald, 1963). At the higher sowing rates, plants begin competing with one another sooner and their growth slows down. At lower seeding rates they are free from competition for longer, and so each plant grows at a faster rate.

As the stand ages, the larger plants kill out the smaller ones, and lucerne stands tend to end up with much the same number of plants per hectare over a big range of seeding rates (Figure 3).

Figure 3: Plants per Hectare from Sowing 5, 10, 15 kg/ha.

Increases in plant numbers above about 300,000 per hectare - 30 plants per square metre, or 4.5 plants per metre of 15 cm rows - give only small increases in yield. Well managed disease free stands will reduce to about this number of plants and stay there (Palmer and Wynn-Williams 1976).

Seeding Rates

There are approximately 450,000 seeds in a kilo of lucerne seed. Normally, about half the seeds sown produce seedling plants, so two kg of seed will produce more than enough plants for maximum production. Doubling this seeding rate to four-five kg will give a large safety margin. This is about half the amount of seed most farmers sow.

There is no reason to expect higher production or longer stand life from precision seeding even at seeding rates below one kg/ha. This recommendation is theoretically sound, and is supported by extensive field trials and farmer experience.
Cover Crop and Weeds

Lucerne seedlings grow slowly, and do not compete strongly with weeds or cover crops. However, a number of trials (Palmer 1968; Palmer and Wynn-Williams 1972; Janson and Knight 1973; Wynn-Williams 1976a; 1976b) have shown that weeds and cover crops do not kill lucerne seedlings, and that when the annual crops come off, or the annual weeds are mown or die down, the lucerne seedlings grow the full size by the first summer after sowing, and produce as much as if grown without earlier competition from weeds or crops.

Post emergence herbicides cannot be used on lucerne until it has produced at least its first trifoliate leaf. By then, weeds are large, hard to kill, and have already reduced lucerne production considerably.

Using pre-plant herbicides to keep lucerne weed-free from sowing may be profitable on highly fertile soils which can give high first year production. For first year seed production it is essential.

Otherwise, sowing with a cover crop will be more profitable than sowing lucerne alone without weed control, which will be more profitable than sowing and using post-emergence herbicides. This worst alternative is often chosen by farmers.

ESTABLISHED LUCERNE

Annual Weeds

As lucerne stands age they thin out and bare ground between plants increases. During the summer, if the interval between cuttings or grazings is long enough, large lucerne plants shade the ground fully, and use all the water available, so the stand remains free of weeds during the summer. During the late autumn, winter and early spring, lucerne growth is slowed down by low temperatures and short days, and is not enough to shade out winter annuals which fill the gaps between the lucerne plants.

If the rainfall is high, the soil wet, the interval between cuttings or grazings are too short, fertiliser application inadequate, or if diseases weaken and kill lucerne plants, winter annuals and then perennial weeds will invade older lucerne stands (Palmer, 1981).

The winter annual weeds such as barley grass, storks bill, shepherd’s purse, sub-clover, poa annua, can be readily controlled in lucerne with herbicides. A large number of trials have shown that doing this reduces total feed produced over the winter-early spring. It often increases the amount of lucerne at the first spring cut, but usually has no lasting effect on lucerne production from the stand. It may reduce feed quality for lamb fattening (Palmer, 1981). If left unsprayed, these annual weeds provide winter and spring feed, and die out by November.

Why, then, spend money on spraying these weeds out? Storks bill and barley grass produce seed heads which devalue lamb pelts, make hay making difficult and reduce the value of hay. Paddock infested with barley grass, storks bill or shepherd’s purse which are intended for hay in November may warrant spraying. Other paddocks do not warrant spraying, and can be more productive if not sprayed.

The possibilities of taking weeds and weed seeds off in an early silage cut, and so reducing infestation in the next year, should be considered.

It is also important that any spraying done when the lucerne is dormant. Spraying growing lucerne with paraquat mixtures reduces spring production even further.
Perennial Weeds
Stands thin out because of mismanagement, disease or wet soil conditions. Summer weeds and perennials come into these gaps, and unless the conditions which led to their “invasion” are corrected, they may push the lucerne out. Stands in this state can be salvaged back to full production if enough lucerne plants are there (20-30 plants per square metre).
Essential to success is management which favours lucerne over grass and weeds. This may mean drainage, more careful grazing management, or more liberal and balanced use of fertilisers (Stephen, 1964). Use of herbicides to start the mending process off will usually be worthwhile, but using herbicides without correcting management will only give short term relief.
In higher rainfall areas, introducing productive grasses into weedy lucerne stands may be a useful alternative to ploughing and re-sowing.

Fertilisers
Lucerne producing 7.5 tonnes of hay per hectare takes out phosphate and sulphur equivalent to 125 kg of superphosphate, and potash equivalent to 250 kg of muriate of potash. On many soils this should be replaced. Sulphur fortified superphosphates provide more sulphur than needed if enough phosphate is applied.
Fertiliser application should be decided after consideration of soil tests (Stephen, 1981).

Cultivars
There is considerable variation in the price of seed of different lucerne cultivars. For short term lucerne on farms not infested with stem nematode, the cheapest lucerne may be the best buy. Lucerne expected to last more than three years should be wilt resistant, but some wilt resistant cultivars are more expensive than others, without being any better.

ESSENTIAL COSTS
While cost savings can be made in seed and herbicides, and profitability increased with cover crops, there are some inputs which cannot be safely reduced. Thorough cultivation must be carried out if perennial weeds are to be eliminated, and if establishment is to be high. Successful nodulation is important for the yield and longevity of stands. The cost of inoculum at recommended rates ($0.11/kg) is slight and money is better spent on using five times the recommended rate than on pelleting seed ($0.95 per cent/kg including inoculum).
Use of lime may have been too low in recent years and the resulting low pH may have contributed to the problems of lucerne thrift and longevity we are encountering today.

Pests
The best way of reducing expenditure on insecticides for apid control is the use of resistant cultivars. Failing this, strategic grazing can greatly reduce the use of insecticides. A complete grazing in winter has been shown to drastically reduce aphid numbers and delay the build up of aphids in the spring. High infestation can be reduced by grazing, providing of course that stands are not frequently grazed at immature stages or for long periods.
CONCLUSIONS

Many farmers could reduce lucerne production costs by reducing seeding rates, by sowing with cover crops and by reducing herbicide use. Fertiliser use should be reviewed in relation to soil tests, and in choosing cultivars the known disease situation, planned life of the stand, and costs of seed should be considered. Cost savings should not include reduced expenditure on inoculum or lime.

References


Lucerne grazing management for the 1980s

J.G.H. White, Reader in Plant Science, Lincoln College.

During the 1970s lucerne became a grazing plant of major importance in the drier regions of New Zealand. In spite of its widespread use, the best grazing management practices have not always been understood or applied, and one of the results has been the recent decline in its usage. This paper puts together our present knowledge into practical management systems so that the advantages of lucerne in terms of dry matter yield and quality may be optimised. An understanding of the principles is essential if successful systems are to be devised.

SPELLING DURATION

Lucerne must be rotationally grazed with a long spelling period to achieve high production. The plant relies on a build-up of root reserves as it approaches maturity, to provide energy for rapid recovery growth. Frequent defoliation lowers these reserves, with consequent lower production, plant death, and invasion of weeds (Table 1). A spelling duration of 42 days is generally recommended although this varies with season. Lucerne quality declines rapidly as it matures, particularly in summer and autumn (Fletcher 1976) when spelling period can be reduced to 35 days. Another guide is when the stand has reached one per cent flower. Spelling duration is thus a balance between restoring root reserves but still supplying high quality feed to livestock.
TABLE 1

EFFECT OF SPELLING PERIOD ON LUCERNE OVER TWO YEARS - FINAL YEARS DATA (Smallfield et al., 1979).

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</thead>
<tbody>
<tr>
<td>Dry Matter Yield (t/ha)</td>
<td>3.5</td>
<td>10.2</td>
</tr>
<tr>
<td>Weed Content (Autumn, % yield)</td>
<td>76</td>
<td>7</td>
</tr>
<tr>
<td>Lucerne Population (plants/m²)</td>
<td>21</td>
<td>52</td>
</tr>
<tr>
<td>Root Weight (g/plant)</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

GRAZING DURATION

Grazing duration is a much more flexible time than spelling period. Contrary to our views of the 1960s (Iversen 1967) we now know that grazing periods of up to 14 days cause little harm to a stand even though a shorter duration may produce slightly greater seasonal production (Janson, paper 13). This enables us to use fewer paddocks and larger mobs in the rotation. Sheep eat the tender shoots and leaves of lucerne first, then the tender stem, and lastly the older basal stem. With a long grazing duration this older stem becomes low in quality, fibrous and unpalatable, and is often rejected (Figure 1). This is less likely if the period is less than a week.

Figure 1: Changes in Digestibility and Available D.M. of Lucerne During Grazing. (Cosgrove, 1978)
LUCERNE VERSUS PASTURE

On shallow stony soils in Canterbury lucerne will out-yield pasture by 50 per cent or more under optimum management, with a much lower annual variation (Figure 2). Most of the dry matter is produced in the three spring months from mid-September to mid-December, while little growth occurs during winter. In contrast, pasture production is greater than lucerne in the cool season, although it is much less in the summer drought.

Figure 2: Comparative Pasture and Lucerne Production on Lismore Soils

PRACTICAL IMPLICATIONS

During winter, a single hard grazing with a large mob of sheep for a short period in June has considerable beneficial effects. Overwintering aphids are largely eliminated (Smallfield et al., 1979) while weeds such as chickweed, annual poa and storksbill receive a severe check from hoof and tooth treatment. Provided that grazing is carried out in dry soil conditions little harm occurs. However, if grazing is delayed until July or August soils are likely to be wetter, and crown damage and nematode spread can be considerable. In addition, the decapitation of lucerne shoots will retard spring growth. During this period it is much better to use alternative feeds such as brassicas, hay, greenfeeds or grass.

The period before and during lambing or calving is the most critical for lucerne management and a time when most harm is done to the stand. As lucerne starts to come away in late August and September there is a real temptation to graze it, as high quality feed is at a premium at this time. Generally the higher the percentage of lucerne on the farm, the greater is the temptation. We now know that hard early spring grazing decreases later production substantially (Janson 1975) and encourages rapid invasion by weeds. Although some early grazing cannot be avoided it
must be kept to a minimum, preferably on the older, weedy stands. At low stocking rates sheep eat the weeds preferentially in early spring and leave the lucerne largely untouched (Brosnan, paper 18, Talbot, paper 15).

There are two management procedures which may be adopted to allow lucerne to be spelled at this time. The first is to supply alternative feeds. Pasture is ideal, as a large bank of feed can be built up under a slow rotation during winter especially if cool-season active species such as ryegrass and subterranean clover are present. The sowing of greenfeed Tama or Paroa ryegrass on a cultivated seedbed in late February-March is a common and reliable practice, while older stands of lucerne are sometimes overdrilled in autumn with the same species (Vartha and Fraser 1978). Overdrilling of greenfeed is much less reliable than conventional sowing, and in a dry autumn may be a complete failure. In wetter districts such as the pumice country Nui ryegrass is overdrilled into older stands in the expectation that they will develop into a ryegrass/white clover pasture as the lucerne disappears. A new concept is to establish the winter-growing Matua prairie grass as a pure stand of perennial greenfeed and thus avoid the cost of cultivation or overdrilling. Early spring growth can be stimulated in Matua or other greenfeeds by use of nitrogen fertiliser.

Hand in hand with alternative feed supplies is the practice of later lambing or calving (Table 2) to coincide with the later grazing requirements and better early summer growth of the lucerne.

**TABLE 2**

**EFFECT OF LUCERNE ON LAMBING OR CALVING DATE**

<table>
<thead>
<tr>
<th>Lucerne on Farm</th>
<th>Lambing date (Light land, Canty)</th>
<th>Calving date (Pumice, N.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>August 1</td>
<td>August 1</td>
</tr>
<tr>
<td>25%</td>
<td>August 15</td>
<td>August 20</td>
</tr>
<tr>
<td>70%</td>
<td>September 7</td>
<td>September 1</td>
</tr>
</tbody>
</table>

Lucerne does not reach the optimum stage for the first spring grazing until early to mid-October, although this varies with cultivar, locality and previous management. After tailing, ewes and lambs can be rotated on lucerne until weaning, starting first on stands spelled in winter and early spring and moving later to stands recovering from early spring grazing. At this stage mob size is particularly important and should not exceed 800 ewes. Above this, real problems of mismothering may occur. Paddock number and size are also major factors to consider (Table 3). There may be 4,000 kg/ha of dry matter on offer in late October, of which 65 per cent may be utilised. Ewes require about 1.8 kg dry matter daily at this stage, and if lucerne is utilised over seven days then stocking rate will need to be 200/ha. For a mob size of 800, paddocks should be no larger than four ha with a total of seven in the rotation. If grazing duration was extended to 14 days then stocking rates could be reduced to 100 ewes/ha, paddock size enlarged to eight ha and the total reduced to four.
 TABLE 3
INTERACTION OF Paddock SIZE AND NUMBER WITH TWO GRAZING DURATIONS, ASSUMING 4,000 KG/HA LUCERNE. DM ON OFFER, UTILISATION OF 65% AND A EWE REQUIREMENT OF 1.8 KG/DAY

<table>
<thead>
<tr>
<th>Grazing Duration (days)</th>
<th>7</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocking rate (ewes/ha)</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>Paddock size (ha)</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Paddock number</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

Lucerne digestibility is lower than pasture due to the high stem fraction and no attempt should be made to clean up the stubble at each grazing, or milk production and lamb growth rate will fall. This stem residue is sacrificed as it will not be consumed at a later grazing. For maintenance of high growth rates, seven day grazing is preferable to 14 days as animals are being presented with leafy high quality material more frequently, and are not forced to eat stems. However there are greater management problems, although large paddocks can be split temporarily with an electric fence.

On dairy farms in the pumice country intensive management of lucerne is well accepted and most farmers use a daily shift, thus maintaining high quality feed on offer. Bloat is controlled by drenching cows before they go on to a fresh break. Stubble stems are either cleaned up by following dry stock or are topped with a mower.

In late spring early summer as a surplus develops, lucerne paddocks can be closed for hay. Provided that winter grazing has been carried out aphids should be no problem until early November, after the first grazing (Table 4). Grazing management should continue to keep them in check but if a high population builds up in late November it may be necessary to spray. Sodium levels are sometimes low in spring lucerne particularly in Rotorua-Taupo and parts of Canterbury and this can retard growth of lambs and milk production of dairy cows. It is a good practice to supply salt to ewes and lambs, or cows especially on pure stands. Weeds usually contain much higher levels of sodium than lucerne and therefore the problem is not so g

 TABLE 4
EFFECT OF WINTER GRAZING ON NUMBERS OF APHIDS ON LUCERNE IN SPRING (Smallfield et al., 1979)

<table>
<thead>
<tr>
<th>Aphids/stem on 31 October</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazed April only</td>
</tr>
<tr>
<td>Grazed April and June</td>
</tr>
</tbody>
</table>
Once lambs have been weaned, the ewes can be boxed into bigger mobs, using larger paddocks, and grazing duration of 14 days. Lambs should precede the ewes in the rotation so they utilise the tender shoots and leaves. In dry seasons when quality feed is short, lambs can be early-weaned quite successfully, at four-six weeks of age, provided they are 12 kg or more liveweight. At this time of year grazing with ewes can be quite hard so they clean up the stems and weeds. There should be little need for regular annual chemical control of weeds in lucerne if the correct hard summer and winter grazing is carried out and rotational grazing is practiced generally. Weed problems are a reflection of unthrifty lucerne due to inadequate nutrients, pests or diseases, or poor grazing management.

Lucerne growth in late summer and autumn is quite variable, a reflection of the wide-ranging rainfall pattern and drought in many districts. Where leaf diseases are present or aphid attack has occurred oestrogen levels may be high and lucerne should be avoided for about three weeks before and three weeks after the commencement of tupping. However, lucerne free of leaf diseases or aphids has low oestrogen levels and is quite safe for flushing and tupping. Young leafy growth is best or a cultivar resistant to leaf diseases.

**CONCLUSIONS**

Lucerne requires a high standard of management to achieve its potential. Under poor management lucerne grazing may be a disappointing and costly exercise. Because of these management problems and the overall lower digestibility compared to pasture, grazed lucerne needs to produce at least 30 per cent more dry matter than pasture to economically replace it. Yields of lucerne on pumice soils in the North Island are 50 per cent higher than pasture, and the marked swing to lucerne has been a major reason why milk fat production has increased 65 per cent in the Rotorua district in the last 10 years. At Ashley Dene, where lucerne outyields pasture by 100 per cent, stocking rate has risen from eight to 13 ewes/ha with the introduction of lucerne.

The proportion of lucerne on a farm depends on its advantage over pasture. If the advantage is very great, then the increased management difficulties of 50-60 per cent lucerne can be tolerated.

Lucerne seems to survive mismanagement better under dry climates of less than 400 mm rainfall than wet, or under dryland farming rather than irrigation. Correct management procedures are vital in moister environments, where stands will yield well for eight years under good management, but may disappear in two-four years otherwise.

We have reached a stage where grazing requirements of lucerne are well understood and it is in the hands of advisers and farmers to integrate the management with animal requirements. In dry climates of New Zealand where this is done intelligently lucerne pastures can result in much higher stocking rates and performance, and improved net incomes.

**References**


Lucerne for grazing: a farmer's view

M. Brosnan, Farmer, Hakataramea Valley.

I am not sure it's fashionable to defend lucerne these days so I won't do that. I'll just tell you about my property which revolved around lucerne and what lucerne has done for me. The humble lucerne plant took my eye while working around the Maniototo, especially on the property of the late Jim Patterson of Gimmerburn. In 1965 I was a young man with a wife and children and not much capital, having just sold a small dairy property and wanting to become a sheep farmer. So, how to buy a farm with the potential of quick development to give my family and I a comparable standard of living to that of my counterparts in town where I came from as a boy.

When we bought "Riverside" - 570 hectares - on the dry side of the Hakataramea Valley we gambled on it growing lucerne well, as it didn't grow much else. The property was carrying 1,100 corriedale ewes, had 25 hectares of lucerne, and the rest left like a dust bowl, after the ravages of cropping and rabbits. Eighty hectares was in wheat stubble when we took over. With my low capital and other interests in life, low labour, low cost farming was my aim. I have always felt a farmer should get off the farm quite a lot, or he starts to look like the place - or to put it another way - you run the business, not let the business run you.

Within five years, 200 ha of lucerne was established, which brought the stock numbers up to 3,000. This fast increase in stock numbers induced the money-lenders to allow us to build a new house in our second year. At this stage the lucerne plant had done us proud.

Lucerne sowings have continued to 365 ha today. Stock numbers were not increased much for nine years, as I questioned the nation's need of the extra productivity with all its attendant problems of labour, getting stock killed, etc. Production per stock unit has been concentrated on, though, with lambing
percentage up from 85 per cent to 110, and wool from 4,000 kg to 18,000. Also with a large area of lucerne we get a great peak of growth in spring and early summer which we can’t handle with stock. We cut this peak off by making 10,000 to 25,000 bales of hay, most of which is sold.

There is a conflict within me here, as my basic beliefs are in organic farming, and selling hay does not tie in with this. I would be pleased if anyone here could tell me how to profitably handle this surplus any other way.

Up till a year ago I worked the farm alone apart from casual labour for hay, contractors and some family help. Last year my son came home, so we bought another 100 ha carrying 250 ewes. By next year 60 ha will be sown down in lucerne with the stocking rate going up to 750 ewes.

“Riverside” has an average rainfall of 450 mm which varies between 175 mm and 640 mm. Soils are droughty with a moderate amount of stones. The property now consists of 365 ha of lucerne on terraces, 60 ha in clover on dark faces, 37 ha of border dyke irrigation, with the rest being unimproved sunny faces. The farm is sub-divided into paddocks of 12 to 20 ha.

Lucerne is sown in January with a light rate of turnips after a cleaning crop of turnips and Tama the previous year. Winter feed consists of turnips and 3 to 4,000 bales of lucerne hay. Double this amount is kept in case of drought, and sold off from the barn in winter. Ewes go out to lamb 10th September.

The latest method of lambing is to set a few ewes in each paddock where they eat mostly the weeds and any sunny sidelings, as they don’t really like green, fast growing lucerne. Once the lucerne growth gets ahead, about tailing time, we box into mobs of about 700 and shut a big area up for hay.

On pure sprayed lucerne stands redgut causes deaths round early November. Many good people have spent years trying to isolate redgut in our sheep. I always felt it was just too much of one plant, and that if we lived on a rich monodiet for a month (even if it was good whisky) we wouldn’t feel too good either! The answer on our place is a balance of feed, such as cocksfoot and lucerne mixtures, weed lucerne mixtures, irrigated grass, or even barley grass which has its uses. Topdressed dark faces improve rapidly as the fertility of the whole farm improves under lucerne.

The ewes will start to die after about 21 days on pure green lucerne. At this stage they must be shifted. Once the lucerne matures a little they can go back on. Very few deaths occur with this method. This problem only lasts for about two weeks over the fast growing period in the spring.

Lambs weaned in mid-December - approximately 500 go fat to works then. The rest are fattened on lucerne. No other fattening crops are grown. The ewes are then run in one large mob cleaning up weeds and lucerne stalks after the young sheep.

Mob stocking with rotational grazing, is essential for lucerne health. We have a stand of lucerne thirty years old, still producing two cuts of hay a year - under dryland conditions. Stock thrift, especially in fine woolled sheep, has to be watched, though, with heavy concentrations. Topping is done on grass if available, but mostly on lucerne which must be young with no damaged leaves.

**PROBLEMS**

In my opinion most pests and diseases develop through environmental reasons. The blue green aphid is the only one that has us on the hop in our climate. We have tried in our area not to spray and let nature take its course, but some years the Piramor 50 comes out. There’s no question that if the aphids are bad and can’t be
controlled any other way, spraying pays well, both from the point of view of immediate production and the retarded future growth.

I would never use anything to kill the ladybirds, though sometimes I wonder, as they are so slow to build up. I believe Warren Thomes at the D.S.I.R. may be working on a super ladybird. I just hope they don’t dislike people! I do wonder if three wet growth seasons have favoured this pest, as they tend to leave when the lucerne hardens.

Where drought is a problem, standing lucerne can carry through from spring to autumn and still have quite good feed value for ewes. We have a small private irrigation scheme which is now all in grass as lucerne won’t last and I felt the cost of trying to keep it there is too great. The scheme helps but as the river gets low in drought years, it is often not there when we want it. So, it’s the lucerne that gets us through. We have never sold or sent stock off the property because of drought.

We used to spray for weeds every second or third year (often for hay). But due to costs, stock health and possible wind blow, we have extended this to three to six years. Grazing management controls a lot of weeds and lambs are shorn in January for seed problems.

We are starting to look closely at stock health, and particularly at trace elements. We feel we are taking them out of the soil and not putting them back. The pH is about 5.9 and calcium levels are relatively high. We have not used any lime but at this stage intend to do so. Selenium and sodium levels very low in our lucerne. We are looking at the new Selina Super. The more we develop the more we have to watch stock health it seems.

Footrot has become a problem in corriedales with development. For this reason we bought 600 Coopworths. Their feet cope so much better. We still need some dry seasons to test their performance though. We feel with this area of lucerne we may be able to handle the change of breed even with the dry climate.

While conservation isn’t a problem, it is a continuing saga, especially on dryland, and is one of my main interests at this stage. We are custodians of the land for the short span of our life and have a great responsibility in this field. We have a Conservation Farm Plan with the Waitaki Catchment Commission which works as well as finance will allow. Conservation fencing, river and creek control, and the number one consideration, tree shelter planting, are the aims. I’m not convinced that lucerne does much for soil structure on dryland. Wind blow of litter and soil between plants on sprayed stands also concerns me.

Soil structure and wind blow problems are closely associated. Shelter planting might be part of the answer, and we are looking at complementary plants with a more fibrous root structure, and the introduction of worms where possible. On the lower, damper terraces where worms abound structure is not a problem.

I’ve been lucky enough to have had two periods wandering around Europe and the top of North Africa - all financed by the lucerne plant. On one of these trips, I concentrated on studying lucerne and looking for other dryland plants to complement it. Wherever I went in the drier countries lucerne was the dominant fodder plant, often grown with two or three tier farming. I came home with two strains of lucerne from Spain which were top producers there. They didn’t compare favourably with ours, but that exercise strengthened my faith in lucerne generally.

The N.Z. Institute of Agricultural Engineering is currently doing an irrigation survey of the valley, mainly centered on water harvesting. As yet lucerne has not lasted under water for us. I guess though, we’re a bit spoilt here with our 20 to 30 year old dryland stands, as we do get 8 to 10 years from irrigated lucerne. New strains could be the answer here. This survey must be of value to the valley.

We’re involved with leaf cutter bees for lucerne seed production. It would also
appear that a viable export market could open up for them. As to cultivars, we are now growing Rere and AS13R. As yet aphids have not troubled either strain.

While the corriedale is the ideal breed for this country in its natural state, under extensive lucerne I feel we must look at the coarser breeds. Life is too short to spend one's time footrotting sheep.

I feel sure that one day we'll be squeezing the protein out of lucerne mechanically, and using the residue for stock or energy. There must be a way of making this protein acceptable for human consumption and more cheaply than meat. Protein extraction from lucerne was first brought to my notice by a Mr R.M. Allison of D.S.I.R., Lincoln, who presented a paper on it in 1971 at this conference. Could this not be a way of shortening the processing chain and perhaps trading with our protein hungry Asian neighbours?

Lucerne has done everything I have asked of it. We have a 4,000 stock unit property, plus a good income from hay sales. It is still able to be run by one man, as my son is finding out! I'm just the boy around the place and enjoying it. If the economic climate was more favourable there would be no problem raising the stock numbers. Apart from our new 100 ha block, we're happy to stay as we are.

Lucerne is a plant that requires a high degree of management skills. The balance between stock health and lucerne health is critical. Hence, I've always felt, if you can grown good grass, do so. But in my view if drought and light soils are a limiting factor, lucerne is well worth the trouble.
Best stock performance on lucerne

K.T. Jagusch, J.F. Smith, Ruakura Agricultural Research Centre, Hamilton
P.V. Rattray, Whatawhata Research Station, Hamilton

LUCERNE IN SYSTEMS (Jagusch et al. 1980)

It is well known lucerne holds agronomic advantages on free draining soils subject to dry summers. High production per hectare, low inter-seasonal variability during its growing period and good summer viability allows systems to carry higher stock numbers than those with grass pastures. Marked increases in sheep output in the South Island and dairy production on the pumice soils of the Central Plateau have been a feature of increased farming of lucerne. Even where lucerne holds little or no agronomic advantage, a minimal injection (15 per cent) can improve lambing percentage and growth of weaned lambs. The reasons for its lack of popularity in the North Island sheep scene are the hassles of establishment, renovation, weed control, different fertiliser requirements, etc. Of course higher injections of lucerne result in both poorer lucerne and pasture production through over-grazing due to lucerne's virtual winter dormancy and delayed spring growth.

Lucerne's nutrient profile in regard to protein, minerals and vitamins readily complements deficiencies in grain-based rations which are the basis for feedlot finishing programmes. Unidentified growth and intrinsic palatability factors have been suggested characteristics of lucerne. Best stock performance therefore comes from high output per hectare and the accommodation of nutrient deficiency.
REPRODUCTION (Smith et al. 1979)

Under static liveweight conditions, ovulation rates and lambing percentages can be high on lucerne compared with pasture. This is perhaps associated with the protein component of the ration. It seems to make little difference whether the lucerne is 20, 35 or 50 day regrowth. However, catastrophic loss of potential lambs through feeding oestrogenic lucerne during mating is shown in Table 1. Foliar disease and in particular, the common leaf spot fungus (Pseudopeziza medicaginis) is the cause of high oestrogenic coumestans in our experiments. If we prepare pellets from poorly grazed, infected stands and from the fresh regrowth of hard grazed fungicide-treated lucerne, we get a direct relationship between oestrogen levels and ovulation rate when we mix the pellets in different proportions according to oestrogen content and feed to ewes (Table 2).

TABLE 1

THE PERFORMANCE OF EWES FLUSHED ON OESTROGENIC LUCERNE

<table>
<thead>
<tr>
<th></th>
<th>Lucerne</th>
<th>Grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovulation rate</td>
<td>1.04</td>
<td>1.38**</td>
</tr>
<tr>
<td>Barren (%)</td>
<td>7.5</td>
<td>7.9NS</td>
</tr>
<tr>
<td>Singles (%)</td>
<td>84.8</td>
<td>69.4**</td>
</tr>
<tr>
<td>Twins (%)</td>
<td>7.7</td>
<td>22.7**</td>
</tr>
<tr>
<td>Lambing (%)</td>
<td>100.2</td>
<td>114.8**</td>
</tr>
<tr>
<td>Lambing deaths (%)</td>
<td>5.3</td>
<td>2.3*</td>
</tr>
</tbody>
</table>

n=500/group

TABLE 2

OVULATION RATE FEEDING OESTROGENIC AND NON-OESTROGENIC PELLETS TO EWES

<table>
<thead>
<tr>
<th>Group</th>
<th>Ratio of pellets</th>
<th>Level of oestrogen (ppm)</th>
<th>Total ovulations</th>
<th>Ovulation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 : 100</td>
<td>0</td>
<td>70</td>
<td>1.43</td>
</tr>
<tr>
<td>2</td>
<td>25 : 75</td>
<td>25</td>
<td>59</td>
<td>1.23</td>
</tr>
<tr>
<td>3</td>
<td>50 : 50</td>
<td>50</td>
<td>56</td>
<td>1.14</td>
</tr>
<tr>
<td>4</td>
<td>75 : 25</td>
<td>75</td>
<td>53</td>
<td>1.08</td>
</tr>
<tr>
<td>5</td>
<td>100 : 0</td>
<td>100</td>
<td>48</td>
<td>0.98</td>
</tr>
</tbody>
</table>
Feeding oestrogenic lucerne for seven days prior to a synchronised oestrous suppressed ovulation, but not for three days, animals recover from ovulation suppression in 14 days. For best performance stands should therefore be prepared for flushing ewes by previous hard grazing, and clean, fresh, young stands and/or early regrowth used if fungal infection occurs regularly. Old, dirty stands riddled with common leaf spot must be avoided. Also remember such fresh regrowth could need sodium supplementation, although presently we have no evidence for sodium increasing ovulation rate.

SODIUM SUPPLEMENTATION (Joyce and Brunswick, 1975)

Minimum concentrations of sodium for satisfactory nutrition of grazing ruminants fed mixed pasture are: sheep 0.07, beef animals 0.10 and dairy cows 0.20 per cent DM respectively. In feedlots, animals get even more. Low sodium levels in New Zealand pastures are characteristic of the land-locked areas of the Central Plateau and Central Otago, and also in Nelson and inland Canterbury. Generally speaking, variability throughout the country reflects pasture composition including weeds, distance from sea and prevailing winds, and potassic fertiliser usage. In contrast to ryegrass-white clover pastures, lucerne concentrates sodium in its roots, rather than aerial parts, due to the plant’s inherently low transpiration rate, although species effect on transpiration are relatively small compared with weather effects. Thus lucerne grown in these areas is likely to be low in sodium (0.03 per cent) and this is indicative of the spectacular responses obtained with sheep, cattle and dairy cows on the Central Plateau. Examples for lambs are given in Tables 3 and 4. In these trials the animals were actually drenched, but salt licks and salt spray have proved equally efficacious.

### TABLE 3

<table>
<thead>
<tr>
<th></th>
<th>H\textsubscript{2}O</th>
<th>NaCl</th>
<th>Minerals (-Na)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucerne</td>
<td>104</td>
<td>170</td>
<td>111</td>
</tr>
<tr>
<td>Lucerne + Tama</td>
<td>99</td>
<td>156</td>
<td>109</td>
</tr>
<tr>
<td>Lucerne + Fungicide</td>
<td>119</td>
<td>179</td>
<td>123</td>
</tr>
</tbody>
</table>

### TABLE 4

<table>
<thead>
<tr>
<th></th>
<th>H\textsubscript{2}O</th>
<th>NaCl</th>
<th>NaHCO\textsubscript{3}</th>
<th>Lucerne sprayed NaCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucerne</td>
<td>109</td>
<td>174</td>
<td>182</td>
<td>157</td>
</tr>
<tr>
<td>Lucerne + Tama</td>
<td>94</td>
<td>153</td>
<td>152</td>
<td>-</td>
</tr>
</tbody>
</table>

99
Magnesium can also occur in low amounts with sodium, and although responses to supplementation were negligible with lambs, Mr Peter Young has shown that magnesium can be critical with restricted dairy cows fed lucerne.

FINISHING LAMBS
(Jagusch et al. 1979a, b, c, 1980, 1981)

Lucerne is an excellent feed for finishing lambs, not only because it is a food of high nutritive value, but also because it is produced at a time when ryegrass-white clover swards are being dominated by reproductive tiller growth and the accumulation of dead material. Best performances are obtained however, when lambs are offered 3-3.5 kg DM allowance/lamb/day, irrespective of whether the lambs are rotationally grazed at one, two, or three week intervals, or continuously grazed. Such a high allowance means lambs can select the leaves and apices of the lucerne plant and leave the stem for "clean up" by adult stock. Forcing lambs to utilise more than 40 per cent of the lucerne plant progressively reduces live weight gain, the reduction being relatively greater in autumn than in spring-summer. The results in Table 5 show lucerne maintains its growth-promoting qualities at an optimum allowance, irrespective of season.

TABLE 5

OPTIMUM HERBAGE ALLOWANCES AND GROWTH RATES FOR LAMBS FED DIFFERENT PASTURE SPECIES

<table>
<thead>
<tr>
<th></th>
<th>December</th>
<th>March</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Allowance (kg DM/1/day)</td>
<td>Gain (g/day)</td>
</tr>
<tr>
<td>Red Clover</td>
<td>2.6</td>
<td>220</td>
</tr>
<tr>
<td>White Clover</td>
<td>2.2</td>
<td>256</td>
</tr>
<tr>
<td>Rye-white Clover</td>
<td>2.7</td>
<td>207</td>
</tr>
<tr>
<td>Lucerne</td>
<td>3.2</td>
<td>177</td>
</tr>
</tbody>
</table>

CONCLUSION

Best performance can be expected from lucerne where, because of agronomic advantages in given areas it produces more DM/ha than conventional swards; it is free of oestrogenic coumestans; it is supplemented with added salt where necessary, and where growing lambs are not forced to eat more than about 40 per cent of the lucerne present pre-grazing. In addition, lucerne complements grain-based rations.


Sitona weevil and aphids in lucerne

T. E. T. Trought, M.A.F., Lincoln

Both the sitona weevil (Sitona humeralis) and the lucerne aphids (generally a mixture of Acyrthosiphon kondoi and A. pisnum) reached New Zealand at about the same time in 1975-76. Where they originated will remain a matter of conjecture: Australia had been troubled by the sitona weevil for a number of years but had not encountered the aphids whilst the U.S.A., where sitona weevil is indigenous, had only suffered attack by the blue green aphid (A. kondoi) shortly before its arrival in New Zealand.

The aphids soon became a major and widespread pest of lucerne whilst the sitona weevil has become progressively more important, and it can now be found wherever lucerne is grown.

LUCERNE APHIDS

The lucerne aphids, which in 1977-78 could be found in virtually all unsprayed lucerne paddocks, seem now to have diminished in importance. The reasons for this are not clear but initially could have been the result of increasing pressure from predators and disease. Now, however, the introduction of aphid resistant lucerne cultivars and the common practice of winter mob stocking to delay the spring invasion appear to have reduced the need for regular spray schedules. Because of these factors it is difficult to make any generalised recommendations for their control. Nevertheless if 10 aphids per stem can be found, and these numbers can easily be seen, it may be necessary to spray. If haymaking, spraying will be necessary before cutting to prevent heavy and damaging infestations on the new
shoots. If rotational grazing is practiced however spraying may not be necessary; but do not graze earlier than usual for aphid control since this may be harmful to the crop. If grazing is not due for a week or more after 10 aphids per shoot are assessed it would be better to spray than to allow a heavy infestation to develop since this would cause long term harm to the crop and make the lucerne less palatable.

Unless resistant cultivars are grown, aphids cannot be ignored; a regular weekly inspection is desirable from November through to April to ensure that any increase in aphid numbers is observed and measures can be taken to combat them before serious damage occurs.

**SITONA WEEVIL**

This small (4-5 mm) brown active beetle is the only one found commonly in lucerne. The characteristic feeding notches in the margins of lucerne leaflets may be observed at any time but the adult is most abundant in November and December. Large numbers of the adult weevil only occur in crops which have had high larval numbers. The larvae are small, legless and white with an orange-brown head and it is the feeding of these on root nodules and root hairs which may cause the greatest damage to the crop. Since damage by larval underground precedes adult damage it is difficult to assess the real damage of the latter though, when they are numerous, considerable defoliation and crop loss can occur. It is probable however that the underground feeding of larvae is more important, long term, than the leaf feeding of the adults.

The larvae would be difficult and expensive to control by insecticides; the adults however are relatively easy to control with sprays. Because of this a study of the life cycle of the pest has been made to discover at which time the adult may be most effectively controlled to prevent egg laying and subsequent larval damage.

Figure 1: Seasonal Distribution of Sitona Weevil Populations in a First Year Stand of Lucerne (1980-81)

![Seasonal Distribution of Sitona Weevil Populations](image)
Figure 1 shows the fluctuations in numbers of sitona weevil adults, larvae and eggs through a one year cycle in a first year stand of lucerne. Two aspects of this cycle are of particular significance. The first is that there are only two main flight periods: the summer flight in December-January indicates flights out of the crop to resting sites - some adults may remain in the crop but none lay eggs until the second flight in March-April. This re-infests lucerne paddocks (or infests paddocks sown in spring or autumn) and egg laying starts. The second aspect of importance is that the numbers of eggs on the soil surface, where they are scattered by the adult females, reaches a peak in August. There may be an egg laying peak in spring but the egg hatch at that time compensates for this and it is not therefore demonstrated as an increase in egg numbers on the ground.

It seems therefore that control of adults in May, at the end of the flight period, should prevent further egg laying and a build-up of egg numbers, and, hence, any harmful presence of larvae in spring.

Control of the adult may be achieved by spraying on warm days in May with chlorpyrifos, diazinon or fenitrothion at one kg active per hectare. Control of adults may also be achieved by mob stocking but the intensity of this, its timing and the conditions at the time will almost certainly affect the efficiency of this method of control and further work is necessary to prove it.

A decision on the need to control adult sitona weevils and the methods of assessing that need still require further work. It is possible that an arbitrary assessment of leaf damage in May will be all that is required. Certainly if leaf notching by adults in May is very obvious the probability of larval damage in spring followed by adult damage in summer is high. This would particularly be true of late or autumn sown lucerne crops which would be especially susceptible to even moderate numbers of larvae in spring.

Since high numbers of adults over the December-January period can cause serious defoliation at a time when growth of dryland lucerne may be slow it may appear necessary to control them with insecticidal sprays. It should be noted however that this summer peak is of relatively short duration; grazing therefore would prevent crop loss and the adult population would naturally disperse. If, however, a decision is made to control the pest by spraying it must be made early since the intensity of attack develops quickly. If delayed, the spray treatment would coincide with the departure of the pest and its cessation of feeding and therefore be wasted.
Longer stand life with the new cultivars

M.W. Dunbier, Crop Research Division, D.S.I.R., Lincoln
H.S. Easton, Grasslands Division, D.S.I.R., Palmerston North.

The most important message for lucerne growers considering sowing a new stand is that for satisfactory production and persistence it is essential to give the appropriate cultivar good management. Good management of the wrong cultivar will give disappointing results, as will poor management of the right cultivar.

Lucerne stands fail because stress factors are too severe for the plant. The effects of stress factors such as too frequent cutting, low pH and low fertility, disease or insect attack add to one another whether they occur separately or at the same time (Leath & Byers 1977). There are only small differences in the ability of cultivars to resist the stress imposed by poor management or low fertility, but there are large differences in their resistance to pests and diseases. Thus choosing the correct cultivar can be a very important factor in determining the life of the stand. This paper discusses some diseases influencing lucerne production and how resistant cultivars can assist farmers in maintaining productive stands.

DISEASE FACTORS

Since 1970 the importance of a number of diseases on lucerne production in NZ has been recognised (see Table 1). The New Zealand lucerne grower should not, however, consider that his position is unique in the number of problems he has to contend with, either in terms of climate or diseases and pests. Some other countries have more pest and disease problems and a less favourable climate than New Zealand, but with resistant cultivars and good management they obtain good performance from lucerne.
TABLE 1

MAJOR DISEASES OF LUCERNE IN NEW ZEALAND

<table>
<thead>
<tr>
<th>Disease</th>
<th>Severity</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial wilt</td>
<td>Severe</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Verticillium wilt</td>
<td>Moderate</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Crown rot</td>
<td>Light-moderate</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Stem nematode</td>
<td>Severe</td>
<td>Localised, especially North Otago, South Canterbury</td>
</tr>
<tr>
<td>Phytophthora root-rot</td>
<td>Severe</td>
<td>Localised, areas with wet soils</td>
</tr>
<tr>
<td>Leaf diseases</td>
<td>Light-moderate</td>
<td>New Zealand, especially humid area</td>
</tr>
</tbody>
</table>

The major diseases, their severity and distribution are shown in Table 1 and the major pests have already been referred to by Trought (1981). Unlike most of the insect pests which can often be economically controlled by spraying or management the only satisfactory method of disease control is with resistant cultivars.

Bacterial wilt, the most important lucerne disease in New Zealand, was first recorded in Canterbury in 1970 (Close & Mulcock 1972) and is now a threat to all lucerne grown in the country whether irrigated or dryland. Bacterial wilt can cause quite rapid stand loss in susceptible cultivars under conditions that favour the disease. Stands can go from being highly productive and apparently healthy to non-productive and weedy in 18 months to three years. In other situations, particularly in extensive dryland stands, this change may take much longer. However, once the disease is established, even in a dryland stand a period favourable for the disease or a stress period for the stand can cause rapid decline in the stand, see Table 2. Some rapid, and so-called unexplained collapses of stands are due to this process.

Most U.S. lucerne cultivars bred over the last thirty years are resistant to bacterial wilt and the disease is now controlled there by the use of these cultivars. With widespread adoption of bacterial wilt resistant cultivars in New Zealand the disease will no longer be important.

Verticillium wilt is considered to be an important disease of lucerne in Europe and North America. It is widespread in New Zealand and the 1975/6 survey carried out by MAF and DSIR staff recorded that 67 per cent of the 247 stands examined contained plants with Verticillium albo-atrum. However the importance of this disease in New Zealand is not well documented. Dunbier et al inoculated plants with V. albo-atrum and showed that it had much less effect on yield and plant survival than inoculation with bacterial wilt, however there is evidence suggesting that some areas may have a more severe problem with Verticillium than others but no more than that.

In Europe and more recently in North America considerable effort has gone into breeding lucerne for resistance to Verticillium wilt. A number of commercial cultivars resistant to Verticillium wilt have been released in Europe, but none of these also have resistance to bacterial wilt. Cultivars resistant to both diseases should be commercially available in North America in the near future.

Crown-rot is ubiquitous in all but very young lucerne stands throughout the world. It is caused by fungi (including Fusarium spp., Rhizoctonia, Stagonospora,
Sclerotinia and Phoma) invading the crown and multiplying in the moist mixture of litter trapped in the crown. The fungi involved vary from place to place and time to time, and this makes breeding for resistance difficult. Crown-rot has not been shown to reduce production. Yield potential may be decreased to some extent by the loss of active crown area, but there is apparently considerable compensatory growth by new stem buds in healthy tissue on the periphery of the crown.

There has not been much breeding for resistance to crown-rot in lucerne. Some cultivars have been released with resistance to Fusarium, and this may reduce crown-rot. However resistance to crown-rot will probably gradually increase with selection following inoculation with ground-up diseased plants. In the meantime management which minimises injury to the crown through trampling or machinery should minimise crown-rot.

During the recent wet winters many lucerne stands have endured extremely wet soil conditions. Many of them failed, and the failure has been attributed to "wet feet". In fact, it is probably not just excess water that has killed plants but lack of aeration and Phytophthora root-rot. This disease is active only when soil is wet for a long time and it may rot off roots completely. When the soil dries out the disease becomes dormant, although other fungi may then come into the roots where Phytophthora had been active. A healthy plant may then produce new roots from above the infection point and while it may survive it is no longer tap-rooted. Some of the apparently poor performance of lucerne under dry conditions following a wet season can be due to the loss of the tap-root through Phytophthora root-rot. A number of U.S. cultivars including AS13R, Washoe and WL318 are resistant to this disease and in areas where the water table level rises markedly these cultivars should be grown.

The other major root/crown disorder in lucerne is caused by the stem nematode or eelworm (Ditylenchus dipsaci). Stem nematode was first reported in New Zealand by Morrison (1957) and now is probably the most serious disease or pest of lucerne in North Otago and parts of South Canterbury. Other infestations are in Central and North Canterbury, but there are few serious infestations in Marlborough, Nelson or the North Island. Infested plants are most apparent in the spring and the nematodes may spread rapidly, particularly in those areas where nematodes are present in irrigation water. Stem nematode may cause dramatic decline of stand under conditions that are favourable for its spread and growth.

Nematicides are effective but uneconomic methods of control in almost all circumstances. Stem nematode is a problem in large areas of North America and Europe and many resistant cultivars have been released. Where stem nematode is known to be present on a farm, or in areas where nematode is widespread then only the nematode resistant cultivars (AS13R and Washoe) should be sown.

A different group of lucerne diseases are those of the stems and leaves. A number of different fungi are involved - including common leafspot (Pseudopeziza medicaginis), pepper spot (Leptosphaerulina briosiana), downy mildew (Peronospora trifoliorum), Stemphylium leafspot (Stemphylium botryosum) and spring blackstem (Phoma medicaginis). The actual loss of production from these diseases in susceptible cultivars can be substantial, particularly with a long interval between harvests or in damp or humid weather. Some assessments have been made using fungicides to control the fungal diseases and losses of 16 per cent in forage yield and 45 per cent in seed (Hart & Close 1976) and 18 per cent in forage yield (Purves et al. 1981) have been reported in Canterbury with a long interval between cuts. Purves et al. (loc.cit.) however showed that with the use of cultivars with resistance to these diseases, or short cutting intervals these diseases caused little loss.
More important than dry matter loss from these diseases are the raised coumes-tan levels which result from infection (Morgan & Parbery 1981, Purves et al. loc.cit.) and their subsequent effects on the reproductive performance (Smith et al. 1979, 1980; Kain & Biggs 1980) of ewes or cows grazed on such lucerne at or just before mating.

Some breeding for resistance to these leaf diseases has been carried out in North America and Europe. Major differences in general resistance to a range of these diseases comes in cultivars or germplasms from different areas. In general lucerne from humid areas have accumulated considerable resistance over generations while those from low rainfall, desert areas have low levels of resistance. Thus cultivars from Northern Europe (Flamande types) or from North-Central or North-Eastern regions of the U.S.A. show good levels of resistance to foliar diseases in New Zealand's marine type climate, while cultivars from Mediterranean regions or from South-Western regions of the U.S.A. are generally susceptible. The cultivars currently grown in New Zealand range in their resistance to leaf diseases (see Table 3) and should be treated accordingly.

RESISTANT CULTIVARS AND STAND LIFE

A large number of cultivar trials have been carried out in New Zealand in the last ten years. They have given several important results. The major practical point is that in the presence of serious diseases such as bacterial wilt or stem nematode resistant cultivars persist and produce where susceptible cultivars are eliminated (Palmer et al. 1975, Dunbier et al. 1979, Easton unpub. data).

## TABLE 2

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>12 months Control</th>
<th>12 months Bacterial wilt</th>
<th>20 months Control</th>
<th>20 months Bacterial wilt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wairau</td>
<td>96Aa</td>
<td>98Aa</td>
<td>84Aa</td>
<td>44Bb</td>
</tr>
<tr>
<td>Saranac</td>
<td>94Aa</td>
<td>96Aa</td>
<td>89Aa</td>
<td>74Aa</td>
</tr>
<tr>
<td>Washoe</td>
<td>94Aa</td>
<td>94Aa</td>
<td>86Aa</td>
<td>86Aa</td>
</tr>
</tbody>
</table>

Cultivar means within a treatment followed by the same letter are not significantly different at 5 per cent (lower case) or 1 per cent (upper case) levels.

** Indicates highly significant difference (1 per cent level) between treatment means within a cultivar.

Results from two recent field trials illustrate this. Table 2 shows the survival of lucerne cultivars in a field trial following inoculation with bacterial wilt. Less than two years after inoculation, more than half of the Wairau plants have died while the bacterial wilt resistant cultivars Saranac and Washoe retained enough plants for a
satisfactory stand. Figure 1 shows how the appropriate combination of resistances is necessary. When grown infected with bacterial wilt and stem nematode, Saranac, which is resistant to bacterial wilt but susceptible to stem nematode, was significantly reduced in plant numbers compared to Washoe which is resistant to stem nematode as well as wilt. In this situation Saranac was no better than Wairau which is susceptible to both bacterial wilt and stem nematode.

Figure 1: Plant Survival of Lucerne Cultivars following Infection with Stem Nematode.

In the trials free of major diseases some of the imported cultivars yielded as well as the New Zealand standard Wairau, and some had added advantages such as better cool season production, or resistance to leaf diseases or aphids. It would be misleading to consider, however, that all disease problems can be controlled with cultivars available now. Some trials have shown poor performance of all cultivars, unrelated to all known diseases and indicating a local problem which New Zealand breeding programmes will have to solve.

RESISTANCE TO INSECT PESTS

Trought (1981) has already described the effects of the various insect pests on lucerne in New Zealand. In North America much of the lucerne breeding efforts have been to achieve resistance to aphids - particularly spotted alfalfa aphid and pea aphid and more recently blue-green aphid. These efforts have been spectacularly successful as resistant cultivars have been produced rapidly and saved producers large sums. However, the results from extensive efforts in breeding for resistance to the alfalfa weevil (Hypera postica) and the Egyptian alfalfa weevil (H. brunneipennis) have not been nearly as successful. No cultivars resistant to these pests have yet been released in the U.S.A.

In New Zealand, as in Australia, rapid progress has been made in breeding for resistance to aphids since these pests arrived in the late 1970's. One aphid resistant,
cultivar (Rere) has been released in New Zealand and several more are undergoing field testing and should be released within the next five years. Six aphid-resistant cultivars have been released in Australia following a large expansion in breeding effort there, but these programmes are now being scaled down.

Much less effort has gone into breeding for resistance to either Sitona weevil or white-fringed weevil in New Zealand. Should breeding for resistance to Sitona weevil prove necessary then Australian experience in selecting for resistance may prove useful. For white-fringed weevil however there is no overseas resistant germplasm available and any New Zealand programme would be working on its own. In either case development of resistant material to these chewing insects would be considerably slower than the production of aphid-resistant cultivars.

### TABLE 3

**CHARACTERISTICS OF MAJOR CULTIVARS AVAILABLE IN 1980**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Blue-green aphid resistance</th>
<th>Pea aphid resistance</th>
<th>Bacterial wilt resistance</th>
<th>Stem nematode resistance</th>
<th>Leaf diseases resistance</th>
<th>Phytophthora root-rot resistance</th>
<th>Leathery leafness</th>
<th>Autumn-spring growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS13R</td>
<td>S</td>
<td>SR</td>
<td>R</td>
<td>R</td>
<td>S</td>
<td>R</td>
<td>G</td>
<td>VG</td>
</tr>
<tr>
<td>Pr 521</td>
<td>S</td>
<td>MR</td>
<td>R</td>
<td>S</td>
<td>SR</td>
<td>S</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>Pr 524</td>
<td>S</td>
<td>MR</td>
<td>R</td>
<td>S</td>
<td>MR</td>
<td>S</td>
<td>VG</td>
<td>L</td>
</tr>
<tr>
<td>Rere</td>
<td>R</td>
<td>R</td>
<td>MR</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Saranac</td>
<td>S</td>
<td>MR</td>
<td>R</td>
<td>S</td>
<td>MR</td>
<td>S</td>
<td>VG</td>
<td>F</td>
</tr>
<tr>
<td>Wairau</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>G</td>
<td>F</td>
</tr>
<tr>
<td>Washoe</td>
<td>S</td>
<td>MR</td>
<td>R</td>
<td>R</td>
<td>S</td>
<td>R</td>
<td>G</td>
<td>F</td>
</tr>
<tr>
<td>WL311</td>
<td>SR</td>
<td>R</td>
<td>R</td>
<td>S</td>
<td>MR</td>
<td>S</td>
<td>VG</td>
<td>F</td>
</tr>
<tr>
<td>WL318</td>
<td>SR</td>
<td>R</td>
<td>R</td>
<td>SR</td>
<td>MR</td>
<td>R</td>
<td>VG</td>
<td>F</td>
</tr>
</tbody>
</table>

Abbreviations: R = resistant; MR = moderately resistant; SR = slight resistance only; S = susceptible; - = no reliable information available; VG = very good; G = good; F = fair; L = low.

### CULTIVARS AVAILABLE FOR SOWING IN 1981

A summary of important differences between cultivars is shown in Table 3 and brief descriptions of these cultivars follows.

**Wairau:** Standard New Zealand cultivar. Well adapted to New Zealand farming regimes involving combined cutting and grazing. Makes high quality hay. However, susceptible to all major diseases and pests making its persistence questionable in all but most favourable environments (Table 2).

**Saranac:** On Acceptable Cultivar List since 1974. Bacterial wilt resistant cultivar with somewhat larger leaves and coarser stems than Wairau. Is more resistant to leaf diseases and pea aphids than Wairau, but grows slightly less in late autumn and early spring.
Washoe: On Acceptable Cultivar List since 1976. Resistant to bacterial wilt, stem nematode, *Phytophthora* root-rot, and spotted alfalfa aphid; moderately resistant to pea aphid; very susceptible to leaf diseases. In trials, Washoe has yielded 10-15 percent less than other cultivars in the first two years but has improved from then on to end up as one of the best cultivars. Has similar seasonal growth pattern to Wairau.

**AS13R:** On Acceptable Cultivar List since 1979. Resistant to bacterial wilt and spotted alfalfa aphid, *Phytophthora* root-rot and stem nematode. AS13R is more productive over late autumn-early spring than any other bacterial wilt resistant cultivar available in New Zealand but is more susceptible to leaf diseases.

**Pr 521:** On Acceptable Cultivar List since 1979. Bacterial wilt and spotted alfalfa aphid resistant cultivar bred in the U.S. Moderately resistant to pea aphid. Similar to Saranac in winter dormancy.

**Pr 524:** On Acceptable Cultivar List since 1979. Bacterial wilt and spotted alfalfa aphid resistant cultivar bred in the U.S. Moderately resistant to pea aphid. Similar to Saranac in winter dormancy.

**Rere:** On Acceptable Cultivar List since 1979. Only cultivar resistant to blue-green aphid and pea aphid. Moderately resistant to spotted alfalfa aphid and bacterial wilt. Shows considerable growth in late autumn and early spring, but less than AS13R. Bred by Crop Research Division, DSIR.

**WL311:** On Acceptable Cultivar List since 1979. Bacterial wilt and pea and spotted alfalfa aphid resistant cultivar bred in the U.S. Same resistance to leaf diseases as Saranac.

**WL318:** On Acceptable Cultivar List since 1979. Bacterial wilt, spotted alfalfa aphid, pea aphid and *Phytophthora* root-rot resistant cultivar bred in the U.S. As resistant to foliar diseases as Saranac.

From these descriptions recommendations of cultivars for particular situations can be made. These recommendations are summarised in Table 4.

**TABLE 4**

**CULTIVAR RECOMMENDATIONS FOR SPECIFIC AREAS AND PURPOSES**

Cultivars are listed in general order of suitability of each group. If of equal suitability cultivars are in alphabetical order.

If the planned stand is:
Where aphid infestations are consistent and severe sow; Rere, WL 311 = WL 318.
On heavy soil where waterlogging is likely, or under heavy irrigation sow; AS 13R = Washoe = WL 318.
Where stem nematode is a particular problem sow; AS 13R = Washoe.
Where lucerne makes good growth in late autumn - early spring, and where this production is particularly valuable sow; AS 13R, Rere.
Where persistence of lucerne is critical (e.g. very stony soils, very extensive grazing systems) sow; Washoe.
For planned short-term stands sow; Wairau.
In any other situation any bacterial wilt resistant cultivar will give satisfactory performance and the choice should depend on commercial considerations.

NEW ZEALAND LUCERNE BREEDING PROGRAMME

While a number of overseas cultivars have given good performance in New Zealand, none is ideal for this country. Ultimately, cultivars selected here will prove superior. Breeding for adapted disease and pest resistant cultivars was only begun in New Zealand following the discovery of bacterial wilt in 1970. The recognition that several pests and diseases other than bacterial wilt are also currently or potentially important emphasises the importance of multiple pest resistance.

There are two lucerne breeding programmes in New Zealand. Crop Research Division, DSIR at Lincoln has a long established programme which initially had national responsibility but now is aimed largely at the South Island. Since 1976 Grasslands Division, DSIR at Palmerston North has established a breeding programme aimed principally at the North Island lucerne growing areas.

In broad terms the objectives of both programmes are similar. Both have as major objectives to breed for resistance to bacterial wilt and blue-green and pea aphids, but other objectives vary according to the different needs for lucerne grown in North and South Islands. The Palmerston North programme emphasises resistance to leaf diseases which are a serious problem in the warmer and more humid areas. In contrast the Lincoln programme has emphasis on resistance to stem nematode which is not known to be widespread in the North Island and to Verticillium wilt which may be a problem in Central Otago. The Lincoln programme will also place additional emphasis on resistance to Phytophthora root-rot.

The blue-green and pea aphid resistant cultivar Rere is the first pest-resistant cultivar released from a New Zealand breeding programme but several pipeline cultivars are likely to be released within the next five years. Grasslands Division have one and Crop Research Division two under off-station field plot testing and further promising material being evaluated on-station.

Over the decade of the 70's the importance of a range of pests and diseases on lucerne production using the traditional cultivar Wairau was recognised. Imported disease and pest resistant cultivars have overcome some of these shortcomings and the new range of New Zealand bred resistant cultivars coming forward will overcome more. Good management of these cultivars will give excellent results to the grower. The challenge to the grower is to choose the correct cultivar for his situation.

References


Part 4

FARM LABOUR
The agricultural workforce and the agricultural industry

Professor B.J. Ross, Agricultural Economics Department, Lincoln College.

With the Agrow campaign fresh in our memories and the farming industry having apparently set its sights on some extremely high targets for output by the end of this decade, it seems a good time to stop and consider the labour force implications of the growth rates in agricultural output proposed for this coming decade.

There have been some very widely varying estimates of the employment implications of the growth in output which has been discussed in the Agrow campaign, but I think that some of the variations stem from the fact that people are talking about different things. It is really a matter of some concern that we are actually rather poorly informed about the current size of the labour force employed on our farms. This has always been the most poorly documented section of our labour force, but recently there has been concern that the official estimates of the numbers of people employed have been getting further and further out of line with reality. We hope that the results of this year's census will help set the record straight.

Nevertheless, Mr Neil Taylor, the Director of the New Zealand Meat and Wool Board's Economic Service, in an address to the Electoral College earlier this year, stated that it is estimated that currently there are approximately 130,000 persons engaged directly on farms. In addition, there are in the vicinity of 70,000 engaged in primary processing industries, half of these in the meat freezing industry. Indirectly there are many more involved in those industries servicing agriculture on one hand and those engaged beyond the initial primary production area whose employment is dependent on the output of the primary sector.

Perhaps as a starting point we could say that there are roughly 130,000 people working on farms and about another 100,000 engaged in either providing inputs for
farmers or processing farm outputs. Thus we are talking about an existing labour force of 230, maybe 250, thousand people.

The estimates of the additional jobs created over the 1980s, which I have read or heard, vary from about 30,000 to 150,000 people. I think some explanation of the wide difference in these estimates is required, and I think the explanation is as follows. The lowest figure is the estimate of the increase in the labour force required on farms and servicing agricultural industry if output grows, but output per labour unit also grows at least as fast as it has over the last fifteen or twenty years. The highest figure cannot possibly represent the numbers of people who will be required on our farms, in our processing works, and so on, as a result of increased output unless the productivity per worker is going to fall catastrophically during the 80s. I can only assume that this figure represents the total direct agricultural employment on and off farms, plus the additional employment in unrelated industries, which could result from the higher level of economic activity which would be permitted in our economy if we were to receive all the additional export earnings which should result from the higher agricultural output. It is often taken as a simple rule of thumb that one worker producing exports earns enough to buy the imports required to employ three other workers. Given the relatively generous productivity assumptions built into the low estimate of 30,000 workers, the figures then do not look so far apart.

Mr Frith is going to concentrate more on the on-farm labour force and I am going to talk about the labour force servicing the farmer and processing his output. Farmers are dependant for many of their inputs on workers in industries such as fertiliser, farm chemicals, wire, machinery repairs, and so on. They only receive an income because their products are taken as raw materials by industries such as the meat processing industry or the milk processing industry, and turned into products which are bought by final consumers. The total agricultural business, or agri-business, sector extends far beyond the farm gate, but every part of it is dependant on every other part for income and employment. If any one part of the total sector fails to perform its function properly, in the end all will suffer. Those of you who attended the seminar on lamb marketing will know that there were many references to the fact that the major problem facing farmers at the moment is not one of marketing their products, but of the present state of the New Zealand economy and in particular the failure to achieve productivity increases in our meat processing works. As luck would have it, I chose to use the meat freezing industry as an example in my discussion of off-farm employment and I think some of the things I have to say fit quite well with the comments made yesterday.

If we take the optimistic stance that agricultural output will grow in the 1980s in the sort of manner which the Agrow programme has tried to demonstrate is possible, then obviously there will be a need for more people to work in the processing industries, and it has been suggested that we will need another twenty-four chains to process the extra lambs produced. Just what extra labour will be required to process all this extra production is difficult to estimate because of the uncertainty surrounding the rate of productivity change which will occur in our freezing works in the years ahead. At a time of economic uncertainty and high unemployment, workers are naturally reluctant to see the introduction of changes in production methods which could result in fewer workers being required. Thus the introduction of automatic pelting machines has been delayed for years, and progress still seems to be excruciatingly slow. But, as we all know, one of the problems facing farmers in recent years has been the fact that the returns for products such as lambs have not increased as rapidly as their costs. As we heard yesterday, market realisations have increased quite satisfactorily, but the farmer's
problem stems from the fact that sharply rising processing costs have reduced the proportion of the final market price which is available to farmers. The meat processing industry is in fact one of the few to have shown negative productivity growth over a number of years. Hygiene regulations have been largely to blame for this, but there has been a failure to offset the labour needs of increased hygiene with labour saving innovations elsewhere.

If the New Zealand pastoral industry is to expand, some way has to be found of making farm production a profitable enterprise. In this connection, I must say that my biggest disappointment with the Agrow campaign was that whilst I was easily convinced that there is plenty of potential still to be developed on New Zealand farms, and that the agricultural industry deserves more resources just as much as the big energy programme, I did not really learn through the media what was going to make farm output grow so much faster in the 1980s than in the 70s. I guess the answer has to be in a greater assurance of reasonably high and continuing profitability, and this has to be found by holding down farmers' costs or raising their returns, or some combination of these two. We cannot afford to ignore any cost cutting technology which may be available to us.

On the input side, technology which can be shown to be profitable is usually taken up quite rapidly by farmers or contractors, but we know that in the meat processing industry the story has been very different. In the long run, however, process workers' employment depends on farmers being prepared to produce lambs for processing, and this will depend on it being a profitable thing for them to do. Certainly increases in production will be dependent on profitability. Thus it is in the best long-term interests of the processing workers to hold costs down as far as possible, to encourage farmers to increase total production. On the other hand it is probably unreasonable to expect workers to sacrifice short-term job security for the less certain prospect of more jobs later, and this is most certainly true for older workers.

Thus we are faced with a position in which it is in the best interests of both farmers and workers, certainly in the long run, to introduce all the new cost saving technology which is available, and to actively seek for more. On the other hand, workers feel that the short-term costs to them of accepting new techniques which lower the requirement for labour are so great that they prefer to exclude this technology from the works for as long as possible.

Mr Jenkinson yesterday made the comment that if an export lamb trade were as important to West Germany or Japan as our trade is to us, then those countries would long ago have put into operation highly automated processing works akin to the types of works we have for poultry processing. I believe that for the future of our meat industry we need such works, and the most important labour question facing the agricultural industry is how we can bring about the introduction of the technology which will make such works a reality.

If it is right that other countries would have introduced a technology which we now need, we should perhaps examine how it is that they can persuade their workers to accept changes for which we seem unable to get acceptance. For Japan at least, I think a large part of the answer lies in the concept of lifetime employment which applies with the larger companies. Workers in these companies know that whatever changes may be introduced into the factories in which they work, and whatever changes in work methods they may have to accept, their jobs with the company, and their seniority, will be protected. In these circumstances workers have nothing to lose from accepting change, and if the change improved the profitability of the company for which they work, then there may be something to gain.
When I was in Japan last year, I found that this process of what might be called "buying technological change by the guarantee of life-time employment" had different effects according to whether the firms were engaged in producing for the home market or for export. For example, I visited a feed mill where compound feeds for livestock were being produced from imported grains. The manager confessed to me after a considerable amount of questioning, that the plant had several more workers than it really needed, but the cost savings resulting from introducing new machinery were such that it paid the company to have the machinery and keep the workers on the pay roll. Thus in the situation of a company which had a limited market, that is, a market limited by the size of the internal economy, then the lifetime employment guarantee associated with introduction of new production methods results in a certain amount of feather-bedding in Japanese industry. With firms producing for the export market, however, the situation is rather different. At Nippon Steel I found that until just a few years ago the market was regarded as being unlimited, since they had turned from the internal market to exporting their products, and when the change to exporting was first taken, the world market seemed infinitely large. In these circumstances the introduction of more productive machinery, coupled with the maintenance of the labour force at its original size, meant that total production was expanded rapidly and the extra output was sold in the world market.

What do we have to learn from this Japanese experience? I think the lesson is that where workers identify with their employers and where employers earn the loyalty of their workers by treating as life-long members of the company, then quite surprising changes can sometimes be made. When I first started preparing this talk I thought it sounded almost impossibly idealistic to suggest that this idea could have some application in the New Zealand meat freezing industry. And then came the news of the settlement reached between the Hawkes' Bay Farmers Freezing Company and the Clerical Workers employed in the freezing industry. The fulsome way in which the Union representative described the company as enlightened made me think that the company must have given away the earth, but the announced provisions of the agreement sound very reasonable: full consultation with the union before introduction of new technology, and no redundancies during the killing season. I should have thought that any company would have been prepared to grant such provisions in return for the introduction of something like the automatic pelting machine. I think that will take something rather more than simply no redundancies during the killing season, but it may be that we are now in a position to strike some sort of bargain between farmers, freezing companies and workers. Farmers need the new technology to be introduced into the works in order to maintain their returns at a level which will encourage them to increase production. We are assured that farm production could be expanded sufficiently to occupy an additional twenty-four chains in the freezing works. Thus, given the technology it may be possible to increase production sufficiently to maintain as many jobs in freezing works as at present by employing workers on additional chains. In the absence of the new technology it may be that our lamb trade will be slowly strangled. This will benefit no-one, farmers, workers, nor companies. The Federated Farmers Agrow campaign has been directed towards people who might be influential in ensuring that the farming industry gets the resources it needs in order to expand in the 80s. Perhaps more efforts should be directed at those people who can ensure that the farming industry will get the incentive that it needs to expand. Some commitment by farmers and companies to ensure that jobs will be protected might achieve the results we have all been looking for, and feather-
bedding could be prevented if the workers made redundant on one chain were given useful employment on another.

Perhaps I have strayed somewhat from what the sorts of issues the organisers of this session thought I would address when they asked me to talk this morning, but I have wanted to highlight the interdependence of the various sections of the total agricultural and processing sectors and I have tried to inject some ideas into what has seemed to be our most intractable problem and possibly our most important. It may very well seem to you that I am still being impossibly idealistic. Perhaps I am, but if you have any better ideas, I, and everybody else here will be interested to hear them. Personally I believe we cannot afford to by-pass any cost saving technological advance which will increase returns to farmers and increase our international competitiveness.
The agricultural workforce and the farmer

D.J. Frith, President, Federated Farmers, Auckland.

It has always puzzled me when I hear the term "worker" used by unionists and politicians, what their idea of a "non worker" would be. We have no such confusion in the Statistics Department analysis of those engaged in the agricultural workforce, where there are four different categories: working owners, paid permanent employees, unpaid family members, and paid casuals. In June 1979 these totalled 152,900, which is an increase of 18 per cent from June 1972.

The development of horticulture and small blocks have resulted in large increases, where horticulture alone employs 110 per cent more than in 1972. Of the total workforce of 152,900, 22,300 are unpaid family members - what would agriculture do without them? - and 45,500 are paid. As people they are as diversified as farmers themselves. They represent every aspect of New Zealand society which is good and makes my task interesting but difficult. There is no typical New Zealand farm employee.

TRAINING OF EMPLOYER AND EMPLOYEES

It has been said that you cannot train anyone who does not want to be trained, but for farmers and their employees it is a continuous process of learning skills and gaining knowledge, and the old saying that "you are never too old to learn" is very true. That is why we are here today. We are here to gain and share knowledge whatever our age.

The very basis of farm training is the practical involvement on the farm and this will continue. Added to this has been the rapid increase in farm training off the
farm. There are now a wide range of options available for an employer or employee to add to his knowledge and skills beyond the farm gate. The introduction to farming, however, is a subject we need to consider in deciding what the best method of introduction is; a few weeks on an introductory course learning basic skills, a year's training at an institution such as Flock House or Telford before going on to the farm, or perhaps straight from school to the farm.

With starting wages high, and farmers having less time available, it seems to me that for those with no farming experience a short course at least is very desirable. For too long the farmer and his trainee underestimate the skills and ability that are required. Historically farm work has often been given a low status, no doubt because so much of the world is farmed on a subsistence or peasant level.

Some years ago I was involved with a group of farmers and agricultural training people in identifying farm tasks so that those involved in training would have a better idea of what a farm trainee would need to know. It was a fascinating experience. After a considerable time and effort some 180 tasks were identified. A person working in a factory is expected to know about 30 tasks identified in the same manner. As one of our group said, "No wonder all the young fellows I have employed were so dumb".

When you say to a young person "Take the tractor, put the spray outfit on, and spray the thistles in the road paddock," just think about what he has to know. For a start he has to know how to drive a tractor - and that requires training in itself. Then he has to know how to use a spray outfit, fit it to the tractor, use the correct chemical, as specified on the label, mix it correctly, calibrate the speed and pressure, not to mention knowing all the pitfalls of the machine. I use this illustration as an example of what training is all about for both the farmer and the employee. For the employee it is acquiring skills that will enable him to carry out a large number of tasks requiring both practical skills and knowledge. The farmer will not only need a reasonable knowledge of these skills, he will have to teach them, and then see that they are carried out in the correct manner. The farmer will also have to have managerial skills and knowledge as well as an understanding of man management. Farmers in my view totally underestimate their own expertise and ability, and therefore underestimate what their employees have to learn or know.

THE PUBLIC PURSE AND THE AGRICULTURAL WORK-FORCE

There are two areas that the taxpayer becomes involved in in farm employment: the farm cadet and his training, and the unemployed. The Farm Cadet scheme is funded by a grant from Government of $170 per cadet for administration expenses. This goes some way to provide a training scheme for some 1200 cadets throughout New Zealand. There is also a tremendous amount of voluntary work carried out by those farmers and others who are involved with the schemes. Causing some confusion and headaches for Cadet Schemes are the incentives offered at present by Government to encourage employment of school leavers and those without work. There is the Farm Employment Scheme (FES) where a farmer recruits an additional person referred from the Labour Department and receives $50 per week for the first six months, $500 after twelve months.

The Farm Cadet Subsidy which is a subsidy for training, both on and off the farm. Payments vary but as a guide, a 17 year old dairy farm cadet would attract a payment of $829 over a three year period. Claims have been made that farmers are taking FES workers rather than farm cadets and there is evidence in some areas that would substantiate this claim.
Unemployment is probably going to be with us for some time. Because employment is difficult to find in our cities, more farmers' sons and daughters are probably staying at home. This is no doubt saving the taxpayer a considerable amount of money. There is no question that there is work on our farms, the problem is the ability of the farmer to pay. But we must ensure that schemes that are devised to assist the unemployed fit in with training and employment within the industry, and those who choose farming as a career are not disadvantaged by others who are given greater assistance and support because they are unemployed.

**CAREER PATHS AND FARMING**

It was an embarrassment many years ago as a farmer to go to a careers day at a secondary school and front up with banks, the state service, and many other sectors of industry with their attractive presentations. In a world of career paths farming was just not with it. Today there are more opportunities and a major one is the Farm Cadet Scheme with some 1200 Cadets. What we as farmers have to do, however, is encourage such schemes. Too often we blame the scheme or training establishment rather than the individual who perhaps will be a failure anyway. We will get what we deserve if we do not encourage capable young people to look at farming as a career; whether in a cadet scheme, or the very large number who map out a training programme of their own working on different farms, and taking a course according to their ability and wishes.

Too many farmers use cadet schemes as employment agencies, just as cadets do not realise their responsibility, that they are in a unique learning situation quite often on a one to one basis. For the person who chooses dairying there is the unique career path leading to sharemilking for example, which I understand is the envy of many dairying countries where great difficulty is being experienced with employment. The value of this unique arrangement must not be overlooked and we should be striving to use it as a base for other farming sectors.

**MEETING THE COSTS OF LABOUR**

While many farmers prefer to farm without labour I believe we have gone too far in many cases in trying to reduce the amount of labour on our farms. Technology and mechanisation have increased the farmers' ability to produce more per labour unit. There will be times, however, when this goes too far. For the dairy farmer for example, with the lates rotary cowshed and other modern equipment, he is for many months running from one machine to the other. In assessing labour versus machinery I believe we have to assess carefully the long-term effects on our farms. We are fortunate on our farms not to have a militant union standing over us, blocking technology and the introduction of equipment. In our effort to reduce labour, however, we must be careful not to spend large sums of capital just to avoid employing people which may well now be a better option, not only for ourselves, but for the nation as a whole.

**SOCIAL CONDITIONS AND INDUSTRIAL RELATIONS**

An Auckland manufacturer who also owns a farm once told me that going from his factory to his farm was like going from one country to another. In the factory getting the job done was not top priority, on the farm it was. This is an attitude to work which we should do all in our power to preserve. For the single employee and the farmer and his wife and family who have to work and live together surely must
be the most difficult industrial relations exercise ever undertaken. We can all relate many stories about these situations, but as a cadet’s sponsor I had some interesting ones. The cadet who had not washed any clothes for two weeks; farmers wife asked what to do?

The cadet who walked five miles to tell me he would leave if his boss kept on talking hour after hour with his neighbour over the fence; he was happy when I explained he had to work twice as hard at the weekend when the cadet had his time off and he was talking to his friends.

The cadet’s mother from the city who told me her 17 year old son was running a 1000 acre sheep farm after being there for a few weeks. Half a day and fifty miles later I found that a rather red-faced cadet had a mother who asked copious questions, and the cadet thought the best way to keep her quiet was to say he was running the place and the boss had gone away for a while.

We should spend more time discussing these problems, both as employees and employers and of course including our wives, in trying to understand this very difficult situation of having an employee in the home. It is extremely important that we think carefully and study all the aspects that matter, from the design of buildings, hours of work, time off, what facilities can be used, and not used, to the use of vehicles. And we should remember that the young employee who works for that the young employee who works for us on a wage is not required to pay our mortgage too by working long hours with us.

In our cities people tend to live in areas associated with the socio-economic group they are in. In the rural community there is no such escape or anonymity for either employer or employee. For the older employee it is extremely important we have an understanding of his desires and aspirations, the demands of his family and his problems. While they might be our employee they are also citizens of the community and must be respected as such.
Farm labour workshops

Participants were invited to join groups, each including a number of people working in the respective workshop areas. Each group was asked to submit a brief report.

FARM LABOUR AND THE PUBLIC PURSE

The task was to identify the ways in which public money is spent in the farm labour area and to make judgements on the costs and benefits. Attention fell into three areas: direct subsidies to those who employ additional (and generally untrained) labour; support for "trade training" e.g., Farm Cadet and Trades Certification Board schemes; and indirect inputs via support for tertiary institutions. With no figures available on the national costs, the workshop looked at the advantages and disadvantages from the user's viewpoint.

Farmers present were virtually unanimous in their contention that their primary requirement is for well-trained labour and that cost is a secondary factor. They expressed general reluctance to employ unskilled personnel in association with sophisticated machinery or on tasks where faulty performance would lead to direct loss of income. Representatives of the Farm Workers' Association supported this stance and stressed the wide range of skills which are necessary on today's farm.

It was agreed that except for low skill operations such as scrub cutting, there is little attraction in direct subsidies of farm labour. There is, however, an unsatisfied demand for the well trained person who is able to make day to day decisions and complete tasks without constant supervision. Public money should therefore be spent where it can best provide for young people to obtain these abilities.

CAREER PATHWAYS IN FARMING

Careers for farm labour can be divided into three groups: labour for the skilled person whose ultimate objective is farm ownership; general skilled labour; and
casual work requiring minimum skills. Discussion centred on careers for the skilled person who did not aspire to farm ownership. Comment was made on the fact that there is considerable movement of people on and off farms at all ages. The owner occupier property is the most attractive and stable arrangement, and for many it is the main goal.

However, an alternative goal is needed for others. Farm managership should be an attractive goal in this respect. There are problems for young employed persons who in mid-career wish for further training in particular skills. This is particularly a problem for those who have had limited initial formal training. There are training opportunities for young farmers from school, but after marriage many difficulties can arise.

Although adequate wages are essential, some farm units cannot afford much. Incentive schemes and production bonuses are desirable, but the farm worker needs to be related in some way to capital gain. It is possible to purchase a house in a town to rent out, but there are real problems on low wages establishing sufficient capital to get started. It is considered much easier for a city person to purchase a property than it is for a rural person, even with the present schemes. The question of equity is very important in considering a career.

A recommendation: That the term "married couple" not be used for advertising for positions on farms. It is not known if this is a matter for the Human Rights Commission, but there is a need to educate those employers who presently use this term, and for them to define the job specification more precisely and use appropriate terms relating to the skills required.

MEETING THE COSTS OF LABOUR

Costs of labour were estimated by seminar members from Southland to be $14-$18,000 for farm managers, $8-$10,000 for married men, and $6-$12,000 for single men. Otago and Mid-Canterbury managers’ salaries were estimated at $9-$20,000 and $8,500-$14,000 respectively. A range of perquisites were allowed on top of these figures. Additional costs of labour which are often overlooked include emotional factors and effects on family privacy.

Methods of offsetting these costs fell into several groups.

* Intensify production. An increase in stock numbers of around 300 will meet a single man’s wages.
* Share labour between farms - labour co-operatives. Most suited to farms of 2,000 to 2,500 SU, and to the employment of single men. Where several men are employed in a co-operative, communal accommodation is satisfactory for short term peak work, but it is not suitable for permanent employees.
* Production related bonuses. Payment of employees of one per cent of net income or 10 per cent of any net production increase.
* Alternative income earning opportunities for employees. Ownership of 100-200 breeding ewes by married men on farms which have sufficient scope was favoured by many. Similarly, an area of potatoes or other cash crop may be permitted. Alternatives such as beekeeping which do not conflict with the management of the farm are acceptable if limited to weekend work. Participants warned of problems which may arise when off-farm earning opportunities are allowed.
• Capital substitution. Investments in plant to reduce taxation liabilities may be reducing labour employed on farms more rapidly than is desirable. Careful financial planning and budgeting may be a more appropriate way to control tax liabilities without distorting labour opportunities.

• Incentives to employ labour. Several means of encouraging farmers to employ more labour was discussed. These included a direct wages subsidy; a wages deduction for taxation inflated by 50 per cent, and a wages deduction for added labour tied to increased stock numbers.

Several members of the group spoke strongly that farmers often regard the employment of labour as a last resort step. There was a general consensus that farmers need confidence in the capacity of well trained labour to generate significant savings and improve production.

SOCIAL CONDITIONS AND THE FARM WORKER

The group discussed "employees", not "workers". While farming is unique in many ways it is still an industry. We should therefore look at employer/employee relationships, and drop the term "worker". With a wide range of areas and limited time, the group concentrated on that issue and on the question of accommodation.

A good criterion for the farmer to use is to ask himself, "Would I be happy living in the house for the length of time the employee is expected to?" Before moving in, the employee and his wife should go through the house with the employer to check its condition, and both parties should sign an agreement to leave it in the same condition. Any faults should be noted.

If a house is provided, you may be eligible to buy a house of your own with a loan from the Housing Corporation. Until you need to live in it yourself you may be entitled to rent it out. This is a "godsend" for married couples' security in retirement.

Building new accommodation, care should be taken to site it so that both employee and employer have independence and privacy - not right by the drive or within plain view of the kitchen window. Single employees should have accommodation separate from the employer's house, with its own cooking facilities. This gives independence, flexibility, and privacy to both parties. The employer's wife can have a break in the weekends.

Both employer and employee should discuss the terms of employment before an appointment is made. Help can be obtained from bodies such as Lincoln College, the Farm Workers' Association, or the Farm Cadet Scheme. If the farmer and the employee can communicate both ways, most disputes and problems can be overcome.

The employee's family is an important element. If the family is not happy it is an extra pressure on the employee. Perhaps the wife or children should be paid for work done, rather than increasing the employee's pay. It costs no more, it could benefit the employee in lower tax, and it shows the wife that her contribution is appreciated and recognised. Perks should be discussed with a qualified person such as an accountant to get the best value for both people.

Work hours should be regular where possible with regular time off - every second weekend for instance. Flexibility is important and there should be allowance for occasional time off to visit school or go shopping with the wife.

Remember always, personal problems come before mechanical problems.

A recommendation: The subject of farm labour is so important that it deserves a conference of its own.
Part 5

AUTUMN FEEDING OF SHEEP
Planning
autumn feed supplies for ewes

K.E. Milligan, Farm Advisory Officer (Animal Husbandry), Hastings.

This paper attempts to put together some clearly researched facts and suggest a farming system for increased production. The message is clear. In any production system the only way to achieve production targets is to plan in advance. Grazing management is simply planning - planning in advance. Good farm managers plan next spring's feed supplies in the autumn and, as will be developed later, planning for the autumn begins early on in the spring. Farming is a biological system and some variables such as climate cannot be controlled. However, planning does allow use of favourable climatic conditions and minimises production losses during unfavourable conditions.

Much research has investigated responses in lambing percentage or ovulation rate to liveweight at mating and liveweight change prior to and during the mating period. The liveweight and flushing story can be made complicated but the simple summary of all this research is this: The heavier ewes are at mating and the faster the liveweight gain over that critical mating period, the higher the ovulation rate and lambing percentage. Figure 1 (Rattray 1980) confirms this.

The diagonal line in Figure 1 goes through probability curves showing that as liveweight at mating increases, so does the chance of multiple ovulation. Also, it is apparent that the faster the rate of liveweight gain over the flushing period the higher the chance of multiple ovulation. The literature shows (Rattray et al., 1978; Smith et al., 1979) that provided the quality of the diet is good enough, liveweight gain targets over the flushing period should approach at least 90 grams per day and that if this liveweight gain occurs over about a 10 day period 80-90 per cent of the total ovulation rate response that can be expected from prolonged flushing will be
Figure 2: Effect of Weight and Weight Gain on Multiple Ovulation in Ewes

Figure 2: Liveweight Patterns
Liveweight gain responses higher than 120-150 g/day do not appear to give further large increases in ovulation rate, and high feeding periods of over 30-40 days are perhaps not the most efficient way of utilising the available feed. Smith (pers. comm.) suggests that the carry-over period of flushing is about three weeks.

Figure 2 shows nine year trends in liveweight profiles of a flock of ewes from weaning in late November until tupping mid to late March. This curve closely resembles many other flocks which the Ministry of Agriculture Advisory Services Division have measured. Although this is Hawke's Bay data it probably represents the pattern that occurs in the drier east coast areas of New Zealand. The over-riding conclusion is that in the majority of years the tupping liveweight of ewes is dependent on their liveweight at weaning. In fact, in this particular flock in eight out of nine years ewes regained their weaning weight at about the end of the first cycle of mating.

From a lambing percentage point of view the important facts about liveweights and liveweight gains are:

- The higher the liveweight and liveweight gain over tupping the better the response.
- Weights at tupping in the dry east coast areas of both islands are very dependent on liveweight at weaning.

With this in mind the need is to devise farm management systems that give high ewe liveweights at weaning and provide for flushing in the majority of years, rather than accepting flushing as a luxury of the occasionally good autumn.

In developing that farming system, advanced planning is the key. Planning for the autumn begins at lambing.

LAMBING TO WEANING MANAGEMENT

The aims are to increase ewe liveweight at weaning and to build up feed surpluses for the summer which give long spells between grazings and avoid repeated overgrazing. The secondary aim is to build up feed surpluses early in the spring for conservation in the form of hay or silage. Silage is probably preferable as it is cheaper to conserve than hay, is easily handled by mechanical means and, provided the quality is good, provides a better feed for flushing ewes than does hay (Rattray et al. 1979). Early conservation of silage for flushing is important since silage made after about mid-December is likely to be of low quality. Over the last two years we have been looking at ways of achieving our aims over the lambing to weaning period. Rotational grazing of ewes and lambs has been compared with set stocking.

In Trials 2 and 3 the stocking rates for rotational grazing and set stocking were the same at seven ewes and lambs/acre. In Trial 1 the stocking rates were 5.8 under set stocking and 6.5 under rotational grazing.

On average, the advantage to rotational grazing was three kg, and this was reflected in pre-tupping liveweights. The other interesting point about these trials was the amount of feed present on the trial sites at weaning time. Visual estimates of the average dry matter present were 900 kg DM/ha for the set stocked areas and 1350 kg DM for the rotational grazing areas. Still more important was that under rotational grazing some paddocks had 1800 kg DM/ha present at weaning, making them available for early silage conservation, whereas under set stocking all paddocks were of similar length and would have taken three-four weeks at the earliest before silage could be taken.
TABLE 1

ROTATIONAL GRazing
VS SET STOCKING EWES AND LAMBS

<table>
<thead>
<tr>
<th>Trial</th>
<th>Lamb Growth (g/day)</th>
<th>Ewe liveweight gain (kg Docking to Weaning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>184</td>
<td>-3.22 kg</td>
</tr>
<tr>
<td></td>
<td>188</td>
<td>-0.16</td>
</tr>
<tr>
<td>Trial 2</td>
<td>209</td>
<td>+2.3</td>
</tr>
<tr>
<td></td>
<td>217</td>
<td>+5.9</td>
</tr>
<tr>
<td>Trial 3</td>
<td>188</td>
<td>+0.9</td>
</tr>
<tr>
<td></td>
<td>188</td>
<td>+3.25</td>
</tr>
</tbody>
</table>

Higher dry matter levels on the rotated areas gave greater ground cover, enabled long summer ewe rotations to commence, and avoided overgrazing in the early summer. The avoidance of summer over-grazing is most important on dry hill country since Brougham (1960) has shown a 35 per cent reduction in annual pasture production with repeated severe summer grazings compared with rather laxer less frequent summer grazings. This management system from lambing to weaning achieved its aims and planning set up the farm for flexibility in the autumn. Planning for autumn begins in the spring.

USING AUTUMN FEED

Having made the plans, and with a bit of co-operation on the climatic front, let's assume that there is feed available at tupping time which could be used for flushing.

Over the last eight years in Hawke's Bay we have measured many factors associated with liveweight gain. The most practical method we have of obtaining the liveweight gain response we desire is to use the Residual Dry Matter (RDM) technique. The principle is quite simple. The more feed that is left behind after grazing the higher the liveweight gain. For ewes at tupping time this can be expressed graphically (Figure 3), and Residual Dry Matter/liveweight gain responses are given in Table 2.

To achieve a liveweight gain of 90 to 150 g/day over the flushing period the residual dry matter must be in the range of 800-1200 kg DM/ha. This represents pasture of about five cm to eight cm in length so flushing is the luxury of a good season and the result of planned grazing management.

GETTING THE BEST OUT OF FLUSH FEED

Over the last couple of years we have been looking at the best grazing management system for different periods of the year. During the autumn set-stock versus rotational grazing trials at similar stocking rates have been run to try to determine which is best for flushing ewes and growing lambs. Needless to say that was a pretty frustrating exercise - some years rotational grazing was better than set stocking, other years the result was the reverse. Looking at all the trials showed...
Figure 3: Residual Dry Matter and Weight Gain in Ewes

![Graph showing the relationship between RDM and Liveweighting gain (g/day)]

**TABLE 2**  
**RELATIONSHIPS BETWEEN RDM’S AND LIVEWIGHT GAINS**

<table>
<thead>
<tr>
<th>Ewes</th>
<th>RDM</th>
<th>Liveweight Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Pregnancy</td>
<td>400-500</td>
<td>Maintenance</td>
</tr>
<tr>
<td>6 weeks pre-lambing</td>
<td>600-700</td>
<td>60-80g/day</td>
</tr>
<tr>
<td>Ewes and lambs</td>
<td>1400-1600</td>
<td>180-200 g/day (lambs)</td>
</tr>
<tr>
<td>Summer</td>
<td>900-1000</td>
<td>100-110 g/day (ewes)</td>
</tr>
<tr>
<td>Flushing</td>
<td>1200-1400</td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120-150 g/day</td>
</tr>
<tr>
<td>Lambs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaned (spring/summer)</td>
<td>1200-1400</td>
<td>160-200 g/day</td>
</tr>
<tr>
<td>Summer</td>
<td>1400</td>
<td>140 g/day</td>
</tr>
<tr>
<td>Autumn</td>
<td>1200</td>
<td>80 g/day</td>
</tr>
<tr>
<td>Winter/spring</td>
<td>1100</td>
<td>100-110 g/day</td>
</tr>
<tr>
<td>Hoggets (summer)</td>
<td>1200-1400</td>
<td>60-80 g/day</td>
</tr>
</tbody>
</table>
there was only one explanation for this variation. In years where feed was plentiful set stocking gave better liveweight gain results whereas when autumn feed was limited rotational grazing was superior. Lamb growth rate data (Kissock 1966) perhaps best explains what happens (Figure 4).

Production per head data shows that at low stocking rates set stocking is superior to rotational grazing. However, at high stocking rates rotational grazing comes out on top. The analogy that can be drawn is that low stocking equates to a feed surplus, and high stocking is equivalent to low levels of feed on offer. Accepting that analogy clarifies the reasons for varying results between years. Consequently, the grazing management decisions made to get the best flushing results will vary year by year depending on feed availability.

Bearing in mind that rotational grazing is the only effective way of building up feed banks and of controlling feed intakes, the decision to set stock or rotationally graze follows certain rules.

Rotationally graze when any of the following conditions apply: when feed supply is short, when liveweight gain requirements are not high, or when there is a requirement to build up feed banks for other classes of stock to use at a later date.

Set stock when both the following conditions apply: previous grazing management or seasonal conditions have built up feed banks, and high per head performance is required.

Planning and use of autumn feed for ewes could follow these lines. Ewes are rotated following weaning. High liveweight gains are not required nor often possible in dry environments. The aim is to work on a residual dry matter of 1000-1100 kg DM/hectare, which should give small liveweight gains. The rotation is continued on until about a week to ten days prior to putting the ram out. Continuing the rotation right up until close to tupping this season produced a good feed bank. Seven to ten days before ram introduction ewes were set stocked on
relatively long feed. On one farm, feed levels were assessed at 2100 to 2200 kg DM/ha. Ewes were set stocked until the end of the first cycle. Over 27 days the liveweight gain was just on five kg or 180 g/day. While the end result in terms of ovulation rate or final lambing percentage are not yet known, tupping results were promising. Over 17 days 91 per cent of the ewes were tupped with 83 per cent of holding to service.

Stocking rates and lambing percentage are the two most important factors influencing profitability of sheep farming. For maximum profit both must be high. Planning and flexibility in management are the keys to achieving profitability aims. Residual dry matter has proven to be a simple effective management tool for obtaining the liveweights and liveweight gain responses desired. Making the best use of available feed at critical times such as tupping provides the production responses necessary for high profitability.

References


Autumn feeding of sheep under border dyke irrigation

C.R. Dick, Farmer, Oamaru.

My property consists of 313 ha on the lower Waitaki Plains. The soil is of the Steward type, very stony and light. The farm comprises about 60 per cent stones. I purchased the property in 1971. It was in a partly developed state, carrying 1,760 ewes. Today there is 232 ha of irrigated land running 2,800 Coopworth ewes including 160 stud ewes, 1900 ewe hoggets, 120 other sheep, and 130 goats for noxious weed control. In total, there are 4,900 sheep, with total Stock Units at 4,530.

The paddock size on irrigated land is around 3.2 ha. There is an annual fertiliser top dressing of 375 kg/ha. Fifteen double row shelter belts have been planted in recent years. Prior to 1977 labour on the property consisted of myself and a very hard working wife, particularly in my many absences. Since than a permanent married man has been employed. Considering the amount of time I now spend off the property, I would estimate that the farm is being run with about one and a half labour units.

Stocking rate over the total grazing area of the property is 16 per ha, with 19.5 per ha on the irrigated area. So, from a dry land situation and a stocking rate in 1971 of 7.5/ha we have reached 20 stock units per hectare under irrigation. I have maintained a higher stocking rate than this in the past, but performance suffered considerably. Emphasis now is on increased production per animal, rather than numbers per hectare.

Extra stock in the form of store cattle are usually purchased for the control of excess feed, and for parasite control during the summer months. Stocking rates on the irrigated land during the period mentioned often reaches as high as 22.5/ha.
During the early days of development, performance suffered considerably. The ewes were mainly Romney and Corriedale, and sheep which would normally be culled were being kept for replacements. Because of the large areas of ground out of grazing use, feeding requirements of sheep also suffered. In our first season, 1972, we taileld 92 per cent of lambs and clipped 4.3 kg of wool. I was fairly disappointed with this result and felt that a change of breed was required. I wanted a type of sheep that could handle a heavy stocking rate, and yet still perform. So a rather bold decision was made in 1973, against most advice forthcoming at the time. The entire flock of Corriedales and all but a few of the Romneys were disposed of and replaced with Border/Romney first cross hoggets. Two-tooth Coopworth rams were used that season - and have been ever since over the majority of ewes. Although some heavy woolled Romney sires have been tried over the lighter boned and poorer woolled sheep.

By 1975 performance had risen to 124 per cent of lambs and since 1978 not less than 140 per cent has been achieved, peaking last season at 144 per cent. Wool weights have remained around 4.5 kg from the ewes and 7 kg from the hoggets in their first 18 months of age from three shearings. You may well ask 'Why are the ewes not clipping more wool?' The answer is, I believe, that most of the ewes are kept until seven years old and some even longer than that.

**MANAGEMENT OF EWES**

A mob stock rotational grazing system is carried out on the property with the only exception being from lambing in early September through until weaning in mid December, when a set stock practice is carried out. Average stocking rate of ewes during this period is around 17.5 per hectare. Previously, large mobs of ewes and lambs were rotated round a number of paddocks with the major beneficiaries appearing to be the ewes. The lambs were found to suffer through excessive competition, unsettledness, mis-mothering, and a number of other factors, I believe.

The quality of pasture, I believe, has also improved through the spring period under set stocking. The pastures remain short, but are kept green and leafy through regular waterings. Irrigation time is reduced owing to the height of pasture, while thistle and other noxious weed control is made much easier. Grass grub and Porina control is also facilitated.

After weaning the ewes are culled, shorn and mobbed into three mobs, 2ths, 4ths and older ewes. They move into a 40-45 day rotation stocked at between 18-21/ha. They remain this way right through the summer and autumn, flushing and tupping period.

The body weight (63.2 kg, 2th) of ewes going to the ram this year was similar to recent seasons; 67.2 kg for the mixed age ewes. It is common practice to maintain this weight through the winter months, or certainly to suffer no dramatic decrease in body weight during that time. I firmly believe that many conceived lambs are prematurely aborted through the manipulation of bodyweight during this period.

Approximately one month after tupping, the ewes are mobbed into one mob and begin an all grass wintering rotation of around 100 days. Supplementary hay is fed and some grain is also used, if and when needed.

The tupping harness is used over all the ewes, and has been now for a number of years, with weekly crayon changes. I regard this method to be of major significance, and a very worthwhile management practice. Apart from it being an extremely valuable culling weapon, enabling you to maintain only those early cycling ewes, the advantages received nearer to lambing, when manipulating vital
pre-lamb feed, are immeasurable.

In recent years I have adopted a spread lambing practice to time mating, tupping the 2ths, 4ths, and stud ewes first (beginning 6 April) followed 16 days later with the older ewes. Although this gives a longer spread lambing, it has many advantages, such as, less mis-mothering, attending fewer ewes any one time, avoiding large losses in stormy weather, and less sheep on lambing ground if it is a slow spring. It also allows you to use fewer rams of higher quality. We use a ram ratio of around 1 to 120 ewes.

MANAGEMENT OF HOGGETS

You may well ask why a property of only this size runs so many hoggets. The major reason is that it enables me to wean all lambs on the clean pasture which has not been grazed with ewes and lambs that spring. Under irrigation farming in our area this is virtually essential to avoid the massive build up of internal parasites which occur in young stock during the spring and summer months. Other advantages from the running of extra hoggets include a far better opportunity for culling, a spread of income, less labour intensiveness, and the fact that they work in well with grass growth patterns under irrigation.

At weaning in mid-December, all lambs are drenched and crutched and put into mobs of around 500-600. Mob size, I believe, is critical for maximum growth during this summer/autumn period. In my experience, the smaller the mob, the better the lambs will thrive, even though stocking rate remains the same. Having tried all methods, I believe that large mobs of lambs concentrated on small areas of ground just aren’t on.

Our lambs move into a rotation of 45-50 days, with an overall stocking rate of 25-30/ha. Weekly shifts in paddocks of around three hectares is normal practice. Fattening cattle are used to follow concentrated on small areas of ground

Our lambs move into a rotation of 45-50 days, with an overall stocking rate of 25-30/ha. Weekly shifts in paddocks of around three hectares is normal practice. Fattening cattle are used to follow up the lambs in order to clean up any remaining roughage, and to help break the parasite cycle.

If the wether lambs have not been sold directly from their mothers, they are drafted at monthly intervals with the remainder being drenched and returned to fresh pasture. The ewe lambs receive regular monthly drenching until May. Shearing of lambs takes place in the first week of February.

As the major lamb growth period comes to an end, about the end of April or early May, the size is doubled, and the hoggets are then crutched and move into a winter rotation. This consists of all grass supplement with lucerne hay if and when required. During our developing years, large areas of turnips were also grown in order to clean the ground prior to border-dyking, and this provided excellent winter feed for hoggets.

In the spring, an area of ground is set aside for the hoggets where they remain under a small mob stock rotational grazing system until mid-December when next seasons lambs are weaned on to that ground. They are shorn around mid-October

Vasectomised rams are used over all the hoggets for two cycles beginning mid-May. This practice has been carried out for the past five seasons. Only those hoggets which show oestrus are considered for the final flock selection.

In recent years hoggets have been weighed regularly from weaning onwards. An average weaning weight is 22 kg. By early March this has increased to 32 kg, including a shearing, and by the end of April 36-38 kg liveweight is expected, with many being over 40 kg. These growth weights have only been achieved in recent
years after much trial and error, and many varied management decisions during this period. Although I certainly don’t regard these as exceptional weights, considering the numbers being run, I would regard them as adequate for an irrigated property.

The reasons why we appear to have overcome many of the ill thrift problems through this summer/autumn period, which plagued us for years and still seems very evident on many properties, are, I believe, as follows.

• Weaning lambs on to clean pasture.
• Maintaining a reasonably long rotation, allowing feed to mature, and breaking the parasite cycle with cattle.
• Keeping mob sizes down to a realistic and manageable level, and minimising unnecessary stress.
• Making management decisions sooner, rather than later, in the disposal of surplus stock.
• Regular drenching with different drenches.
• Not over-irrigating, and never allowing the pastures to become too soft.
• Weaning lambs at about 13 weeks old.
• Using grass species such as cocksfoot and prairie grass in the permanent pasture mix, allowing some available roughage.

SUMMER/AUTUMN

I am of the firm opinion that the autumn period on any sheep farm is by far the most critical and most important.

With hoggets, it is the one period of their life when they must reach a satisfactory body weight, before their first winter. Much evidence has shown that if a sheep is small going into its first winter, this influences its lifetime performance.

Regarding breeding ewes, I believe that it is absolutely imperative for a satisfactory body weight to be reached throughout this period, and then maintained, if next season’s performance is to be worthwhile. Naturally this is only made possible on an irrigated property, as drought and other climatic conditions have a direct effect in a dryland situation.

I firmly believe that management decisions must be made regarding the disposal of surplus stock, whether it be in the form of fattening lambs or works ewes. If these stock are kept beyond a certain point, they then start eating valuable feed which should be going into your capital stock. I realise that this is a very controversial and sometimes hotly debated subject, with many factors often beyond the producer’s control, contributing to a backlog of surplus stock. However, in many instances producers would be far better off killing lambs at lighter weights, and either selling works ewes to a dealer, or sending out on grazing in order to save that very valuable autumn feed for capital stock.

In our situation, farming under irrigation, the key to success is making certain that a bank of feed is always available ahead of both the hoggets and the ewes during this period. The length of our rotation, 45-50 days, makes certain that this is always possible. Many critics would argue that the food is wasting, allowing it to grow to that length at this time of the year. My answer is that the cheapest and most efficient hay that you will ever feed, is the hay that you never have to make!

In our situation the available feed is more mature, and yet the pastures still
maintain a strong leafy clover base. Allowing paddocks to have a substantial cover during this period increases the root reserve build up in the plant, and so you receive far better recovery well into the winter. If you adopt a much shorter rotation during these months, in my experience the feed is soft and sappy and does very little to increase body weight. The only thing that does increase is the number of empty drench containers you accumulate during the season - along with a definite increase in your annual sale of dags.

**MAJOR PROBLEMS**

There is no question that the advent of irrigation to the area has brought many problems. Being able to adapt from a fairly low stocking rate under a free range system to a rather heavy stocking rate, small paddock, very concentrated grass land farming situation, in itself, is quite a challenge.

Apart from the many problems facing all farmers today, in the area of increased costs and static returns for produce, an irrigation farm has the added burden of rapidly rising rates, both for water and for all general purposes. There is probably a higher annual fertiliser maintenance than on a dryland situation. One must be more conscious of noxious weeds, and of the battle against internal parasites and general stock health. There also appears to be a mineral and trace element deficiency on the plains, and we have done much experimenting with mineral fertilisers, mineral drenches, and mineral stock licks in recent years.

However, I am very conscious of the fact that it would be easy to go from a deficiency situation in some particular trace elements to an excess, with equally disastrous results.

**EXPECTATIONS IN PRODUCTIVITY**

I believe we still have a long way to go in reaching the ultimate in productivity from the property. My present goal is to achieve 150 per cent of lambs and 5 kg of wool from the ewes under present stocking rates. I consider that this will only be achieved by further use of vasectomised rams, coupled with conscientious fleece weighing, culminating in a ruthless culling of hoggets. Body weight must also be improved and maintained, particularly in the young stock. Further development of the Coopworth stud will also hopefully play an important role in achieving this objective.

Farming today is far more than just a way of life. With tremendous increases in on farm costs over recent years, livestock farmers have had to increase production and look to ways and means of improving stock performance in order to stay in business.

New Zealand is a world leader in pastoral farming and the growing of high quality pasture. Surely our challenge as producers must be to endeavour to convert that pasture into as many dollars as possible, both for the farmer and the nation. I believe there is much room for improvement, particularly in the field of increased lambing percentages.

I am confident that with careful management and long term planning particularly during the late summer and autumn period, utilising this valuable feed to the best advantage, coupled with a favourable economic climate, much progress will be made in improving both the livestock industry and the nation.
Autumn feeding of sheep under dryland conditions

R.I. Middleton, Farmer, Temuka

Briefly, the history of our place is this. My father bought in 35 years ago. The property was totally undeveloped and unfenced and able to maintain perhaps one sheep to two acres. During the following 26 years he fenced it and developed the pastures, and when he retired nine years ago we were carrying about 5,500 Stock Units on the 790 ha. The soil is Lismore stony silt loam. Rainfall averages 600 mm with variation from 450 mm to 900 mm since 1971. The property is located on the coastal side of State Highway 1 at Rangitata in South Canterbury.

Over the last spring/summer/autumn since 1 August 1980 we have had about 25 mm of rain each month for nine months with the exception of November (125 mm) and March (50 mm) - I might add that we made good use of that response too! Anyway, that adds up to a severe drought for us, and I hope things come right before next spring.

We always have a mid summer drought, often an autumn drought, and occasionally an unusually dry winter when the ground is too hard to ram wooden fencing posts in. This makes it risky to carry too many ewes and replacements per ha. We run at present 6,000 ewes, 2,800 hoggets to select replacements from, and 100 rams and wethers. This amounts to 8,030 S.U., 10.20/ha which I consider is above the district average.

Warm strong Nor-west winds at any time of the year are common, and cold southerly and Nor-west gales are unpredictable. Prevailing wind in late spring and during the summer is the strong coastal easterly, so generally we live in what I consider is an amazingly harsh environment, particularly so when coupled with the Lismore soils.

In 1977, we began an extensive shelter planting programme and when these are nearer maturity they will be valuable stock and pasture shelter and I look forward to
that time. Meanwhile the replacement rate for the young trees has been from 40-65 per cent which will give you some idea of the difficulty we have to establish shelter belts, and without the incentives and encouragement from the Catchment Board and their soil conservators it would be difficult to continue at a practical rate under the present cost increases, in this climate.

Until 10 years ago we grew conventional ryegrass and cocksfoot/white clover pastures, and sub clover also played a major role in the pasture production. Much of our district is still in this category. At that time we had 80 ha of lucerne to grow hay supplies in the spring, when there is almost always a surplus of growth. Lambs would fatten quickly on the sub clover in the spring, and during summer ewes and rising 2 teeths would graze the dry stalky residue of the spring growth during the drought. Lambs would be little more than maintained until autumn rains kicked off the sub clover again. Grass grub would then move in and destroy most of the pasture and hay, and turnips would carry the stock through the winter while root reserves built up the pastures again in readiness for the spring. Good pasture had a short life with summer overgrazing in the droughts under set stocking and grass grubs in the autumn, thus inhibiting any significant increase in carrying capacity.

The decision was made to replace grass pasture with lucerne, and since the spring of 1973 all replacements of pastures have been with lucerne. The farm is now 75 per cent lucerne which is an increase to 605 ha. 120 ha is in grass, 600 ha in turnips and Italian ryegrass, with four ha in shelter belts.

Surplus grass still never eventuates, but any surplus of lucerne is quickly made into wilted silage and stored until there is a feed shortage. This system complements the lucerne very well. The general outcome of those changes is that we have increased carrying capacity very comfortably by 2,500 S.U.

This unit was, in 1973, a fairly well developed dryland farm, and still is, yet even this year under a severe drought, the following production increases have taken place, above those we had before grazing lucerne. There has been an increase of 2.5 S.U./ha. Lambing percentage has improved slightly but 2,000 more lambs are produced to about the same weights we used to average. Labour units have remained the same. Average surplus made into wilted silage has remained about the same. Wool production has risen 70 per cent or 21 kg/ha.

My policy is still to farm for a dry year, in the driest - buy grazing, sell store lambs etc., and in the wettest - sell grazing, buy in store lambs, store cattle etc., but I don't sell hay, and aim to waste nothing.

If possible, it is always the greatest pleasure to fatten sale stock, and works stock to prime condition. I have never struck two seasons or, for that matter, two years in general, the same on the dryland, and all dryland feeding policies have got to be flexible season to season and year to year. It is essential to plan ahead and essential to review plans and management frequently. The feed must be moved (rotational grazing, wilted silage etc) as required to keep feed supply, and demand, in balance.

Flock replacements have always been bred on the property and have always been Romneys. The South Sufforkram is used after the second cycle at tupping time. The flock, I believe, are genetically hardy and forage well in the droughts, and respond well to extra feed when it is available. I select for easy-care ewes and must have the genetic base by now, to get the response I am looking for, when I can produce more for them to eat. Naturally lucerne inhibits the ovulation rate of the ewes but sub clover used to too - probably to a greater extent. I expect to increase the per head production rather than stock numbers for the short term while the standard of the flock improves, before starting the next phase of farm development.
MANAGEMENT

The lucerne does not grow much in early spring so the lambing date is early September, weaning at 9-10 weeks average age of the lambs. Apparently only four per cent of the differences in lamb growth rates after this age can be explained by differences in milk supply, this has been done for several years now. Lambs are rotationally grazed in more or less two big mobs, shifted frequently, rising 2 tooths follow lambs and mixed age follow the 2 tooths so it is regular shifting.

I do not hold back the ewes in early summer when it gets dry to keep a bank of dried up feed in front of them. If it is there they eat it off, put on the weight, and if they run out in, say, late January, at least the weight is on their backs and the feed quality was better.

My autumn management relates to liveweights and feed budgeting. Having considered these two matters, I use rotational grazing to allocate the feed and to encourage pasture and root growth, and wilted silage, to make up the deficiencies in requirements.

Liveweights

The biggest factor that I can influence in getting a higher lambing percentage is ewe liveweights. It is difficult when dry matter production can not be even roughly forecast for the autumn, and assessing a rotation to feed stock for months on end can be a worry, unless it is planned to be simple and efficient. To get big breeding ewes I need big 2 tooths and there are scales set up in the sheepyards which are easily and often used to keep a check on management.

I set myself realistic target liveweights: the ewe lambs in late autumn last year were 35 kg. My October target for them was 48 kg and target for tupping as a 2 tooth was 60 kg. They were given plenty of turnips in the winter and, as I expected, reached spring target. I had to buy grazing for them for eight weeks from early November as I could see they would not make the next target if I didn’t.

It is particularly obvious when using scales that light 2 tooths in the autumn will become light mixed aged ewes. They reached 56 kg by early March and I have only managed to maintain this until the rams went out at the beginning of April, but thanks to the target, I have not ended up with 46 kg 2 tooths like we had three years ago, and before.

During the summer, autumn and winter a regular exercise of drafting three ways on condition is practised and I check liveweights then. Regular weighing makes me conscious of the liveweights. Before the rams go out in April, the ewes are set stocked and pastures bore off quickly having been spelled for a few weeks to freshen up during the rotation, before set stocking.

This set stocking for the first cycle is a ‘trap; to my surprise ewes can appear to be doing well but can very easily be losing weight over that critical first 17 days having taken out the best of the feed in the flushing time when they first went on. They are checked for liveweight and if necessary wilted silage is fed out as I think it is essential to offer them more than they can eat and the weighing will show progress.

We have been feeding wilted silage to mixed age ewes since January and they maintained weight at 55 kg from shearing in December until flushing, and for three weeks until the end of the first cycle we managed to get another 1 kg onto them. I know 56 kg isn’t very good - my target was 60 kg which also is not very high, but I am satisfied with this result considering the present shortage of feed and will continue to feed out to maintain liveweight until all stocks of wilted silage run out.

By the end of the second cycle the set stocked mobs have been bunched up. As
they are ready, they are shifted into about four or five mobs and rotation speeds up until they are in two mobs and stay that way until lambing. The stress of this situation will no doubt take a few kg off them and as the ewes become used to the system they will hold their bodyweight at an acceptable level until six weeks before lambing. To start with I will give them a shift every other day with a maintenance D.M. of grass on the breaks and maintenance of wilted silage as well, for the second day. If I want to increase their liveweight we simply shift every day and if that does not have enough effect, then we also increase the size of the breaks and offer them more.

**Feed Budgeting**

Autumn feeding with the aim of all grass wintering is impossible without a feed budget. This will be the fourth successive winter that the ewes have had no turnips, and until 1981 they have had almost no wilted silage during that period either! I do three things for the feed budget in the autumn. I work out the order I want to graze off paddocks in, e.g. the first ones grazed are the early lambing paddocks, last ones are hay paddocks. I have a quick look at each paddock and estimate D.M. I add the feed budget back from the lambing date towards the autumn. And when it stops, I will know how big the deficit for the winter is and can then, for the first time, this year, feed wilted silage to make it up. My policy would always be to feed it out in the autumn, allowing as much of the farm to be shut up and growing as possible while there may still be some growth. This will give the ewes short, but high quality, guaranteed tucker, when they need it just before lambing.

What I mean when I say that rotational grazing even on dryland in a drought promotes pasture and root growth is this (and I refer to lucerne as pasture). Proper control on dryland is not possible without mob stocking (rotational grazing) for the summer, autumn and winter. A deficiency or surplus, of feed, is apparent much sooner under this system. Lucerne fits into a rotational grazing system obviously and autumn is the pattern of the year for root growth, so rotational grazing must encourage this to take place as much as possible.

When the topsoil has dried out and pasture has apparently stopped growing, the deep roots of lucerne draw moisture up from below and feed the leaves. If a shower of rain falls and soaks in a few inches, the lucerne is already in a growing state and the small roots close to the surface are ready to respond immediately to assist the main root.

After closing up a paddock of lucerne a heavy dew is enough to provide a host of small leaves above the crown of a lucerne plant. It is my belief, that this is adequate herbage to photosynthesise and begin the task of pulling any moisture out of the soil and although under stress, it always amazes me to see the lucerne grow at least a few inches above the ground and give us something before there is the faintest trace of a green shoot even in a grass paddock.

Lucerne paddocks, by nature of their growth and by the time there has been heavy grazing in times of moisture stress, have a large proportion of bare ground. Many of you will be aware of the wonderful opportunity this situation offers the nodding thistles. We have always had them even in the grass paddocks after droughts when the sward opened up or the grass grubs cleared the way. I accept that under lucerne I can’t get rid of the last thistle. In spring and summer, if the infestation is heavy the paddock is closed up for wilted silage. This kills the seed and, being high in sugar, the lucerne wilts well. The paddock is chopped before plants get too stalky and the extra D.M. becomes a palatable stored feed to use when there is a deficiency in pasture growth. We had some over mature 50 per cent
moisture silage full of nodding thistles analysed once and it was 15 per cent protein and 17 per cent crude fibre! It is good to be able to make use of this rotten weed.

If infestation is light, the paddock is topped to shatter the stem, not clean cut it. Just when the big mobs of ewes think they are due for a shift, they eat the ground bare and this provides further low quality feed in a time of need.

In autumn, with the rotational grazing system in operation again after tupping, any big thistles are eaten to the ground and any small ones are trampled under the heavy stocking rate (up to 800/ha). As I said earlier, I aim to waste nothing, and that is why I mentioned the thistles. And anyway, light land wouldn’t be light land without them!

The ewe lambs have not been forgotten. Although I do not work out a feed budget for them, they are allocated enough paddocks, in mid-February (when I hope to see the start of the autumn showers), to take them through until the end of May when they start on turnips. Normally this works out, as by late April wethers have mostly gone to works and more paddocks come into the rotation for the ewe lambs, I am careful not to let the ewes have any of these paddocks because after the summer maintenance and shearing of lambs, they get regular drenching, regular shifting, and occasional weighing to check on likelihood of reaching target liveweight. Depending on these factors I can easily decide how heavy to take the wethers before they are killed.

Relating particularly to this autumn, to enable me to reach the target liveweight for the ewe lambs I decided in early January to maintain the mixed age ewes by supplementing wilted silage. The 2 tooths had paddocks of their own to rotate around, and the lambs had the rest of the farm, in two big mobs as usual each of about 2,200. Every 3-4 days they were shifted and the ewes followed on getting as much wilted silage as they would eat, fed out every second day. This worked out at about 2½ kg of material per sheep depending on the pick the lambs had left behind.

By having a liveweight target for the lamb their response can be adjusted by rotating in these big mobs quickly and they gain weight moderately and don’t eat too much, or by reducing mob sizes drastically and reducing shifting frequency.

Under these methods lambs are more settled, and do well.

I began with some background on the operation and our harsh environment with the extremes in wind, rain and temperature when coupled with the stony Lismore soils. I gave you the reasons I think lucerne has suited my property, so well, I now grow 1,500 acres of it. I never strike two seasons the same on the dryland, or for that matter, two years, and all dryland feeding policies have got to be flexible, especially the autumn, as the available feed in the autumn depends on the summer stock numbers and rainfall, and the winter feed budget.

It is essential to review plans and management frequently, balancing feed supply and demand. Because of the seasonal fluctuations in growth, I set autumn target liveweights for both ewes and lambs and the feeding decisions for the rest of the year revolve around these targets, thus focusing attention on liveweight and using scales to monitor progress. This is how I have improved and intensified the autumn management to level optimum production under a dryland situation.
Animal health problems associated with grain feeding

A.S. Familton, V.R. Clark and A.M. Nicol, Animal Sciences Group, Lincoln College

Grain is a common livestock feed. In New Zealand it is offered to sheep directly as a supplementary feed or indirectly when sheep are given access to grain stubble paddocks after harvest. In feedlot systems, used in other countries where high levels of animal performance are required, grain can be the major dietary component. Grain is considered to be a high quality feed but many farmers who have fed grain to livestock will have experienced problems of animal ill health in animals eating grain. There are three animal health problems associated with grain feeding. These are grain poisoning, lameness, and problems associated with feeding mouldy grain. Of these, grain poisoning is the most important.

GRAIN POISONING

In many cases the first symptom of grain poisoning is one or two dead animals in the mob. However, on closer inspection additional animals are likely to be recognised as dull, listless and not eating. A swelling of the lower parts of the rumen may be obvious and the rumen often does not show normal movements. Affected animals often show signs of dehydration such as sunken eyes. The animal can progress from this stage to staggering, coma and death, or to recovery, which may take up to a week. Recovered animals may often show lameness. In many respects the symptoms of grain poisoning are similar to those of pregnancy toxaemia but grain poisoning can be distinguished by the lack of rumen movements and swelling of the rumen.
To appreciate the recommendations for prevention and cure of grain poisoning, an understanding of the causes of the condition may be helpful. Technically, grain poisoning is known as lactic acidosis, which suggests the condition is associated with lactic acid, a very common, relatively simple organic acid. The biochemical structure of lactic acid is not very different from the volatile fatty acids (VFAs) (Figure 1) which are the source of over 80 per cent of the energy used by ruminants. The VFAs are produced continuously in the rumen from the fermentation of plant materials by the rumen micro-organisms. Lactic acid is also normally produced in the rumen. Grain poisoning is caused not by a chemical compound which is normally absent from the rumen, but by additional quantities of a normal product of rumen fermentation.

Figure 1: Biochemical Structure of Lactic, Acetic, and Propionic Acid.

Changes in the Rumen with Grain feeding

On a grain diet, compared with a roughage (grass or hay) diet, the time a sheep spends chewing and ruminating declines. The secretion of saliva is associated with chewing and ruminating. Saliva is important in maintaining the level of acidity (pH) in the rumen. Normally the rumen is just on the acidic side of neutrality (pH = 7) (neither acidic or alkaline) (Figure 2).

On grain diets the rumen is more acid than on roughage diets partly because of decreased saliva production. Provided that rumen pH does not become too acidic (above pH 6), those micro-organisms in the rumen which break down or use lactic acid and produce propionic and acetic acid, just about maintain balance with those organisms producing lactic acid. Any lactic acid produced is thus removed and there is no build up of lactic acid in the rumen (Figure 3). However at a pH below 6.0, the micro-organisms which remove lactic acid are less active, whereas lactic acid-producing micro-organisms are unaffected and so lactic acid builds up in the rumen.
Figure 2: Changes in Ruminating Time and Saliva Output with a Dietary Change from Roughage to Grain

Figure 3: Influence of Rumen pH on Rumen Micro-organisms Involved in Lactate Metabolism
rumen. Since lactic acid is a strong acid, its build up reduces pH further, which simply stimulates the further production of lactic acid. Below pH 5.0, all activity in the rumen ceases so a very acidic mass of digesta stays in the rumen.

**Lactate in the Body**

As the concentration of lactic acid in the rumen increases it is absorbed across the rumen wall into the blood of the animal. Lactic acid, or lactate as it is usually called, is a common and normal biochemical intermediate in the body (Figure 4). Lactate is produced in muscles when they are required to work hard in short bursts, as in the sprinter. Lactate is normally either reconverted in the liver back to glucose or is oxidised completely as a source of energy in organs like the heart and kidney.

**Figure 4: Lactate Balance in Animals**

It is only when lactic acid in the blood exceeds the body’s ability to use it and excrete it in the urine that the symptoms associated with acid build up in the animal occur such as listlessness, coma, and death. A further complicating factor exists. In response to low pH in the rumen, water moves from the body into the rumen. It is this water movement which induces the increase in rumen contents which is commonly observed. This shift of water from the body to the rumen dehydrates the animal, reduces saliva and urine production and exacerbates the acidosis.

With grain feeding the pH of the rumen is reduced. Micro-organisms which produce lactic acid in the rumen are more active in low pH than those which use lactate. Lactic acid builds up in the rumen and is absorbed into the blood. When blood levels of lactate exceed those which can normally be metabolised by the animal, acidosis occurs and they symptoms of grain poisoning develop. Lactic acidosis, like so many of our so called diseases, is simply a disruption of the normal balance of the animal’s system. Given time (10-14 days) the rumen and the animal’s body can adapt to high grain diets but the risk of developing lactic acidosis is always present.
Susceptibility of Animals

Only a proportion of any particular mob of stock will show the symptoms of grain poisoning and those that are affected show differing severity of symptoms. Why does this variability occur? Animals on a grain ration can vary in two ways. They may eat different amounts of grain, or they may respond differently to the grain they eat.

It is known that if the same amount of grain is offered to sheep, some will develop grain poisoning but others will not. If the animal eats slowly, the rate of fermentation in the rumen may not be sufficiently rapid to cause the pH to fall to low levels. Individual animal differences exist in saliva production and in the ability of saliva to "buffer" or adjust rumen pH. Furthermore, some individual animals are able to handle greater amounts of lactate in the body than others. For example, a human not in top physical condition is more likely to experience cramp (lactic acid build-up) than the physically fit person.

In the group feeding situation, quite large differences in feed intake are likely to occur and some of these can be at least partially explained on animal behaviour grounds. All groups of animals develop a social dominance hierarchy, known as "bunt" or "peck" order. Under extensive grazing conditions where animals are able to maintain "their distance", the dominance of one animal over another has only minor effects on feed intake. However, when animals are held under crowded conditions or where there is competition for a resource such as food then social dominance becomes more important. Contrary to common belief, studies have shown that the most aggressive animals do not always consume the greatest amount of feed. They spend too much time being aggressive. On the other hand, "shy feeders" tend to be low on the social bunt order.

When animals are introduced to a feed of which they have no previous experience, they react in different ways, some will eat very little, others a moderate amount and a few will gorge themselves. If the new feed is grain then those that gorge are likely to be those that suffer from grain poisoning. The fact that some eat very little, means that more is available for the greedy sheep. Previous experience earlier in life, especially while the animal is in a non-productive stage, of various feedstuffs which an animal may be expected to encounter later in life may lead to fewer problems when these feeds are again introduced. It is believed that sheep and cattle can "remember" feedstuffs which they were introduced for at least three years.

Hungry animals will eat rapidly. It follows then that if grain is fed as part of a ration, the roughage (hay or grazing) should be fed before the grain to reduce the rate of eating. Animals can be induced to eat rapidly. While this may be an advantage when allocating a greenfeed crop for example it is not desirable from a grain feeding viewpoint.

Prevention

To prevent grain poisoning, stock must be protected against eating large quantities of grain over short periods of time. This recommendation applies both on a mob and individual basis. Some of the following husbandry techniques should be considered.

On a mob basis

* Limit the quantity of grain fed during introductory periods. With
sheep start feeding at low levels of 20-30 g/head per day and build up slowly to allow the rumen to adapt. Up to 250 g can be fed to sheep quite safely once they have become accustomed to the feed.

- Offer roughage before grain to reduce the rate of eating the grain and prevent marked reduction in rumen pH.
- Consider feeding grain and roughages irregularly to prevent formation of habits and boredom in the mob.
- Assess carefully the grain left in a stubble paddock and break-feed if necessary.

For the individual animal

- Spread grain out evenly and thinly on the ground.
- Spread spills of grain in harvested paddocks.
- Introduce grain early in life as an experience to prevent variation in intakes when grain is again fed.

It should be remembered that unless total feed intake is very low a grain supplement may substitute for part of the roughage intake, so that the grain may become a higher proportion of the diet than expected. The likelihood of grain poisoning developing depends on the rate at which fermentation occurs in the rumen. The chances of an outbreak of grain poisoning may therefore vary with species of grain and its processing. Wheat will be worse than barley or oats and crushed grain worse than whole grain. Where grain makes up the bulk of a finishing ration, such as in feedlots, buffer chemicals such as bicarbonate which help maintain normal rumen pH are often incorporated into the diet to overcome these problems.

Treatment

When grain poisoning does occur, for example, in sheep given access to a stubble paddock where considerable quantities of grain have been overlooked, treatment can be attempted. By the time sick animals are noticed, rumen movements have ceased leaving a stagnant mass of acidic contents in the rumen and tissues of the animal are being damaged by the lactic acid which is building up in the body. If tissue damage in the animal is too severe, little can be done and death will occur. In earlier stages if the rumen acidity can be reduced then severe tissue damage may be prevented. An alkali such as sodium bicarbonate (baking soda), 6-12 g (1-2 teaspoonsful) dissolved and given by mouth will neutralise much of the rumen lactic acid.

Only if rumen acidity has been reduced, is a laxative such as Epsom salts (30 g dissolved in water) useful for promoting movement of digesta down the gut. Other alkalis such as chalk, magnesium carbonate and laxatives can be used.

With very valuable animals surgical emptying of the rumen will certainly remove the source of the lactic acid but if tissue damage is advanced this treatment may not prevent death of the animal.

Even if the pH of the rumen can be brought back to normal a large proportion of the micro-organisms will have been killed. Drenching of affected animals four to five days later with warm fresh rumen fluid from a normal, freshly-killed sheep will help to re-establish normal rumen functioning.
Treatment and recovery of animals from lactic acid poisoning in anything other than a mild form is not very satisfactory and emphasis should be given to prevention.

LAMENESS

The lameness which occurs in some animals which have suffered from lactic acidosis is thought to be related to the release of histamine from cells which have been damaged by the acidosis. Injections of anti-histamines, if given early enough may prevent the histamine release but often animals are in a too advanced stage of the disease for this treatment to be very effective.

MOULDY GRAIN

When substantial amounts of mouldy grain are consumed, fungal spores can develop in the digestive tract and a temporary diarrhoea can develop. Worse still, if the animal is in the last third of pregnancy, the fungal hyphae may grow in the cotyledons of the placenta and abortion can occur. It is sensible to avoid the feeding of mouldy grain to pregnant sheep or cattle.

SUMMARY

Although grain is an important and widely used high energy feed, it use is not free from risk of animal health problems. Of these grain poisoning is the most important. Grain poisoning is caused by an imbalance in rumen function which results in a build-up of lactic acid in the rumen. This lactic acid is absorbed into the blood in quantities in excess of that which the body can metabolise or excrete and therefore acidosis develops. Measures which prevent large intakes of grain by groups or individual animals will reduce the incidence of the disease. Treatment of affected animals is often unsatisfactory.

References

Readers wishing further information on lactic acidosis are referred to:


Kaufmann, W., Hagemeister, H. and Dirksen (1980). Adaptation to changes in dietary composition, level and frequency of feeding in "Digestive physiology and metabolism in ruminants" (Eds. Y. Ruckebusch & P. Thivend) MTP Press Ltd.
Whole flock management - the alloation of feed supplies and costs of alternatives

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In this paper I will deal with the following aspects of autumn feeding.

- Feeding objectives
- The actual situation
- Feed supply and demand
- Provision of autumn feed
- Cost of alternatives

FEEDING OBJECTIVES

Ewes

Most ewes are tupped during the March, April, May period. The level of feeding during this period largely determines the lambing results that you will either wish to forget or be proud of in the following spring. The significance of autumn feeding as it relates to lambing percentage is generally more significant than the weather conditions and other factors prevailing during the lambing itself. As the income from lamb sales generally accounts for in excess of 40 per cent of income on a sheep farm, the lambing percentage is one of the main factors determining the economic performance of the property.

Most sheep farmers appreciate that there is a close relationship between body weight at mating and fertility. In the mating weight range of 40-60 kg, an increase
of about two per cent in lambs born per ewe lambing, results from every one kg increase in liveweight at mating. An additional effect which is occurring at mating is the liveweight change within the flock. If the ewes are losing weight prior to mating, a depression in lambing results compared with those gaining weight or holding weight. Rattray has shown that Coopworth ewes increasing from 46 to 51 kg in the six week period prior to mating have a similar lamb drop to those 60 kg ewes held at static liveweight. Thus it is desirable to have either heavy sheep held at a static level during the pre mating period, or lighter ewes gaining weight or being “flushed” as most practical farmers refer to the process.

A farmer with 2,500 ewes who is able to feed his ewes well during the autumn period could well obtain a lambing percentage 20 per cent ahead of the district average. This would result in an additional 500 lambs being available for fattening, perhaps worth $20 each or $10,000 next season. Not only does the farmer gain the added advantage of having more lambs to sell, but also considerably more to select his replacement ewe lambs from. This has an obvious economic advantage in the subsequent productive years of the ewe flock, as only the best progeny are being retained as replacements.

In considering ewe mating weights, I believe it is desirable to have ewes at 60 kg liveweight at tupping, or increasing to this weight from a pre flushing weight of 55 kg during a five or six week period. For the above reasons, I consider feeding of the ewe flock top priority during the autumn period.

Ewe Lambs

It is desirable to have the ewe lamb replacements as heavy as possible during the autumn period, so that satisfactory adult liveweights can be obtained as 2 tooths for the reasons outlined above. Many of you will be familiar with the target growth graphs presented to you by the Plunket Nurses, so that you can record the progress of your own progeny. Figure 1 illustrates a “Plunket type” graph for the growth of replacement ewe lambs through to the 2 tooth stage. In order to obtain 2 tooths weighting close to 60 kg, a liveweight of 35-40 kg is desirable by the end of May.

Figure 1: Target Growth Rates for Hoggets.
Due to the drought conditions prevailing across much of Canterbury this year, many farmers still have replacement lambs weighing less than 30 kg. If they are not mating these until the 2 tooth stage, they still have another 12 months to obtain the additional 30 kg required, and I would suggest that the time to do this is during the next spring/summer period, rather than have these stock compete too drastically for limited feed with the ewes during this critical autumn/winter period.

In terms of feed consumption, it is more efficient to mate ewe hoggets at 7-8 months of age rather than as 2 tooths at 18-20 months of age. For this to be successful, and so that a lambing percentage of 55 per cent or more is obtained, these ewe hoggets need to be 35-40 kg liveweight. Some breed differences exist with Coopworths, Perendales and perhaps Booroola cross lambs showing oestrus at relatively lighter weights than other breeds.

Many farmers resist the temptation to mate hoggets by pointing out that they will not grow out to be such heavy 2 tooths and their subsequent lambing performance from that stage on will suffer. However, there is now ample scientific and practical evidence which would indicate that animals which have lambed as hoggets, have a greater lifetime lamb production record than ewes mated as 2 tooths. On many Canterbury farms, a better relationship of feed supply and demand results if adult ewe numbers are reduced and ewe hoggets are mated. This will be illustrated later in this paper.

Fat Lambs

The other main class of stock still likely to be present on many farms during this autumn period is the fattening lambs. Although it is highly desirable to off-load fat lambs earlier than the March/April/May period under a dryland situation, this is very difficult to achieve in a year such as we have just experienced. On farms where this problem frequently occurs, it is desirable to have specialist fattening feed such as rape or lucerne for the purpose of finishing tail-end lambs so that you are not in the position where they are competing with the ewes or replacement stock. Lamb growth rates on most Canterbury farms are highly variable. Some lambs grow at 350 g a day and are ready to kill in 10 or 12 weeks. However, on many of the farms I am dealing with, only about half the fat lambs are sold by 20 weeks of age. Such lambs have grown at a daily growth rate of about 140 g a day since birth. The "tail end" lambs still on hand in the autumn average about 80 g a day from birth by the time they are slaughtered. Thus a four-fold variation in lamb growth rate occurs between the lambs which fatten early and those lambs remaining on the farm in autumn. Three factors account for this variation: the level of nutrition, the incidence of parasitism, and the mineral supply.

Obviously, considerable scope exists via management to improve the daily growth rates of more of the lambs born as a large number of variable factors are involved. It is not within the terms of reference of this paper to elaborate on lamb fattening, but the point I am endeavouring to make is that it is undesirable to have large numbers of fattening lambs competing with other stock during the pre-mating period, and that scope exists to alleviate the problem.

THE ACTUAL SITUATION

In earlier sections I have indicated that it is desirable to feed stock well during the autumn so that increased economic benefits can be gained. Many of you will be thinking back to your drought stricken pastures and light stock and thinking that in
a season such as this, feeding stock well during the autumn is easier said than done. Later on, we will look at methods of reducing the effect of an autumn feed deficit should it eventuate next year, or subsequently.

I have been interested in the problem of summer/autumn feed shortages for some years. Figure 2 shows the vulnerability of sheep farmers to the drought effect that we are currently experiencing. The graph compares the lambing percentage estimates as supplied to the Statistics Department since 1953 and compares this with the January/February rainfall in the county.

Figure 2: Lambing Percentage and January/February Rainfall.

The reason I have examined the Rangiora statistics rather than those from another county was that I had ready access to the rainfall figures over a considerable period of time in that locality. It can be seen from the graph that peaks in the January/February total rainfall are often matched by above average lambing percentages in the following spring. Where little rainfall is experienced during those two months, the subsequent lambing percentage is often reduced. There are some unexplained variations in this pattern, which could relate to March rainfall, or the incidence of storms and lamb deaths during lambing.

Another interesting feature of the graph which I cannot explain is the steady increase in lambing performance through until 1965, followed by a steady decline through until 1973. Since then, the lambing percentage has followed the expected pattern to a large degree.

I hope that his graph illustrates that if it doesn't rain in Canterbury, the grass doesn't grow, and the sheep do not put on weight, and as a result, lambing percentages are low. This pattern indicates to me that it is desirable that farmers have something "up their sleeve" in terms of feed reserves to ensure that the pattern I have illustrated in the past is less predictable in the future. In other words, they should not "fly completely by the seat of their pants!"
The difficulties of recent seasons are illustrated in Table 1 which shows the weighing results representative of about 25,000 ewes in the Carlton and Cust Discussion Groups over the last three seasons. These farmers weighed these ewes at a six week interval with the first weighing immediately before the rams were introduced to the flock. Each Discussion Group represents about 15 farms in the district.

**TABLE 1**

<table>
<thead>
<tr>
<th>Discussion group autumn flock liveweight changes (kgs)</th>
<th>Initial</th>
<th>Final</th>
<th>Gain</th>
<th>Gms/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979 Carlton</td>
<td>48.4</td>
<td>53.7</td>
<td>5.3</td>
<td>114</td>
</tr>
<tr>
<td>1980 Carlton</td>
<td>54.6</td>
<td>55.8</td>
<td>1.2</td>
<td>26</td>
</tr>
<tr>
<td>1981 Cust</td>
<td>55.8</td>
<td>55.8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

In 1979 those farmers in the Carlton Discussion Group managed to achieve new weight gains averaging 5.2 kg during the six week period. The following season, the average weight gain only averaged 1.12 kg. With the Cust Group this year, no average weight change was recorded. However, within these flocks, some farmers managed to put weight on the ewes whilst others lost weight. Thus a considerable variation occurs season to season and flock to flock, depending upon the growth conditions and farmer manipulations of feed supply. Even when farmers have made a concerted effort to put weight on their sheep, results have been variable, indicating a general lack of awareness of autumn feed requirements.

**FEED SUPPLY AND DEMAND**

Figure 3 shows the pattern of pasture growth on a 300 ha farm near Rangiora. This farm is on light land and annual pasture growth amounts to 7,100 kg with a variation of 20-30 per cent year to year and seasonal fluctuations can be greater still. The farm is stocked at 12.33 stock units/ha and 3,000 ewes are carried and 1,000 ewe hoggets, killers and rams. The red line illustrates the pattern of feed demand for that number of stock at recommended feed intakes. It can be seen that except for the months of September/October/November/December and part of January, a feed deficit occurs for much of the year in relation to stock requirements.

In an average year, if there is such a thing in Canterbury, a "flush" in autumn feed occurs during March/April and May which nearly matches the increase in demand from the ewe flock. However, this flush is subject to considerable variation season to season and this year, did not occur. As a result, a considerable feed deficit resulted. This farmer's sheep have dropped in weight to around 50 kg and a lambing percentage of about 100 per cent is forecast compared with the 125 per cent obtained during the more abundant summer feed conditions last year.

Basically, this farm appears to be overstocked in relation to average pasture growth. As a result, the lambing percentage and wool weights fluctuate up and down depending on the incidence of rainfall. The effect of varying stocking rate can be illustrated by moving the demand line up and down on the graph. The effect of altering the lambing date and reproductive pattern of the ewe flock
can be varied by moving the demand line backwards and forwards horizontally.

In this example, the average annual feed supply amounts to 2,145 tonnes of dry matter and stock demands 2,068 tonnes of dry matter. A spring/summer feed surplus of 437 tonnes occurs and an autumn/winter deficit of 360 tonnes of dry matter. In an average season, the deficit during March, April and May amounts to 100 tonnes of dry matter. So although feed supply exceeds demand on an annual basis, wide variations occur season to season and feed demand and supply become out of phase. In an exceptionally dry year such as this, the autumn deficit is more likely to be 200 tonnes DM rather than 100, thus creating a dramatic feed shortage and putting considerable stress on the ewe flock and other stock.

Professor Stewart once told us during Farm Management lectures that the general objective in sheep farming is to fit feed supply and demand at minimum cost. This statement still holds true and farmers are able to manipulate the pattern of feed supply and demand as illustrated in the graphs, by altering stock numbers, lambing dates, weaning dates, shifting feed from one season to another by way of conservation, or forage crops, or by buying in feed from elsewhere.

In considering this example, it can be seen that the simple solution to the problem is to reduce stocking rate by 20-25 per cent. This would result in the feed supply exceeding the demand during most months of the year. One advantage of hogget mating is to increase the number of lambs born and feed demand during the spring period, whilst at the same time keeping stock maintenance requirements to a minimum during the winter period.

Other methods of manipulating demand include reducing sheep intakes at non critical times of the year, altering lambing dates, and in times of autumn feed shortage, shorten the duration of the flushing period, and draft off light sheep and feed at a higher rate in relation to the other ewes.
PROVISION OF AUTUMN FEED

Having looked at ways of manipulating the pattern of feed demand, we must now turn our attention to feed supply. Obviously the first thing is to maximise the amount of feed grown by whatever means possible. Attention must be paid to the soil fertility to ensure that nutrients are not limiting growth. This probably means getting the farm soil tested and ensuring that adequate supplies of phosphate, nitrogen and lime are available.

Underproducing pastures can be improved by introducing more productive species such as Nui ryegrass. Direct drilling as a means of pasture renovation is an ideal way of doing this.

Different species can be sown which have a better summer/autumn pattern of growth. Lucerne performs better under dry conditions than ryegrass based pastures and should not be overlooked as a means of enhancing the summer/autumn feed supply. Matua prairie grass also has performed well during the mid summer and remains more digestible than ryegrass at this time of the year.

Although feed can be carried forward into the autumn period, “on the paddock”, the feed is likely to deteriorate in quality and be inadequate for flushing. However, some manipulation by this means is possible, depending on grazing management and actual pasture composition. In many districts, autumn feed supply is increased by cultivating ground to grown forage crops to be fed off at this time. In Canterbury, rape is often used for this purpose, but other crops such as maize, lupins, field peas, kale, and cereal greenfeeds have been tried.

Probably the most productive of these is greenfeed maize, but it is more suitable as a maintenance ration before tupping starts, as high weight gains cannot be achieved on this feed in most situations. However, if a proportion of the farm is allocated to a forage crop, such as maize, the stock can be kept off pastures elsewhere on the farm and these can be saved for the mating period.

Irrigation is an obvious means of overcoming dry conditions and autumn feed shortages, but is not always available as an alternative due to either a shortage of irrigation water, or restricted development capital.

Another common means of shifting seasonal feed surpluses into periods of shortage is by way of hay or silage. Numerous methods of conserving these materials are available and of the two, silage is probably more satisfactory for increasing sheep weights at mating. In many Canterbury situations a wider use of silage is desirable to maintain or improve autumn sheep weights during periods of shortage. The removal of hay and silage during the spring also helps to control excessive growth on pastures, thus reducing rank growth and deterioration in quality.

Subdivision and correct grazing management is another means of ensuring that the feed available is not wasted. Generally this will mean a slow rotation of 40 days duration during the summer months in order to clean out pastures and allow higher quality re-growth for the autumn. During the actual mating time, ewes can either be rotated quickly around the farm, on a 18-20 day rotation, or alternatively, set stocked for two or three weeks on feed set aside for flushing.

Considerable pasture damage is evident this year from populations of grass grub and porina caterpillar. These pests must be controlled by chemicals, or management means to ensure that this underground population is not competing with the livestock for the limited feed available. In general, the effects of these pests do not become obvious until April onwards, but it is important to establish how widespread the pests are to determine whether or not control methods are required.

The effect of taking weight off ewes at non critical times is also a means of
### TABLE 2

**RELATIVE COSTS – AUTUMN SUPPLEMENTS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep Nuts, High protein</td>
<td>32 c./kg</td>
</tr>
<tr>
<td>Grain, Barley</td>
<td>18</td>
</tr>
<tr>
<td>Bought-in meadow hay $2.75/18kg past equivalent</td>
<td>15</td>
</tr>
<tr>
<td>Lucerne hay $3.50/20kg</td>
<td>17.5</td>
</tr>
<tr>
<td>Silage $300 tonnes Bunker $800</td>
<td></td>
</tr>
<tr>
<td>Contractor $1,100</td>
<td></td>
</tr>
<tr>
<td>Polythene &amp; Depn Bunker $120</td>
<td></td>
</tr>
<tr>
<td>Interest &amp; Depreciation</td>
<td>$1,220/yr</td>
</tr>
<tr>
<td>on Feeding Out Wagon $1,000/yr</td>
<td></td>
</tr>
<tr>
<td>Annual Cost</td>
<td>$2,220</td>
</tr>
<tr>
<td>Per 300 tonnes $7.40/tonne</td>
<td></td>
</tr>
<tr>
<td>300,000kg @ 30% D.M. 66% digestibility</td>
<td>$60,000 D.M. = 3.7</td>
</tr>
</tbody>
</table>

**Use of Nitrogen**

<table>
<thead>
<tr>
<th>Nitrogen Source</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphate of ammonia 250kg/ha</td>
<td>$52.5/kg</td>
</tr>
<tr>
<td>Response = 15kg D.M. per 1kgN</td>
<td></td>
</tr>
<tr>
<td>Extra kg/D.M./ha = 787</td>
<td></td>
</tr>
<tr>
<td>Cost Sulphate of Ammonia $230/tonne applied</td>
<td>$57.50</td>
</tr>
<tr>
<td>Cost/ha = $57.50 = 7.3</td>
<td></td>
</tr>
</tbody>
</table>

**Forage Crops - maize**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation 4hrs/ha @ $20</td>
<td>$80.00</td>
</tr>
<tr>
<td>Seed 120kg @ $0.45</td>
<td>$54.00</td>
</tr>
<tr>
<td>Extra fertilizer nitrogen</td>
<td>$40.00</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$174.00</td>
</tr>
<tr>
<td>Dry MAter produced Dec, Jan, Feb, March.</td>
<td>$9,000 D.M. = 2.6</td>
</tr>
<tr>
<td>Less loss in pasture prod.</td>
<td>2,382</td>
</tr>
<tr>
<td>Advantage to maize</td>
<td>6,618  = 2.6</td>
</tr>
<tr>
<td>Porinaa &amp; Grassgrub Control</td>
<td></td>
</tr>
<tr>
<td>If required, could save 500kg D.M./winter</td>
<td></td>
</tr>
<tr>
<td>Cost = $15/ha</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Irrigation**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray irrigation - growth response 4,000kg/ha</td>
<td></td>
</tr>
<tr>
<td>Annual Cost/ha, including Interest, R &amp; M. power</td>
<td>$150/ha</td>
</tr>
<tr>
<td></td>
<td>3.75</td>
</tr>
</tbody>
</table>
improving the feed supply/demand relationship. Whereas it takes about seven kg DM over and above maintenance to put on one kg of liveweight, on a sheep, it takes nearly double this amount in terms of deficiency for an animal to lose a kilogram of weight. This aspect can be considered during feed planning exercises in order to save feed from one period to a more critical time of the year.

COST OF ALTERNATIVES

Feed costs vary dramatically. In general, conserved feeds or traded feeds are substantially more expensive than those grown in the paddock on the farm. The greater the labour, machinery, or commercial content of providing the source of feed, the greater the cost. Table 2 illustrates the relative costs of various feed alternatives available to Canterbury farmers. Where the feed is commonly traded, market values have been used as this is the opportunity value of these products. It can be seen that the costs range from 32c/kg for sheep nuts down to 2.6c/kg for maize. Other alternatives are intermediate in terms of cost. In considering our previous example whereby the farmer has an average feed deficit during the autumn of 100 tonnes DM, the cost of overcoming this by sheep nuts would be $32,000 and by maize, $2,600. The cost factors should be borne in mind when planning autumn feed rations and steps taken well in advance of the crisis occurring are likely to be the least cost means of providing additional feed.

CONCLUSIONS

Considering this subject in detail, my conclusions are these:

• Maximise pasture growth and utilization - fertilizer, species, composition, irrigation, fencing etc.
• Control pasture pests
• Do not overstock; grow out young stock and mate hoggets
• If feed limited, shorten flushing period, draft off light ewes for preferential treatment
• Alter lambing date to get best fit of autumn and spring growth
• Get rid of fat lambs early
• Grow specialist forage crops such as rape and maize
• Consider using silage or top quality hay
• Apply nitrogen if adequate moisture
• Feed limited amount of grain/nuts, etc., if no alternative
• Avoid losing weight off ewes until after tupping. Losing 2-3 kg during 2nd and 3rd month of pregnancy saves a lot of feed
Part 6

DAIRY AND PORK
Pre and post calving grazing management

A.M. Bryant, Ruakura Animal Research Station, Hamilton.

Management of the herd from autumn through to spring is important for two reasons. Firstly, for spring-calving cows the level of feeding achieved during this time sets a ceiling on production not only in early lactation but also for the whole lactation. Secondly, the dominating influence of stocking rate on determining farm output and profitability is now well established. It is also recognised that management appropriate for a low stocking rate, say 2.5 cows/ha, is not appropriate for one of 3.5 cows/ha. Nowhere is this more evident than in winter and spring feeding. At low stocking rates, the margin between feed requirements and feed supply is sufficiently great for reasonable per cow performance to be achieved with poorly planned management. As stocking rate increases this margin decreases and room for error is reduced. Careful planning and implementation of management is required if per cow performance is to be maintained.

The objective of this paper is to emphasise the important components of cow nutrition before and after calving. These must be taken into account when devising management systems whether they be for town milk or factory supply herds.

**DRY COW MANAGEMENT**

The objectives of winter management while the cows are dry are twofold; to calve the herd in good condition, and to provide sufficient quality feed in early lactation to ensure high production.
Cow liveweight and conditioning at Calving

A large amount of work both here and overseas has compared the effects on milk production of contrasting levels of feeding before calving. Major conclusions are that there is no production advantage in increasing still further the liveweight at calving of heavy, well conditioned cows. In contrast, for light conditioned animals those better fed during the dry period subsequently produce at a higher level. For example, in a recent review of 10 such New Zealand experiments, differences in liveweight at calving induced by differential feeding were 11-93 kg whereas milkfat production varied by 5-25 kg per cow. The reviewers concluded that for light conditioned stock an extra 20 kg of liveweight at calving results in an extra 5-10 kg milkfat during the subsequent lactation.

Condition scoring, the subjective assessment of degree of fatness is now widely used as a management aid. Recent estimates are that one condition score is the equivalent of 15-20 kg of concepta-free liveweight, and that improving lightly conditioned cows by one score before calving will result in an extra 5-10 kg of milkfat.

The changing relationship between condition score, liveweight and feeding level as calving approaches needs to be recognised. At drying off, the weight of the uterine contents in a Friesian cow is about 15 kg. This increases rapidly during the latter stages of pregnancy to reach about 65 kg at calving. To supply the nutrients for this development requires daily intake to increase from 6 kg of dry matter (DM) at drying off to about 12 kg at calving. Thus in order to just maintain condition from drying off to calving involves a doubling of intake and an increase in liveweight of about 50 kg.

Feed cost of improving condition

An important concept is that the performance of the grazing animal is largely determined by the amount of pasture offered or pasture allowance. This refers to the amount of pasture DM, measured to ground level offered per animal per day. The percentage of this removed by the animal is referred to as the degree of defoliation. The concept is important because pasture allowance is to a large extent under the control of the farmer and it determines intake and hence performance. Pasture allowance and degree of defoliation are inversely related. Thus where high liveweight gains are required during the dry period, or if high levels of milk production are required as in early lactation, then pasture allowance has to be high with a consequent low degree of defoliation. This is illustrated in Table 1 which is based on a trial at Ruakura last winter. For nine weeks 11 groups of Jersey cattle were offered contrasting break sizes and hence pasture allowances. A daily allowance of 8 kg DM resulted in only a small change in condition score and severe grazing as indicated by the high degree of defoliation and small amount of pasture remaining after grazing. In contrast, a high allowance and relatively lenient grazing was necessary to achieve a big improvement in condition. Too often situations are encountered where dry cows are expected to achieve the impossible of both gaining appreciably in condition and grazing severely.

It is calculated from these data that an extra 130 kg of pasture DM per cow were required to increase condition by one score. Allowing for the generally inferior quality of hay, this is the equivalent of about eight bales of hay per cow. This is feed additional to that required for maintenance. Clearly there is a very high feed cost in regaining the inevitable loss in condition that occurs during dry summers. This largely accounts for why time of drying off is one of the most critical decisions at
high stocking rates. Where pasture growth in summer is not limited by lack of water, both milk production and condition can be maintained at satisfactory levels. The need to build up pasture reserves for winter rationing and not condition score becomes the most important criteria for drying off.

**TABLE 1**

**EFFECT OF DAILY PASTURE ALLOWANCE ON INTAKE, SCORE AND GRAZING SEVERITY**

<table>
<thead>
<tr>
<th>Pasture allowance (kg DM/cow/day)</th>
<th>Intake (kg DM/cow/day)</th>
<th>Change in condition score in 63 days</th>
<th>Degree of defoliation (%)</th>
<th>Pasture remaining after grazing (kg DM/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>5.5</td>
<td>+0.3</td>
<td>70</td>
<td>950</td>
</tr>
<tr>
<td>16</td>
<td>9.1</td>
<td>+2.1</td>
<td>55</td>
<td>1450</td>
</tr>
</tbody>
</table>

**Autumn-Winter grazing management**

The management that best meets most of the requirements outlined above was described in detail by Dr Hutton at the 1972 Ruakura Farmers' Conference. It starts for the spring calving herd in early autumn by using hay or silage to lengthen the rotation to at least 80 days by mid-May. It is essential that the good growth that occurs in autumn be used to establish the bank of feed required for winter rationing. Pasture growth rates rapidly decrease with the onset of frosts to a quarter or less than those in early autumn. Because of this, establishing a feed bank in mid winter can only be achieved by using large amounts of supplementary feed or shifting the cows to a run-off. Further, if cows are to be underfed it is preferable to do so early rather than later in their dry period. Feed supply will gradually decrease since the amount eaten by the herd exceeds gains due to pasture growth. To achieve the increase in intake necessary as calving approaches requires a gradual shortening of the round to 30-60 days at the start of calving. This can be further shortened to 10-15 days once spring is well under way. At Ruakura this is usually in early September.

The severe grazing of much of the farm in autumn and early winter that this form of management involves has an added advantage. It helps remove accumulated pasture litter and encourages the growth of the better pasture species, particularly ryegrass and clovers.

Experimental verification of this type of management was presented by Bryant and Cook at the 1980 Ruakura Farmers' Conference. The experiment demonstrated over two successive winters that a slow rotation system similar to that described above resulted in 10-15 per cent more milkfat during the subsequent lactation than a fast system in which the rotation did not exceed 50 days. Perhaps the most important feature of the slow rotation system is that once the feed bank is established, feed for winter and early lactation is more assured than relying on the uncertainties of expected pasture growth. It also has the effect that the cow's level of feeding as calving approaches is dependent on the farmer, rather than the vagaries of the weather.
There is undoubtedly a danger of allowing too much feed to accumulate. A compromise has to be made between the amount of pasture on an area, its quality and its ability to recover from grazing. This necessity to compromise accounts for why the old autumn saved pasture system in which a third or more of the farm was not grazed during autumn and winter has fallen into disfavour.

**EARLY LACTATION PRODUCTION**

Satisfactory condition of the herd at calving will only ensure that the cows can perform to their potential after calving. The extent that their potential is realised depends primarily on the level of feeding and quality of the ration.

**Level of Feeding**

As can be expected from what has been said for dry cows, there is a strong relationship between pasture allowance and milk production in early lactation. As shown in Table 2, high daily milk yields per cow require generous pasture allowances and lenient grazing. The decrease in milk yield that accompanies restricted feeding in early lactation emphasises that good feeding before calving will not compensate for poor feeding after calving. It is also true that good feeding after calving will not entirely compensate for poor feeding before calving.

**TABLE 2**

**RELATIONSHIPS IN EARLY LACTATION BETWEEN MILKFAT YIELD, AMOUNT OF PASTURE OFFERED AND GRAZING SEVERITY**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area offered (m²/cow/day)</td>
<td>160</td>
<td>120</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Pasture allowance (kg DM/cow/day)</td>
<td>52</td>
<td>40</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Milkfat yield (kg/cow/day)</td>
<td>0.82</td>
<td>0.77</td>
<td>0.70</td>
<td>0.64</td>
</tr>
<tr>
<td>Pasture remaining after grazing (kg DM/ha)</td>
<td>2,400</td>
<td>2,250</td>
<td>2,000</td>
<td>900</td>
</tr>
<tr>
<td>Degree of defoliation (%)</td>
<td>24</td>
<td>29</td>
<td>36</td>
<td>70</td>
</tr>
</tbody>
</table>

**Ration Quality**

High intakes and hence high milk yields depend not only on the amount of pasture offered but also on its quality. For grazed pastures, the higher the quality the higher the intake. Since quality declines with increasing pasture maturity, leaves are of higher quality than stems, and clovers are of higher feeding value than grasses, milk yields are likely to be greatest where an abundance of young leafy pasture with a high clover content is grazed.
There is then a dilemma regarding management in early lactation. High pasture allowances result in high intakes and milk yields but also eventually an accumulation of rank growth of low quality. It is not possible to maintain both quantity and quality without resorting to either the silorator or topping machine. Certainly quality is too important a consideration to leave the control of excess growth until the onset of reliable weather makes hay making possible. During the last two seasons the effect of topping on milk production has been examined. In both years milk production on pastures topped after the previous grazing was about 10 per cent higher than on those not topped. This is not the say that topping is profitable but it does support the view that quality is an important consideration.

In practice the best compromise is one of offering pasture allowances less than are required for maximum intake, and foregoing some production in the interests of better pasture control. Many progressive farmers thus prefer to achieve a modest peak production of 0.8-0.9 kg fat per cow per day that is sustained rather than a short-lived peak in excess of 1.0 kg per day.

It was previously considered that a reduced production in early lactation because of underfeeding persisted to some extent throughout the whole lactation. Recent evidence clearly indicates that these carry-over effects are not always present. This being so, then considerable flexibility in the management of the feed supply is possible in early lactation. It supports the view that the advantages of achieving some pasture control with the cows in early lactation outweighs any disadvantages.

**CONCLUSIONS**

As stocking rate increases the margin between feed supply and herd requirements decreases and the need for good management increases. The required management is one that achieves target liveweight or condition at calving without prejudicing feed supplies for after calving. Three essential components of this management are time of drying off, grazing management in autumn/winter and calving date. Drying-off is one of the most critical decisions at high stocking rates. It determines the extent of loss in late lactation and therefore the amount of feed required during the dry period to replace that condition. It determines the time available not only to make good that condition but also to accumulate pasture reserves for use around calving time. Thus the determinant of when to dry-off is not current level of production but rather cow condition, existing and expected feed supplies, and length of the dry period.

The advantages of grazing management that rations autumn and early winter pasture growth to accumulate feed on the farm appears to be particularly important. The importance of calving date at high stocking rates is now widely accepted. Timing calving to coincide with the onset of spring growth greatly assists in achieving better herd nutrition at that time.
Dairy shed hygiene and the standard plate count

M.T. Eden, Dairy Advisory Officer, Ministry of Agriculture and Fisheries, Hamilton

Many farmers are still understandably concerned about the "new" test and whether their milk will continue to be finest all the time. They can be assured that if their milking machine cleaning system is satisfactory, the refrigeration system is working, and their cows are healthy, the chances of down grading are remote. In fact, they will be treated much more fairly than with the old Methylene Blue Reductase Test (MBRT) which often down graded milk of a very low Standard Plate Count (SPC) and vice versa.

The desire for milk to be of the highest possible quality is obvious to everyone. The reasons are not so well known, however, and relate to three main areas. New Zealand is the world's largest international trader in dairy products and must maintain its reputation for quality. Although product quality is not directly related to the quality of the raw milk, there are many cases where poor quality milk affects, for example, the yield of cheese and casein, the flavour and keeping quality of milk powder and butter. The ability to make high profit products such as low heat powders, lactic casein and caseinates is totally dependant on milk quality. Alternatively, high cost treatments may be needed. Even today companies have problems with product quality defects because of the quality of raw milk.

The quality of milk on the farms may well be marginally acceptable, but deterioration before processing is a function of time, temperature and the initial quality. Better quality milk gives the manufacturing units greater flexibility - a chance to improve the payout.

The problem of one supplier with poor milk affecting other farmers milk in the same tanker or milk silo is a very serious one causing occasional, but severe losses, especially when that milk is not being identified accurately by the grading test.
WHY CHANGE THE GRADING SYSTEM?

Milk quality assessment has been an area of investigation by scientists ever since milk was first offered for sale. The primary purpose is to satisfy the manufacturers of dairy products that they are getting a raw material capable of ending up as saleable products.

The MBRT was used first in 1931 for unrefrigerated milks. The bacteria present in warm milk are mainly lactose fermenters which if in large enough numbers, say 250,000/ml decolourise methylene blue dye. The milk under those conditions went sour.

Today with milk kept refrigerated the bacteria present are mainly proteolytic and lipolytic types (which attack proteins and fats) which even in large numbers do not decolourise methylene blue readily. Their affect in milk can be disastrous - the milk goes rotten. Previously poor quality milk produced under unhygienic conditions was not being clearly identified. A fairer more accurate test was needed and many hours of scientific work have been devoted to this cause - to ensure that those farmers with high quality milk receive the benefits for their efforts. Those farms where milk is of inferior quality need to be identified so that action can be taken to overcome the problem.

In the early 1970's the National Dairy Laboratory (NDL) introduced pre-incubation of the sample, that is, the milk was held overnight to allow the bacteria to multiply up to affect the MBRT sooner. The Nitrate Reductase Test was introduced about the same time as a simple, more sensitive, but still indirect method of assessing the number of bacteria present. It also has been relatively unsatisfactory and as laboratories have become better equipped with skilled staff over the intervening years, the SPC has become the test of choice in New Zealand as in the rest of the dairy world.

Countries with the same problems as New Zealand in assessing milk quality have also adopted the SPC. A few examples of the standards set for finest quality milk are listed below:

<table>
<thead>
<tr>
<th>Country</th>
<th>Bacteria/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>California, Washington</td>
<td>Less Than 10,000</td>
</tr>
<tr>
<td>Norway</td>
<td>30,000</td>
</tr>
<tr>
<td>Victoria, New South Wales, South Australia</td>
<td>50,000</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>80,000</td>
</tr>
<tr>
<td>Missouri, France</td>
<td>100,000</td>
</tr>
<tr>
<td>Denmark</td>
<td>200,000</td>
</tr>
<tr>
<td>Germany, Hungary, Italy, Brazil</td>
<td>500,000</td>
</tr>
</tbody>
</table>

Professor Kielwein, West Germany, a noted worker in the field of milk quality, considers that reasonable standards should be 50,000, 50,000-100,000 and over 200,000. He doubts that milk with greater than 200,000 bacteria per millilitre should be marketable.
ADVANTAGES OF THE STANDARD PLATE COUNT

The SPC is a much more reliable test for higher quality milks than the MBRT which, on controlled experiments, penalised 10 per cent of milks containing less than 50,000 bacteria/ml. The MBRT also failed to detect about 16 per cent of milks with over 200,000 bacteria/ml. The MBRT becomes increasingly unreliable for milks whose dye reduction time is greater than four hours, i.e. as milk quality has improved the MBRT has become less satisfactory.

The SPC is accepted internationally as a direct method of determining the numbers of bacteria present in milk, milk products and other foodstuffs. The results are more meaningful to suppliers. The SPC has been likened to the temperature gauge on a car. It gives a gradual warning of increasing temperature as compared to a warning light which, with a high performance car, can be too late!

Disadvantages are few, but not to be ignored. A higher cost and time is needed per test although this problem is being overcome with automation. More skill is needed at the laboratory, but the skilled operators are needed anyway to analyse the products. The long delay before the supplier is notified is serious with the test taking 72 hours instead of the MBRT's five hours. Some companies have been telephoning warnings through after an examination at 48 hours, but one major company at least, has decided that the early warning is unnecessary.

The SPC as carried out in most dairy company laboratories is a very simple process. Generally, one thousandth of one millilitre of a carefully chosen, carefully stored, carefully mixed sample of the supplier's milk is mixed with nutrient agar on to a sterile plate which is then incubated at 30 degrees C for 72 hours. The bacteria which grow in the agar multiply up to become visible colonies and are counted. The number multiplied by 1000 is the Standard Plate Count.

One should be aware, however, of the need for careful sampling, continued sample care and for a standard laboratory technique. A SPC of less than 50,000 is a statement that the milk is of finest quality. The range from 50,000 to 200,000 could be looked on as a grey area - of doubtful quality. Milk with over 200,000 bacteria per millilitre is definitely inferior.

There is no doubt that the SPC results provide a much better guide to the farmer on his cleaning system performance. A slowly increasing SPC is a clear indication of a cleaning fault caused, for example, by low detergent concentration (water quality can also affect the quantity of detergent needed). Wild fluctuations are experienced by a few farmers. Again the cause could be a faulty cleaning system where milk deposits containing large numbers of bacteria are being constantly exposed or sloughed off into the passing milk. An inefficient or a failed refrigeration unit can account for other sharp rises.

Where high SPCs are associated with a high somatic cell count, but low thermoduric and coliform levels, mastitis can be implicated. Cows with clinical cases of streptococcal mastitis shed large numbers of bacteria. Those with staphylococcal mastitis have a much lesser effect on the SPC or somatic cell count.

In any problem involving a high somatic cell count or high incidence of clinical mastitis the first step to take is a check on the milking machine for efficiency.

CLEANING THE MILK PLANT

Several systems have been developed over recent years to reduce the drudgery of cleaning and, more recently, to reduce the cost. Faults are most commonly found in the vat where milk sits for several hours before collection, or from the receiver, milk pump cooler and delivery line. Far too many farmers rely on hand cleaning the
vat. They also neglect to take care of the milk delivery system. These two areas cause 90-95 per cent of grade problems according to work done by NDL. Recent work has centred on the machines themselves.

SYSTEMS AVAILABLE - THE FARMER'S CHOICE

Hot water. In the triple system prior to milking an iodophor rinse dissolves acid, soluble deposits and sanitizes the plant. After milking a cold non-ionic rinse is followed by a hot alkaline wash and boiling rinse. Cost conscious farmers can recover and reuse the iodophor solutions. An acidic QAC system is also available where the post milking non-ionic rinse is followed by a hot acid sanitizer. A pre milking rinse is needed to remove the sanitizer. A periodic hot alkaline wash is needed to remove any build up of fat and protein.

Medium Temperature. This is similar to the above, but uses the water obtained from a Zelos or NDA Heat Exchanger on the vat refrigeration unit or from solar panels plus a somewhat stronger detergent. The pre milking rinse of water removes any QAC left in the machine. After milking the warm 50 degree C alkaline wash is followed by a warm acid/sanitizer.

Cold Water Systems. Two are currently available either using a strong alkaline detergent immediately followed by an acid sanitizer - the Wellcome system or alternatively a six day acid sanitizer and 7th day hot alkaline wash with the CCL system. Both use pre-wash water rinses to flush out milk residues and both require the weekly hot alkaline wash to remove deposited fat.

The farmer has a choice. Jetters are preferred if retaining the cleaning solutions for reuse - a substantial cost saving - with the cold water options. An automatic vat wash unit can and should be incorporated into the system as an effective way to reduce the standard plate count.

Using the above methods reasonable conscientious farmers consistently have standard plate counts of 10,000/ml or less and look carefully at detergent concentrations, etc if the SPC starts to rise above 20,000/ml. Results from random sample of farmers who have had several years experience in use of the SPC are listed below:

<table>
<thead>
<tr>
<th>Farmer</th>
<th>24/9</th>
<th>15/10</th>
<th>18/11</th>
<th>17/12</th>
<th>18/1</th>
<th>11/2</th>
<th>18/3</th>
<th>30/3</th>
<th>4/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>14</td>
<td>13</td>
<td>78</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>19</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>94</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>3</td>
<td>13</td>
<td>15</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>23</td>
<td>115</td>
<td>142</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>13</td>
<td>17</td>
<td>32</td>
<td>3</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>54</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>37</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>18</td>
<td>9</td>
<td>20</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>3</td>
<td>18</td>
<td>32</td>
<td>12</td>
<td>6</td>
<td>7</td>
<td>160</td>
<td>124</td>
</tr>
</tbody>
</table>
Laboratories now have skilled staff and the equipment needed to take advantage of the SPC - a fairer more useful test for milk quality. The methods of cleaning to meet the standards at low cost and with reasonable effort are not as well known as one would like, but the extension services such as Dairy Companies and Dairy Division of MAF are available to guide farmers in their choice of cleaning systems and to overcome any teething problems.

References

Tj. d Vries. Netherlands Milk Dairy J. 29 1975
Parasitism and young stock

A.R. Sykes, Animal Science Department, Lincoln College.

In a paper to a recent Lincoln Farmers’ Conference Sykes (1980) outlined the problems of assessing the extent of the effect of nematode parasites on the performance of sheep and of controlling such infections. The principles of control in cattle are similar to those required in sheep and were outlined by Brunsdon (1975). An appreciation of the biology of the parasite and of its effect on the host is required for a full understanding. In this discussion I will confine myself to those nematode parasites which inhibit the digestive tract, and exclude lungworm and liver fluke.

BIOLOGY

The nematode parasites of greatest significance to cattle in New Zealand are Ostertagia ostertagia, and Trichostrongylus axei which inhabit the small intestine. Both these worms cause damage to the host by burrowing into the glands and cells lining the digestive tract as a result of which cells are lost and proteins and other nutrients leak out from the blood and into the gut. This is one of the reasons why scour is a frequent symptom of severe infection. In many cases absorption of nutrients can be impaired and almost invariably food intake is reduced, often as a result of quite mild infections. Improvements in growth rate of 28-100 per cent have been observed on infected pasture as a result of anthelmintic treatment (Brunsdon, 1971;1972).

Worm eggs deposited on pasture by infected stock will develop into larvae capable of further infection within 10 days, if conditions are optimal. This requires a temperature of about 20-25 degree C and moisture for the larvae to hatch and swim in water films onto herbage. Development does occur at lower temperatures but is much slower. This, in part, explains the typical pattern of infection of
pastures - low in spring when temperatures are low and conversely higher in summer and autumn. Dry summers and autumns will tend to reduce development, though a sudden wet spell after drought can often result in rapid hatching of eggs and migration of larvae. Under hot dry conditions larvae will not survive on pasture, but under moist cool conditions they can survive for six months. Larvae, once ingested generally take about 17 days to develop to mature worms to perpetrate the cycle and further increase contamination by egg laying.

There are two further factors of importance. The susceptibility of stock to the development of larvae to maturity within their gut, and the effect of climate on the larvae themselves.

Young stock are generally more susceptible than older stock to the development of the parasite within their body and are therefore likely to suffer a greater reduction in performance for the same intake of larvae. They will also lead to greater contamination of pasture.

Larvae, particularly of *Ostertagia ostertagia*, after being exposed to cold conditions during autumn may not develop to maturity within the normal 17 day period but may suffer delayed development within the host. Scientists call these “inhibited”, “arrested” or “hypobiotic” larvae. Over a period of time during winter these larvae accumulate as immature worms in the gut of the host often to considerable numbers before suddenly developing simultaneously to cause severe acute disease in otherwise apparently normal animals. The problem caused by larvae developing continuously through to maturity normally is called Type I Ostertagiasis while the situation where development is delayed before suddenly developing is called Type II Ostertagiasis.

**CONTROL**

Discussion of control measures will be confined to stock under 12 months of age since we have no data to suggest economic response in adult stock. The most effective control of parasitism is to ensure that larvae are not present on herbage in large numbers. Frequent (i.e. every three weeks) use of anthelmintics, will provide improvement in performance (Brunsdon, 1968 and Sykes, 1980), but will not restore full performance as was demonstrated in sheep by Sykes (1980). Production of "clean" pasture is not easy, firstly because it is difficult to measure contamination and secondly because it is difficult to predict the effect of changes in climate on contamination.

The safety first approach is to drench all young stock every three weeks, thus breaking the parasite cycle and ensuring that parasite eggs can’t be deposited on pasture to cause infection. This is expensive and, especially if significant infection is not present, wasteful. In addition, scientists and veterinarians are concerned that this will exacerbate the development of drug resistance in the parasite. In his recommendations Brunsdon (1975) recommended drenching at 4-6 weekly intervals as a compromise.

A second approach is to drench when stock are moved into fresh paddocks. This ensures little build up of infection from their own contamination and is especially effective if they can be allocated pasture not grazed by young stock during the previous 12 months. Rotational grazing systems which return stock to the same pasture after 6-8 weeks are no better than set stocked systems for parasite control because, as stated earlier, larvae from eggs which may take three weeks to hatch can remain viable on pasture for up to six months given suitable conditions. Both systems rely on frequent suppressive drenching of stock.

Where separate ‘clean’ pasture is not available for young stock, as occurs on
most properties a knowledge of the fact that young stock cause greatest contamination and older stock tend to remove contamination can be used to advantage. If young stock on dairy farms are spread out across paddocks and set stocked they spread contamination thinly. Moreover, as the main milking herd and followers come through and graze hard they remove much of that contamination. It may be possible under this system to minimise anthelmintic use to strategic times. In this case dosing two weeks after rain following a substantial dry spell and prior to and during mid-winter to prevent build up and remove any arrested larvae accumulated in small numbers over autumn, especially where there is a history of this type of infection on the property, could be advocated. Other strategies are clearly required on sheep and beef properties.

CONCLUSIONS

Parasites do impair stock performance even though clinical symptoms of disease may not be apparent. There are several strategies to combat this based on knowledge of the biology of the parasite and its interaction with the host. Each requires careful planning to avoid contamination. Cost benefit analysis is not appropriate because we can never be certain about the level of infection present. This will vary between paddocks on farms depending on previous grazing and anthelmintic use. Careful planning of grazing management can improve effectiveness of anthelmintic usage and increase stock performance.

REFERENCES

Big bale silage: balage

J.S. Dunn, N.Z.A.E.I., Lincoln College

A technique to conserve feed when conditions are unsuited to hay making has gained a considerable following in the U.K. and Europe although it is only two years since it was first tried. It could fulfil a real need here in difficult seasons or for end of season use.

A large round baler is used to make half size bales of wilted material and these are then placed in individual polythene bags, stacked and sealed. It is a modified method of making silage, although the end product is termed Balage. Analysis of balage has shown a feed value almost as high as that of the original fresh material. Additives are not necessary.

Unfortunately not all big round balers are suitable. Only New Holland and Vermeer machines are capable of handling wilted material and turning out a dense half-size bale.* The half tonne package is no heavier than a full sized bale of hay so it does not overload the baler. It can be handled by most front end loaders without difficulty.

With access to the right kind of baler the cost is little more than that of the polythene bags and with care these can be used for more than one season.

* The Claas machine can also be used for making balage but the bale it produces is full size and weighs 0.8 to 1.0 tonne. A new model making a 1.2 m diameter bale is to be introduced shortly.
The operations required in producing balage are as follows.

**Mow** - in the normal way. Any machine is suitable. Moisture content of freshly mown grass is around 80 per cent.

**Wilt** - for 24 to 36 hours to reduce moisture content to between 65 and 75 per cent.

**Windrow** - 2 swaths into 1, or 4 into 1 if crops are thin, to produce a swath half the width of the baler pick-up.

**Bale** - Aim to produce a firm square-edged bale which will stack. This is done by weaving from side to side and holding each tack for approximately 10 seconds. Tie the bale with twine two turns at each end and 4 to 6 in between. Bales should be 1.2 m (4 ft) diameter. Check the bag size with the first few bales made to ensure that they are compatible. They should fit snuggly to displace as much air as possible from the bag. A tractor of 50 kW (70 hp) will make 25 bales an hour. A tractor of 75 kW (100 hp) will make 35 bales an hour.

**Transport** - Depending on distance to storage area trailer, truck or front or rear end loader may be used.

**Loading** - A conventional front end loader should be fitted with one or two spikes each 1 m long to impale the bale. A power tilt or push-off attachment is necessary to make tidy stacks.

**Bagging** - Bag within 24 hours of making bales. Impale each bale and apply a bag prior to placing each bale in stack. Don’t tie any bags until the full stack height is reached or the lower bags may burst. Bags will be available from Agpac Plastics Ltd., P.O. Box 16051, Hornby, Christchurch, and Trigon Plastics Ltd., Private Bag, Hamilton. Their approximate cost will be $4 each.

**Stacking** - The site should be level with a smooth surface to prevent damage to bags. Stack up to four bales high. If stacking outside support the first row to prevent bales slipping.

**Tying** - Use soft heavy duty polypropylene twine. Tie each bag twice tightly; once at the opening of the bag and again when the neck has been bent back on itself.
Cover Outside Stacks - with weighted netting to prevent wind movement of bag material. Movement pumps out accumulated carbon dioxide and allows oxygen to enter the bags. Alternatively an outer polythene sheet or old tarpaulin may be used. This also prevents ultra-violet degradation of the outer bags in the stack and prolongs their life.

Rodents - Prevent mice or rat infestation. Bag puncturing allows air to enter causing waste. Site the stack away from drains or any likely cover. Bait regularly if their presence is suspected.

Feeding out - Open the bag, impale the bale and lift. Remove the bag carefully and store for re-use after taping any punctures. Bales may be fed out with an NZAEI type Bale Buggy. Forage wagon use is not advised.

The best results have been obtained where balage is made as a planned operation rather than as a salvage operation with weathered hay.

The Agricultural Development and Advisory Service of the British Ministry of Agriculture, Fisheries and Food suggest that balage should be made in 100 bale batches (50 tonnes). This is the produce from about 2½ ha.

ADVANTAGES OF BALAGE

Grass or lucerne can be cut and conserved at the optimum growth stage even if the weather is uncooperative. The same machine will handle hay, straw and balage. The power requirement is relatively low. One farmer with a Ford 7600 tractor made 200 tonnes of balage on a tank full of fuel (120 litres of diesel). The same amount produced only 60 to 70 tonnes of silage with a forage harvester.

With the uniform package which the balage system produces accurate rationing is possible and reserves are known. One bale will provide enough bulk feed for 0 cows or 250 ewes a day. A reliable high quality product can be produced predictably if care is taken to ensure bags are well tied and remain entire.

Feed can be conserved in small or large amounts any time throughout the growing season. No deterioration occurs during the feeding period as the bags are opened only as required.

The NZAEI does not normally recommend a practice that it has not proven but in this case the technique is relatively simple and results in the UK have been so good. If the services of a suitable baler are available locally it is possible for any farmer to try the technique in a small way without a large capital investment. Some work using this technique will be undertaken by the NZAEI during the 1981/82 season.
Effective conservation is the transfer of dry matter (DM) surplus to animal requirements at one stage in a production cycle to another, resulting in an overall increase in both animal and pasture production. In dairying this transfer occurs most commonly in the spring to periods of feed deficit in summer, autumn or winter. With the ever-increasing costs of conservation both quality and quantity losses must be minimized.

It is not necessarily true that conservation will increase farm production, especially in situations where rigid conservation in practised although no real surplus exists (Campbell, 1966; McKeekan and Walshe, 1963). All too often high levels of conserved feed cloud farmers' decision-making to the extent that pasture and stock management suffers. This is seen most clearly in the autumn where because of excess hay feeding, pasture management deteriorates and cows are milked on under the false premise that conserved feeds will restore cow condition in the dry period.

Why Silage?

While it is true that hay and wilted silage made from the same grass crop at the same time and fed to lactating cows shows an advantage to hay as a means of conservation, the difference is minimal. Silage, however, can conserve grass at a higher moisture content in spring when pasture quality is at its peak. Silage making also enables a longer pasture recovery before summer droughts, is less weather dependent, cheaper to make (Marsh, 1978), but more difficult to make properly.
Making Quality Silage

In the absence of oxygen, bacteria called \textit{lactobacilli} produce lactic acid. In high enough concentrations this acid will inhibit respiration by plant enzymes and further fermentation by bacteria, thus stabilizing herbage as silage (see Figure 1). This primary fermentation process also involves the breakdown of some of the forage protein into its constituent amino acids. A secondary fermentation may occur, however, where the concentration of lactic acid is insufficient to prevent further fermentation. In this situation free amino acids are further degraded to VFAs (volatile fatty acids), ammonia, and non-protein nitrogen (NPN). These products reduce intake, nitrogen uptake from the diet, and the protein level in the stored feed. The lactic acid is also further reduced to foul smelling butyric acid.

Figure 1: Fermentation Process

\begin{align*}
\text{INITIAL FERMENTATION} & \quad \text{pH}6.7 \\
\text{Water Soluble Carbohydrates} & \quad \text{Proteins} \\
\text{Lactic Acid} & \quad \text{Amino Acid} \\
\text{SECONDARY FERMENTATION} & \\
\text{Butyric Acid} & \quad \text{Ammonia} \\
& \quad \text{VFAs} \quad \text{NPN}
\end{align*}

Factors affecting Lactic Acid Production

Rapid production of lactic acid and the subsequent preservation of the conserved product is dependent on plant sugar levels, anaerobic conditions, wilting, and additives. The higher the concentration of plant sugars (WSC) the quicker the fermentation and formation of lactic acid. Water soluble carbohydrate levels are higher in ryegrasses than legumes, which may also contain buffers which prevent rapid increases in acidity. Harvesting at either very immature or seed head stage and the excessive use of fertiliser nitrogen decreases WSC. Wilting may increase the WSC concentration and is essential when making silage from legumes. Wilted silage has a decreased level of fermentation and preserves at a lower level of acidity and a higher remaining WSC concentration.

To provide an anaerobic environment, air is removed by consolidation, compaction, or vacuum. The product should then be sealed from the atmosphere. Greatest losses in harvested DM during storage occur in inadequately covered...
stacks. Consolidation is easier to achieve by chopping with double or precision chop machines. Wilting, however, while increasing WSC concentration and decreasing storage losses, makes consolidation more difficult. A full review of additives which may not be economical in the New Zealand situation can be found in Barry et al. (1980).

**Losses during Conservation**

Figure 2 outlines the major form and extent of DM losses from conserved feeds. Marsh (1978) recorded losses of 15 per cent for unwilted flail and 11 per cent for precision chop wilted silage between harvesting and feeding. In high moisture silage (see Table 1) the major forms of DM loss are from seepage, secondary fermentation and surface wastage. In high DM silages although field harvesting losses increase slightly, seepage loss ceases at 28 per cent DM as does secondary clostridial fermentation.

**Nutritive Value**

Provided the correct procedures are followed it is possible to make a silage similar in quality to the grass crop from which it is made. Nutritive values of silage made in the Canterbury region are compared with spring pasture in Table 2. These are the average values from silage samples analysed at Lincoln College over the last three years.
TABLE 1
Losses in Silage Making

<table>
<thead>
<tr>
<th></th>
<th>High Moisture</th>
<th>Wilted Silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting Losses</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Respiration</td>
<td>1-5%</td>
<td>1-3%</td>
</tr>
<tr>
<td>Secondary Fermentation</td>
<td>0-15%</td>
<td>0-5%</td>
</tr>
<tr>
<td>Seepage</td>
<td>0-15%</td>
<td>0-5%</td>
</tr>
<tr>
<td>Surface Wastage</td>
<td>0-50%</td>
<td>0-20%</td>
</tr>
<tr>
<td>(0-85%)</td>
<td>(1-35%)</td>
<td></td>
</tr>
<tr>
<td>DM Recovered as Edible Silage (Average Figure)</td>
<td>66%</td>
<td>80%</td>
</tr>
</tbody>
</table>

TABLE 2
Feeding Value Compared to Pasture

<table>
<thead>
<tr>
<th></th>
<th>MJ ME/kg</th>
<th>Digestibility (%)</th>
<th>CP %</th>
<th>DM %</th>
<th>Equiv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Spring Pasture</td>
<td>15</td>
<td>12.1</td>
<td>80</td>
<td>27</td>
<td>100</td>
</tr>
<tr>
<td>Unwilted Pasture Silage</td>
<td>15-20</td>
<td>8.0-9.5</td>
<td>55-75</td>
<td>12-20</td>
<td>65-80</td>
</tr>
<tr>
<td>Wilted Lucerne Silage</td>
<td>30-40</td>
<td>8.5-10.0</td>
<td>60-80</td>
<td>15-25</td>
<td>70-85</td>
</tr>
<tr>
<td>Wilted Pasture Silage</td>
<td>28.35</td>
<td>8.5-10.0</td>
<td>60-80</td>
<td>12-20</td>
<td>70-85</td>
</tr>
</tbody>
</table>

Animal Responses

Wiltoning ensures that DM losses during preservation are minimized rather than improving nutritive value. Digestibility of unwilted silage is generally higher than the wilted product from the same crop. However there is a decided intake advantage (range 19-33 per cent Marsh, 1978) in favour of wilted silage for dairy cattle. While fine chop silage appears to be crucial to ensure high intakes by sheep (Demarquilly, 1973) more work is needed to assess its value for cattle, especially as a supplementary feed.

References


Sow productivity and its improvement

W.C. Smith, Pig Research Centre, Massey University

The financial outcome of pig farming is determined by a number of crucial factors. Among these can be listed sow productivity. It is the aim of this contribution to examine in some detail the significance of this factor in profitable pig production and briefly mention ways in which the gap between potential and observed levels of breeding herd performance can be narrowed to the financial advantage of the producer and benefit the pig industry as a whole.

The sow has one commercial purpose in life - to produce offspring which are subsequently grown and sold. A useful omnibus parameter of sow productivity is the number of pigs reared per sow per annum. Bearing in mind, however, that reproductive output of the sow is influenced by her age a more correct measure of sow productivity is the number of offspring produced by the sow in her lifetime. Also of importance is the early performance of the piglets themselves particularly as we move towards earlier weaning systems with less dependence placed on the sow for the nutrition of the litter.

Before considering reproductive performance of the breeding herd in detail it is appropriate to look at current levels of production to determine if there is scope for improvement of reproductive output from pig breeding herds in New Zealand.

CURRENT LEVELS OF REPRODUCTIVE PERFORMANCE

Accepting a sow output of two litters per annum and a litter size of ten pigs born alive, both of which are modest production targets, it should be possible to produce eighteen saleable pigs.
TABLE 1

Annual sow productivity in the major pig producing countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Sow No ('000 head)</th>
<th>Total slaughter pigs ('000 head)</th>
<th>Sow productivity slaughter pigs/ sow/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>886</td>
<td>12,881</td>
<td>14.5</td>
</tr>
<tr>
<td>W. Germany</td>
<td>2,329</td>
<td>31,785</td>
<td>13.6</td>
</tr>
<tr>
<td>Denmark</td>
<td>1,022</td>
<td>10,329</td>
<td>10.1</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>8,000</td>
<td>74,250</td>
<td>9.4</td>
</tr>
</tbody>
</table>

As can be seen from Table 1, there is a large discrepancy for all these nations between the modest target figure for sow productivity and that actually achieved. The figure for sow output in New Zealand would appear to be in the order of twelve to thirteen pigs/sow/year.

On the other hand it is well known that marked variation exists between breeding herds in the performance of their stock (Table 2), with many exceeding eighteen pigs/sow/annum. In terms of sow productivity, figures given in Table 2 show a difference of more than five pigs/sow/annum between the best and worst herds in the recording scheme.

Clearly there is room for a marked improvement of sow productivity. Many producers are not utilising efficiently the resources at their disposal. What does this considerable shortfall between potential and actual levels of performance in the breeding herd mean in terms of profitability?

TABLE 2

Difference between the best and worst herds in a U.K. recording scheme.

<table>
<thead>
<tr>
<th></th>
<th>Best 20 herds</th>
<th>Worst 20 herds</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of sows in the herd</td>
<td>129</td>
<td>136</td>
</tr>
<tr>
<td>Litters/sow/annum</td>
<td>2.20</td>
<td>1.86</td>
</tr>
<tr>
<td>Weaners/litter</td>
<td>9.3</td>
<td>8.1</td>
</tr>
<tr>
<td>Weaners/sow/annum</td>
<td>20.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Weaning age (days)</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>
ECONOMIC CONSIDERATIONS

Figures given in Table 3 clearly demonstrate the importance of sow output in improving efficiency and increasing profitability on the New Zealand farm.

TABLE 3
Effect of variation in output/sow/annum on herd profitability

<table>
<thead>
<tr>
<th>25kg weaners/sow/annum</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>22</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed cost/kg weaner produced (cents)</td>
<td>85.1</td>
<td>77.8</td>
<td>72.2</td>
<td>67.6</td>
<td>64.0</td>
</tr>
<tr>
<td>Labour and variable costs per kg weaner produced (cents)</td>
<td>20.1</td>
<td>18.0</td>
<td>16.0</td>
<td>15.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Gross margin per kg weaner (cents)</td>
<td>39.9</td>
<td>49.2</td>
<td>56.8</td>
<td>62.4</td>
<td>67.0</td>
</tr>
<tr>
<td>Gross margin/weaner ($)</td>
<td>9.98</td>
<td>12.3</td>
<td>14.2</td>
<td>15.6</td>
<td>16.75</td>
</tr>
<tr>
<td>Gross margin/sow($)</td>
<td>140</td>
<td>197</td>
<td>256</td>
<td>312</td>
<td>369</td>
</tr>
<tr>
<td>Weaners produced/tonne feed</td>
<td>9.4</td>
<td>10.3</td>
<td>11.3</td>
<td>12.1</td>
<td>13.7</td>
</tr>
</tbody>
</table>

Further data on this aspect (Table 4) emphasise the disproportionately large impact that variation in breeding herd performance has on profitability and thus the key position that this factor holds in the economics of pig production.

TABLE 4
The effect of 1% variation and of estimated maximum variation in some production variables on gross margin ($/sow/year) and returns of capital (%) for a 150 sow herd producing weaners.

<table>
<thead>
<tr>
<th>1% variation</th>
<th>Maximum variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross margin</td>
<td>Return on capital</td>
</tr>
<tr>
<td>Breeding herd performance</td>
<td>5.1</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>6.2</td>
</tr>
<tr>
<td>Grading profile</td>
<td>1.1</td>
</tr>
<tr>
<td>Growth rate</td>
<td>0.0</td>
</tr>
<tr>
<td>Feed cost</td>
<td>9.2</td>
</tr>
</tbody>
</table>

189
This large effect that sow output has on profitability is understandable when it is realised that the cost of keeping the breeding sow must be borne by the number of weaners she produces. Most of the cost of producing the weaner is expenditure incurred in keeping the sow and much of this is a fixed cost which does not vary much with the number of pigs produced. Thus, under any particular system the more piglets a sow produces the cheaper will be the cost of each one (Table 5).

### TABLE 5

**Efficiency of feed use at different levels of output**

<table>
<thead>
<tr>
<th>Weaners/sow/year</th>
<th>Total weight (kg)</th>
<th>Food/kg weaner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weaners</td>
<td>Food</td>
</tr>
<tr>
<td>24</td>
<td>257</td>
<td>1310</td>
</tr>
<tr>
<td>22</td>
<td>237</td>
<td>1271</td>
</tr>
<tr>
<td>20</td>
<td>220</td>
<td>1232</td>
</tr>
<tr>
<td>18</td>
<td>202</td>
<td>1192</td>
</tr>
<tr>
<td>16</td>
<td>184</td>
<td>1153</td>
</tr>
<tr>
<td>14</td>
<td>164</td>
<td>1114</td>
</tr>
<tr>
<td>12</td>
<td>144</td>
<td>1075</td>
</tr>
</tbody>
</table>

In view of the marked effect that sow output has on the profitability of the pig enterprise it is pertinent to determine what factors are limiting the production of piglets on many breeding units and how can they be overcome?

**COMPONENTS OF REPRODUCTIVE OUTPUT**

Sow profitability, expressed as pigs reared/sow/lifetime has three main components. These are litter size, farrowing index ie the number of litters reared/sow-year and longevity or productive lifespan of the sow herself. These in turn have various components contributing to their expression. The main ones are illustrated in Figure 1.

In attempting to close the gap between potential and observed levels of sow productivity, attention must be focused on these components, with some receiving more attention than others. This raises the question of which factors are likely to be the most rewarding financially to concentrate upon in striving to improve sow output in the breeding herd.

**Litter Size**

Since litter size is the end product of all the effort and manipulation that goes into the breeding herd, it is important to consider how it can be maximised. Litter size at birth in the sow is generally adequate in healthy herds. However, since some 45 per cent of the total eggs shed at ovulation are lost by the time of farrowing (Figure 2) there is still room for improvement. Unfortunately technology must await a while longer for research effort to come up with the answer to this problem.
ECONOMIC CONSIDERATIONS

Figures given in Table 3 clearly demonstrate the importance of sow output in improving efficiency and increasing profitability on the New Zealand farm.

TABLE 3
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<table>
<thead>
<tr>
<th>25kg weaners/sow/annum</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>22</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed cost/kg weaner produced (cents)</td>
<td>85.1</td>
<td>77.8</td>
<td>72.2</td>
<td>67.6</td>
<td>64.0</td>
</tr>
<tr>
<td>Labour and variable costs per kg weaner produced (cents)</td>
<td>20.1</td>
<td>18.0</td>
<td>16.0</td>
<td>15.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Gross margin per kg weaner (cents)</td>
<td>39.9</td>
<td>49.2</td>
<td>56.8</td>
<td>62.4</td>
<td>67.0</td>
</tr>
<tr>
<td>Gross margin/weaner ($)</td>
<td>9.98</td>
<td>12.3</td>
<td>14.2</td>
<td>15.6</td>
<td>16.75</td>
</tr>
<tr>
<td>Gross margin/sow($)</td>
<td>140</td>
<td>197</td>
<td>256</td>
<td>312</td>
<td>369</td>
</tr>
</tbody>
</table>

Further data on this aspect (Table 4) emphasise the disproportionately large impact that variation in breeding herd performance has on profitability and thus the key position that this factor holds in the economics of pig production.

TABLE 4
The effect of 1% variation and of estimated maximum variation in some production variables on gross margin ($/sow/year) and returns of capital (%) for a 150 sow herd producing weaners.

<table>
<thead>
<tr>
<th>1% variation</th>
<th>Maximum variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross margin</td>
<td>Return on capital</td>
</tr>
<tr>
<td>5.1</td>
<td>0.31</td>
</tr>
<tr>
<td>6.2</td>
<td>0.39</td>
</tr>
<tr>
<td>1.1</td>
<td>0.07</td>
</tr>
<tr>
<td>0.0</td>
<td>0.07</td>
</tr>
<tr>
<td>9.2</td>
<td>0.58</td>
</tr>
</tbody>
</table>
This large effect that sow output has on profitability is understandable when it is realised that the cost of keeping the breeding sow must be borne by the number of weaners she produces. Most of the cost of producing the weaner is expenditure incurred in keeping the sow and much of this is a fixed cost which does not vary much with the number of pigs produced. Thus, under any particular system the more piglets a sow produces the cheaper will be the cost of each one (Table 5).

### TABLE 5

**Efficiency of feed use at different levels of output**

<table>
<thead>
<tr>
<th>Weaners/sow/year</th>
<th>Total weight (kg)</th>
<th>Food/kg weaner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weaners</td>
<td>Food</td>
</tr>
<tr>
<td>24</td>
<td>257</td>
<td>1310</td>
</tr>
<tr>
<td>22</td>
<td>237</td>
<td>1271</td>
</tr>
<tr>
<td>20</td>
<td>220</td>
<td>1232</td>
</tr>
<tr>
<td>18</td>
<td>202</td>
<td>1192</td>
</tr>
<tr>
<td>16</td>
<td>184</td>
<td>1153</td>
</tr>
<tr>
<td>14</td>
<td>164</td>
<td>1114</td>
</tr>
<tr>
<td>12</td>
<td>144</td>
<td>1075</td>
</tr>
</tbody>
</table>

In view of the marked effect that sow output has on the profitability of the pig enterprise it is pertinent to determine what factors are limiting the production of piglets on many breeding units and how can they be overcome?

**COMPONENTS OF REPRODUCTIVE OUTPUT**

Sow profitability, expressed as pigs reared/sow/lifetime has three main components. These are litter size, farrowing index i.e. the number of litters reared/sow-year and longevity or productive lifespan of the sow herself. These in turn have various components contributing to their expression. The main ones are illustrated in Figure 1.

In attempting to close the gap between potential and observed levels of sow productivity, attention must be focused on these components, with some receiving more attention than others. This raises the question of which factors are likely to be the most rewarding financially to concentrate upon in striving to improve sow output in the breeding herd.

**Litter Size**

Since litter size is the end product of all the effort and manipulation that goes into the breeding herd, it is important to consider how it can be maximised. Litter size at birth in the sow is generally adequate in healthy herds. However, since some 45 per cent of the total eggs shed at ovulation are lost by the time of farrowing (Figure 2) there is still room for improvement. Unfortunately technology must await a while longer for research effort to come up with the answer to this problem.
Where a low litter size at birth is being experienced this can generally be attributed to excessive embryo mortality during early pregnancy and not a low ovulation rate. Such losses could be attributed to weaning the previous litter too early, the stock subjected to stress post-weaning, a high feeding level in early pregnancy or failure to maintain adequate body condition in the sow.

In most herds it is generally the actual number of piglets in each litter which fail to survive to weaning that is more of a problem than the numbers born. Current pre-weaning mortality rates in reasonably managed herds still average around 17 per cent of live births, a figure which, although subject to considerable variation, seldom falls below 10 per cent on individual units.

Particularly disturbing is the fact that although attention has been directed at reducing piglet mortality over a number of years the death rate has abated only slightly. It makes one wonder if there is anything further we can do to prevent piglet deaths in the early post-partum period. Certainly one can hardly imagine that the sow could be more closely confined than she is at present in the various types of farrowing crate in use while the range of supplementary heating devices to encourage piglets to lie from the dam is numerous.

Bearing in mind that the majority of piglet deaths occur in the first few days after birth (Table 6) and can be attributed to physical causes (eg overlaying and starvation), the best advice that can be given is more individual attention at this critical time. Control of the time of parturition by the use of prostaglandins offers scope on large units for greater supervision at the birth of litters, through allowing batch farrowing at a convenient time of day with scope for fostering of piglets.

On less advanced units as regards husbandry practices the following check-list should serve as a guide to adequate litter size and keeping piglet mortality levels to the lower end of the range:

* Use of crossbred as opposed to purebred breeding females.
* Adequate levels of feeding during pregnancy and lactation to ensure heavy birthweights and maintain body condition of the dam.
* Flushing of gilts to ensure a high ovulation rate and improve body
condition followed by a reduction in the plane of nutrition to avoid high embryo losses.

- Provision of comfort and warmth; insulated construction to avoid temperature extremes; adequate air movement.
- Confinement of the dam at farrowing.

**Farrowing Index**

The number of litters produced per sow per year is rightly regarded as a factor of crucial economic importance in any calculation of the efficiency of sow output. To increase sow productivity in this respect attention must be focused on both the productive and unproductive periods of the sow (Figure 3) the aim being to increase the number of the former and reduce the length of the latter.

**Figure 2: Potential Piglet Numbers Throughout Pregnancy And After Birth**

| Eggs shed | 18 |
| Eggs fertilised | 15 |
| Embryos | 12 |
| Foetuses | 11 |
| Born alive | 10 |
| Weaned | 9 |

Of the two productive periods in the life of the sow (Figure 3) gestation length is a fairly constant herd component more or less out of the scope of influence by management. Lactation length on the other hand is a period that can be dramatically altered by earlier weaning of the litter thereby allowing the next pregnancy to begin earlier and permit more litters/sow/year.

There is undoubtedly scope on efficient units weaning at five to six weeks of age for further reduction in lactation length but by how far is the critical question. Weaning at piglet ages younger than three weeks appears to bring about its own special problems. Invariably other factors beneficial to sow productivity are negatively influenced by very early weaning (Table 7).

Furthermore, as lactation length is reduced there is certainly need for extra inputs at the management level to provide for special housing, nutrition and the health requirements of very young newly weaned piglets.

From studies undertaken in several modern pig producing countries little financial benefit appears to be gained from weaning earlier than three to four weeks of age. It seems that the highest number of pigs produced annually coincides with weaning at 21 to 28 days of age while this lactation length also requires least total feed/pig reared. In fact when weaning at less than three weeks of age the situation becomes so extreme as to demand a new technology in housing, husbandry, animal health and diet.
TABLE 6

The pattern of pre-weaning piglet deaths

<table>
<thead>
<tr>
<th>Days after birth</th>
<th>% of total pre-weaning deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>50</td>
</tr>
<tr>
<td>3-7</td>
<td>18</td>
</tr>
<tr>
<td>8-21</td>
<td>17</td>
</tr>
<tr>
<td>22-56</td>
<td>15</td>
</tr>
</tbody>
</table>

Figure 3: Productive and Unproductive Periods in the Life of the Sow.

TABLE 7

Influence of lactation length on annual sow productivity

<table>
<thead>
<tr>
<th>Lactation length (days)</th>
<th>Weaning-remating interval (days)</th>
<th>Conception rate (%)</th>
<th>Subsequent litter size</th>
<th>Potential annual sow output</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>12.7</td>
<td>71.7</td>
<td>7.6</td>
<td>20.0</td>
</tr>
<tr>
<td>11-20</td>
<td>9.7</td>
<td>76.7</td>
<td>9.2</td>
<td>23.2</td>
</tr>
<tr>
<td>21-30</td>
<td>7.9</td>
<td>84.7</td>
<td>10.1</td>
<td>25.9</td>
</tr>
<tr>
<td>30+</td>
<td>7.8</td>
<td>83.9</td>
<td>10.8</td>
<td>24.4</td>
</tr>
</tbody>
</table>
As shown in Figure 3, the unproductive periods are three in number and all can be influenced by management.

Selection - conception (gilts). The practical application of recent findings in this very topical field at present can be summarised as follows. The use of crossbred females ensures earlier attainment of puberty and less mating problems. Gilts should be housed adjacent to a mature stock boar from around 160 to 170 days of age. Increase feeding level from first to second oestrus by 30-40 per cent (ie flush) and double mate at second oestrus. Reduce daily meal intake to normal pregnancy level immediately after mating to avoid high embryo mortality. Confine in small groups during pregnancy with provision for individual feeding.

Weaning to effective service interval. There is marked scope for improving sow productivity on many units by reducing the interval from weaning to conception. The importance of "empty days" is seen from figures given in Table 8.

<table>
<thead>
<tr>
<th>TABLE 8</th>
<th>The importance of empty days in the sow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning age (weeks)</td>
<td>3-4</td>
</tr>
<tr>
<td>Average No. of litters/sow/year</td>
<td>2.2</td>
</tr>
<tr>
<td>Average farrowing interval (days)</td>
<td>166</td>
</tr>
<tr>
<td>Average length of pregnancy + lactation (days)</td>
<td>140</td>
</tr>
<tr>
<td>Average &quot;empty days&quot;/reproductive cycle</td>
<td>26</td>
</tr>
<tr>
<td>Average empty days/year</td>
<td>57</td>
</tr>
</tbody>
</table>

The average number of empty days/sow/year probably exceeds 70 in many herds in New Zealand i.e. a fairly long period of housing, feeding and caring for the sow for no production. The following is a summary of what should be done to ensure efficient breeding performance.

Pen in small groups of similar size at weaning, keep in close proximity to the boar, and ensure individual feeding. Avoid excessive loss of condition while sucking; flush from weaning to service but avoid high level feeding post-mating. Inspect newly weaned stock twice daily. Avoid over and under use of boar (four/five services/week); careful timing and supervision of services. Record all services; observe closely and frequently for returns particularly during warmer months. Adopt a preventative medicine programme in consultation with veterinary practitioner; closed herd policy if possible.

Final weaning to culling interval. On many units there is a long interval between weaning and culling of sows and this has an adverse effect on herd output. Recent data from U.K. herds reveals that of sows before service some 24 per cent were not removed from the herd until more than three weeks after weaning. Sows culled after service remained in the herd for an average of 88 days after their first service while those culled on account of repeated matings following return to service, remained in the herd for an average of 79 days after first being served. In the same survey sows culled when found not to be in-pig remained in the herd for an average of 121 days after their first mating.

Clearly the failure to identify and to dispose of "passenger" sows at an early stage has an important effect on the farrowing interval and therefore herd output. There
is need for an increased awareness of the reproductive state of the sow at all times. Effective oestrus and pregnancy detection, control of mating, efficient recording and a policy of culling infertile sows at an early stage are all important factors in the drive to maximise herd output.

**Longevity of the Sow**

Making rapid genetic progress implies a quick turnover of generations. However, this is not economically possible in commercial pig breeding herds due to the increase in litter size with later parities. On this basis a sow should remain in the herd for at least six litters but how many do and what are the consequences in terms of sow productivity of failing to do so?

A recent U.K. survey suggests that only some 64 per cent of sows make a fourth litter and 55 per cent a fifth one. Outside the U.K. the average age at culling appears to lie somewhere between the second and fourth litters. This is the result of a high proportion of sows culled after their first and second litters.

Early culling adversely affects herd performance in several ways: a reduced output of piglets per sow through failure to reach peak litter size; difficulty in obtaining an adequate number of replacement gilts, leading to a sub-optimal size of breeding herd; and a high proportion of young breeding females in the herd, presenting an increased health risk. Keeping sows in place of gilts means ease of synchronising oestrus through weaning.

How can we improve on longevity in the sow herd? Sows are culled for several reasons but to the fore are failure to breed and locomotor disturbances (Table 9).

**TABLE 9**

<table>
<thead>
<tr>
<th>Reason for culling sows</th>
<th>% of total culled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.4</td>
</tr>
<tr>
<td>Failure to breed</td>
<td>37.5</td>
</tr>
<tr>
<td>Performance</td>
<td>13.8</td>
</tr>
<tr>
<td>Locomotor disturbances</td>
<td>11.8</td>
</tr>
<tr>
<td>Milk failure and udder problems</td>
<td>0.6</td>
</tr>
<tr>
<td>Disease</td>
<td>3.3</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>8.6</td>
</tr>
</tbody>
</table>

The former is a complex problem and much is still to be learned concerning the cause, diagnosis and therapy of reproductive disorders. In the case of locomotor disturbances, there are indications that the incidence of lameness and posterior paralysis has increased in recent years possibly associated with intensification of management systems.

It seems doubtful if in the short term breeding life expectancy is going to be dramatically improved as commercial pressures force the industry deeper into intensification. Bearing in mind that the sow is a biological entity in its own right and not a machine and that her ability to adapt to rapidly changing methods of production is limited, we may well have to strike a closer balance between what
nature intended and what economic pressures are forcing on the industry if the full potential of the sow in terms of productivity is to be realised.

There is clearly scope for the improvement of sow productivity on pig breeding units in New Zealand. Despite gaps in our knowledge the technology is there to markedly improve herd output. Unfortunately, while technical information is essential to enable good husbandry, it does not necessarily bring it about. The resolution of many of the problem areas discussed in this contribution lies with the individual producer or his staff in whose hands rests the well being of the breeding herd.
I will take as my topic the involvement of the Pork Industry Council in pig genetic improvement, with special reference to the National Pig Breeding Centre (N.P.B.C.). With the application of well-tried objective breeding techniques, the word "research" is not entirely appropriate in this context.

The first significant involvement of the national industry in pig improvement occurred with the opening of the N.P.B.C. near Hamilton in 1956. A survey conducted by the then Department of Agriculture indicated a demand for improved breeding stock. Earlier efforts had involved the establishment of breed registers, sow productivity recording and carcass competitions. The initial aim of the centre was to supply first cross hybrid females derived from purebred Large Whites and Berkshires which had themselves been selected on reproductive and growth performance. The initial screening took place at the Ruakura Pig Research Centre.

The number of pigs marketed per sow per year was considered a major weakness in the national industry and in the early stages considerable emphasis was placed upon reproductive performance. However, for the first time on a systematic basis, carcass quality was assessed by objective measurements on a selection of progeny together with daily growth rate and conformation characteristics used as a basis for determining which parents should supply stock for breeding, transfer to the Massey College Pig Research Centre multiplying unit, or for sale to commercial producers. This was a form of progeny testing. Although inefficient by today’s standards, it was important in establishing a method of evaluating the economic breeding value of breeds by objective measurement rather than the subjective eye appraisal of the presence of the centre, suggesting the applied breeding practices would result in
traditional breeder. Not surprisingly, many farmers and breeders objected to the breeding stock of poor condition and physical characteristics. However, at the request of breeders, more emphasis was placed on providing larger numbers of proven purebred boars to the industry.

The Landrace breed was imported into New Zealand during 1959. Following a comprehensive crossbreeding research programme at the National Centre, the Berkshire herd was disbanded due to the clear advantage in favour of Large White and Landrace for performance traits of economic significance. This advantage persisted in the crossbreds which involved the Berkshire. The National Centre was established partly due to the reluctance of traditional breeders to adopt modern methods.

However, in 1965, a boar performance testing unit was established at the National Centre and breeders were invited to submit stock for testing. After a slow start, there was greater interest when the financial cost of the exercise was reduced and also when some breeders received good prices for boars of high performance. Therefore the emphasis had shifted to the performance testing of boars, made possible by the ultrasonic measurement of backfat thickness on the live animal. Due to the support received from some breeders, the McMeekan Centre, as a central boar performance testing facility was opened on land near Lincoln College in 1972.

After considerable industry debate, it was decided to re-establish the N.P.B.C. on land adjacent to Massey University, Palmerston North. The original unit had sustained heavy financial losses due to a low standard of productivity, and the need to feed meal in a unit designed for the feeding of dairy by-products. However, many breeders and commercial farmers agreed that an industry involvement in breeding was justified on the basis of past progress in developing lean fast growing stock (in comparison with other boars tested at the McMeekan Centre) and to act as an impartial assessor of breeding material available locally or imported. It also assured that modern breeding methods continued whereas many breeders lacked commitment, were too small to allow effective breeding plans, and showed a high turnover in membership.

The breeding scheme in operation was adopted as the recommendation of Dr C.A. Morris, a geneticist, in conjunction with Prof. A.L. Rae and Dr J.L. Adam. This involves the intensive selection of 70 sow herds each of purebred Large White and Landrace on speed of growth and backfat thickness, a rapid generation turnover of boars and sows, and a crossbreeding programme involving a proportion of the older purebred sows. The exploitation of hybrid vigour to allow greater potential for sow productivity was given high priority by the consulting geneticists and to provide the breeding industry with some illustration of how this can be done, the crossbreeding element was introduced. In the classical breeding pyramid or tiered structure, the N.P.B.C. is seen as performing a nucleus role, contributing improved genes to multiplier and commercial herds. In practice the N.P.B.C. distributes the major proportion of its breeding stock to larger commercial farmers who operate their own multiplication programmes.

An on farm testing scheme, available to breeders and commercial farmers, was introduced in 1975. It has been well supported by breeders, but is now restricted to members of the Voluntary Improvement Plan (V.I.P.), a group who use the McMeekan Centre and On Far Testing Service as aids to genetic improvement.

One measure of the effectiveness of the improvement programmes undertaken is to measure the penetration of improved stock into the commercial farming sector. In 1976 Dr Morris conducted a survey which suggests that 40 per cent of the annual purchase of boar replacement was derived from herds involved in performance
selection programmes. This level was considered inadequate. For each McMeekan Centre and On Farm Testing Service as aids to genetic improvement, indicating only a small fraction of the multiplying potential in these herds was being realised. Also, the predominant female replacement was as the crossbred, but the survey did not allow an evaluation of the source of this stock where purchased from other farms.

**FUTURE PIG BREEDING IN NEW ZEALAND**

An important development is the appearance of large breeding organisations which operate on a bigger scale than has been usual in the past, and have a fully intergrated multiplier phase, particularly with regard to crossbred gilts.

They have the potential for making rapid progress through the disciplined use of modern breeding methods and are able to offer large numbers of animals for sale - important with the continuing trend for larger commercial herds. It is likely that one or more breeds will attempt to develop a place as terminal sire in a three breed breeding programme. The North American Durco is gaining in popularity in this regard.

The N.Z. pig farmer, through the Pork Industry Council, makes a significant financial contribution to modern pig breeding methods. However it has not been possible to establish with any reasonable degree of precision what the benefits have been for him in return. The Meat & Livestock Commission, who administer a pig improvement scheme in the United Kingdom (and which has been closely followed in forming the N.Z. equivalent), have been able to demonstrate that the U.K. pig farmer is probably receiving a financial benefit ten times the cost input associated with the scheme. Despite the inherent inefficiencies, there is some evidence to suggest the New Zealand farmer is receiving a financial reward representing several times the cost input. Many farmers, some on a large scale, have been able to detect significant differences in performance directly attributable to the breeding background of growing pigs from various sources. Even minor changes can mean significant differences in financial margins on a medium to large unit.

The measured progress in economically important traits of medium to high hereditability in the pig, namely growth rate, feed conversion efficiency and carcass quality, has been shown overseas to be small - in the region of 2-3 per cent per year. However, these effects are cumulative and can demonstrate significant differences from stock unselected for performance, even after a relatively short period of time. The McMeekan Centre has provided the industry with evidence that a few breeders, including the National Pig Breeding Centre, have been able to demonstrate genetic superiority in their herds through the application of performance testing as a basis for selection. Although the incentive from commercial farmers in terms of demand for these improved pigs is often less than desirable, there is little doubt that performance testing has played a major part in improving the pig farmers potential to grow profitable pigs.

Apart from a change in selection indices to place more emphasis upon feed conversion ratio, due to the relatively high cost of feed, there has been little change to selection objectives. In the allocation of scarce resources, it still appears desirable to continue selecting for economy of lean meat production in the growing pig with the two major white breeds, and leave higher sow productivity to crossbreeding and the application of good housing and management techniques.
Formulation of feed rations for the modern pig


The subject matter of this paper is more specific than the title. My comments will be confined to the growing pig between 20 and 80 kilograms liveweight. It is in this phase that nutrition influences growth rate and economics more than management, whereas in all other aspects of pig production, the reverse is true.

In the early 1970s, John Carr, (who was then Director of the Massey University Pig Research Centre) went on sabbatical leave to the U.K. where he undertook research on protein metabolism in pigs. During this time he realised much of the research on pig nutrition had been conducted by studying one nutrient in isolation from all others. He realised that the way pigs respond to protein was very dependent on the amount of energy and other nutrients present and yet little research had been conducted in this field. On his return he designed an experiment to look at the effect of energy intake in relation to protein intake and the effect of these on performance. The results of this experiment were more than he could have hoped for and they will form the basis of feeding programmes for growing pigs in New Zealand for many years to come.

The experiment was conducted in 1976-79 at the Massey University Pig Research Centre and Ruakura. The dimensions of the experiment were enormous, compared with pig research previously conducted in New Zealand. Three sexes were considered: entires, castrates and gilts. Stock were Large White cross Landrace. Animals were fed four different diets which represented four different protein
concentrations in relation to lysine. Lysine was 0.5, 0.75, 1.0 and 1.25 per cent. These diets were fed at four different levels of intake related to ad libitum intake. They were 90, 79, 68 and 57 per cent of ad libitum intake for each sex.

The trial commenced when the animals were 20 kg liveweight. Pigs were weighed and slaughtered at 20, 40, 80 and 100 kg liveweight. Backfat measurements were recorded and a sample of pigs were totally dissected to obtain information on carcass yield, body composition and muscle quality. The total experiment involved the individual recording of 543 pigs at Massey and more at Ruakura. The aim was to obtain input/output data which could be used for predicting nutritional responses. Once these are obtained it is possible to undertake economic analyses and choose the feeding programme that maximises profit.

**EXPERIMENTAL RESULTS**

The results of the Massey research are contained in a 100 page document and are complex in nature. However we can summarise some trends as follows.

Entires grow faster, convert more efficiently and are leaner than gilts which in turn are superior to castrates.

When the feeding levels are increased, pigs grow faster but fat content increases. When lysine (protein) is increased pigs grow faster and the fat content decreases.

When feeding levels are increased to about 85 per cent ad libitum pigs convert more efficiently but when feed intakes are increased above this level feed conversion deteriorates slightly.

These trends have been well known for some time. However the Massey research goes a step further and quantifies the relationship between the performance criteria (growth rate, feed conversion, backfat, etc.) and the input data (energy and protein concentration of the diet and feeding levels). The result of the Massey experiment have been analysed statistically and regression equations have been calculated from the data produced. These equations enable us to predict performance.

When the experiment was designed there were a set of variables (diet, feeding level, sex) which represented the experimental treatments. For each different treatment, measurements were taken of growth rate, feed conversion ratio, backfat, grading etc. The prediction equations allow us to tie the two together. If we know what our diet is, what our feeding level is and what the sex of the animals are, then we can predict growth rate, feed conversion ratio, backfat, grading, etc.

The equations are too complex to illustrate in full in this paper. However for those who are mathematically inclined I will present one as a means of illustration and also to introduce the terms and units we will use later. The average daily lightweight gain for gilts between 20 and 80 kg is represented by the following equation (G=average daily liveweight gain (grams), X=average daily lysine intake (grams), and Z=average daily digestible energy intake (M.J.):\

\[
G = -63.841 - 1.8168 X + 23.385 Z - 1.5745 X - 0.8192 Z + 2.4355 X Z
\]

Similarly there are prediction equations for entires and castrates. Also, there are prediction equations for feed conversion ratio, backfat and grading.

All of these equations have been put on a computer which allows us to manipulate diets and feeding levels to examine the effects on physical and economic performance.
SOME PRACTICAL APPLICATIONS

To demonstrate how a feeding model works it is best to give examples that are of practical relevance. We must first define the input data. This is:

(a) Dietary energy concentration (DE)
(b) Dietary lysine concentration (LYSINE)
(c) Average daily intake 20-80 kg (FEED)
(d) Price of the diet on farm (COST)
(e) Schedule prices for Prime Choice and Standard grades ($PR, $CH, $ST)

We then key this information into the computer which processes it and gives us:

(a) Average daily liveweight gain (ADG)
(b) Feed onversion ratio (FCE)
(c) C4 measurement (C4)
(d) Dressing out percentage (K%)
(e) Days from 20 to 80 kg liveweight (DAYS)
(f) Grading profile (PR%, CH%, ST%)
(g) Margin over Grower feed cost (GM)
(h) Margin per pig space per year (P)

If you consider the above for a minute you will realise we have a very powerful tool for decision making. Let us examine the four examples below.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Barrow</td>
<td>Entire</td>
<td>Entire</td>
<td>Entire</td>
<td>Gilt</td>
</tr>
<tr>
<td>Daily Feed (kg)</td>
<td>1.50</td>
<td>1.50</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>D.E. (mj/kg)</td>
<td>13.50</td>
<td>13.50</td>
<td>13.50</td>
<td>13.50</td>
<td>13.50</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>1.20</td>
<td>0.80</td>
</tr>
<tr>
<td>Cost ($/t)</td>
<td>300.00</td>
<td>300.00</td>
<td>300.00</td>
<td>320.00</td>
<td>300.00</td>
</tr>
<tr>
<td>$Pr</td>
<td></td>
<td></td>
<td></td>
<td>2.13</td>
<td></td>
</tr>
<tr>
<td>$Ch</td>
<td></td>
<td></td>
<td></td>
<td>2.03</td>
<td></td>
</tr>
<tr>
<td>$St</td>
<td></td>
<td></td>
<td></td>
<td>1.78</td>
<td></td>
</tr>
<tr>
<td>Adg.</td>
<td>516.00</td>
<td>563.00</td>
<td>764.00</td>
<td>805.00</td>
<td>725.00</td>
</tr>
<tr>
<td>Fce</td>
<td>2.91</td>
<td>2.66</td>
<td>2.62</td>
<td>2.48</td>
<td>2.75</td>
</tr>
<tr>
<td>Days</td>
<td>116.20</td>
<td>106.50</td>
<td>78.50</td>
<td>74.50</td>
<td>82.70</td>
</tr>
<tr>
<td>K%</td>
<td>78.00</td>
<td>77.10</td>
<td>76.90</td>
<td>75.80</td>
<td>79.10</td>
</tr>
<tr>
<td>C4 (MM)</td>
<td>18.00</td>
<td>15.10</td>
<td>17.10</td>
<td>14.30</td>
<td>19.80</td>
</tr>
<tr>
<td>Pr%</td>
<td>60.00</td>
<td>87.00</td>
<td>70.00</td>
<td>90.00</td>
<td>37.00</td>
</tr>
<tr>
<td>Ch%</td>
<td>32.00</td>
<td>11.00</td>
<td>25.00</td>
<td>8.00</td>
<td>46.00</td>
</tr>
<tr>
<td>St%</td>
<td>8.00</td>
<td>2.00</td>
<td>5.00</td>
<td>2.00</td>
<td>17.00</td>
</tr>
<tr>
<td>G.M. ($)</td>
<td>77.05</td>
<td>82.37</td>
<td>81.49</td>
<td>80.79</td>
<td>78.57</td>
</tr>
<tr>
<td>P ($)</td>
<td>242.00</td>
<td>282.00</td>
<td>379.00</td>
<td>396.00</td>
<td>346.00</td>
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</table>
A comparison of A and B shows that entires grow faster than barrows thereby converting more efficiently. They are leaner, grade better and are more profitable.

A comparison of B and C shows that profitability can be improved by increasing the average daily feed intake from 1.5 to 2.0 kg. The daily liveweight gain is increased by 36 per cent with a resultant deterioration in grading.

We can improve grading by increasing the protein level of the feed (Example D). However the increased cost of the diet is probably not sufficient to justify this under normal marketing conditions.

The comparison of C and E us of entires and gilts on the same feeding level. Gilts do not grow as fast or convert as efficiently and their grading is significantly inferior.

Once we have the model set up we can go on for hours exploring different possibilities and studying the effect of nutrition and feeding levels on physical and financial performance. We can use the model to assess what feeding programme suits our production and marketing methods best and from this we hope to choose the feeding programme which maximises the bank balance.

You will note that the conclusions reached in the above comparison were no different than those stated earlier. However the big difference is that we have put numbers on them and this is what keeps bank Managers happy.

It is all very well to talk of computer models and experimental results but it is important that these realistically reflect the practical situation.

The Massey pig model is currently being used by at least three agencies, one of which is in Australia. The initial indications are that the correlation between the field situation and the theoretical situation is extremely close. To illustrate this the following comparisons have been achieved from New Zealand farms.

<table>
<thead>
<tr>
<th>Gilts ADG (g)</th>
<th>Predicted</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCE</td>
<td>628.00</td>
<td>625.00</td>
</tr>
<tr>
<td>DAYS (20-80 kg)</td>
<td>2.86</td>
<td>2.90</td>
</tr>
<tr>
<td></td>
<td>95.50</td>
<td>96.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boars ADG (g)</th>
<th>Predicted</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCE</td>
<td>701.00</td>
<td>670.00</td>
</tr>
<tr>
<td>DAYS (20-80 kg)</td>
<td>2.56</td>
<td>2.63</td>
</tr>
<tr>
<td></td>
<td>85.50</td>
<td>87.00</td>
</tr>
</tbody>
</table>

The above figures clearly demonstrate that the relationship between predicted and actual performance is very good. Although this is only one example, others are as precise. There has been a problem correlating grading with the model as it is difficult to get an accurate assessment on grading at 80 kg since pigs may not be scheduled for slaughter until a heavier weight.

WHERE DO WE GO FROM NOW?

I have spent a large proportion of this paper discussing the background to the Massey computer model and the research from which it was derived. I have done this to demonstrate the type of research currently being conducted in New Zealand and how this can be used by the farmer to make decisions on how to feed his pigs. I have not told you how to formulate diets as the title of this paper may have suggested. Formulation, *per se*, is a specialised discipline which takes account of energy amino acid relationships, amino acid availability, vitamin and mineral supplementation, cation - anion balance etc. What I hope I have demonstrated, however, is the rationale behind choosing a dietary specification and the relation-
ship between diet, feeding level and livestock performance and profitability.

The New Zealand pig industry is only beginning to implement feeding pro-
grammes which are designed to a sound quantifiable base. However, we have a
long way to go before feeding programmes integrate all aspects of production and
marketing to the benefit of the industry as a whole. The future development of
feeding programmes places responsibilities on the researcher, the nutritionist, the
advisor, the farmer and the processor.

The research scientist must continue with research which provides information
which allows us to have more confidence in our model. Current work at Massey
University is looking at the availability of amino acids and this work must be
supported.

The nutritionist has a responsibility to use the modelling approach to diet
formulation and must use economic factors as his final determinant in choosing
feeding programmes.

The advisor must understand how pigs respond to different feeding programmes
and must be able to quantify the result of any changes he makes to the feeding
management of the growing pig.

The farmer has a responsibility to keep records. The nutritionist and the advisor
can assist the farmer who knows what his base performance is. Basic recording of
feed intake and liveweight gain is essential before advice can be given on
alternative feeding programmes. More detailed recording, which includes grading,
is essential if overall profitability of feeding programmes is to be compared.

The economic model which is used for comparing feeding programmes includes
all the physical input-output data which is under the control of the farmer (e.g.
feeding levels, growth rates). It also includes feed prices and pigmeat prices. Feed
prices are a function of ingredient costs and dietary nutrient density and are readily
obtainable. However, I believe that the grading scheme, as it now stands, and the
relativity of prices within it, is going to require a major overhaul if farmers are to use
economic aspects of a pig model with any confidence.

Our experience with the model so far indicates that improved profitability is
consistent with faster growth rates. Fast growth rates are consistent with high
feeding levels. Fast growth rates also result in a deterioration in grading because
pigs are fatter. What we must do now is to assess whether or not it is more efficient
from an industry viewpoint to grow fatter pigs and discard the fat or to grow lean
pigs. The industry now has the tools available which allow us to assess the
economics of producing any type of pig on the farm.

However, the farmer has no way of assessing the true value of any pig because he
is only guided by three grade prices. If he produces fatter pigs, he is often told
there is no market for these. There is a market for everything, but the squeal of a
pig. What the farmer needs to know is the true market price for any carcass. Now
that "Trim Pork" is a reality, it should be a relatively simple task for processors to
assess the cost of discarding fat and establishing a price at which they would be
prepared to buy a carcass. I can therefore foresee the time when the current
grading system is abolished and pigs will be re-classified into more classes which
will enable true market values to be a reality.

When the farmer knows the true market value for his pigs, he is then in a strong
position to use an economic pig model which integrates the on-farm economics
with the economics of processing. When this point is reached, the pig industry will
be producing pigmeat most efficiently and must therefore be more confident in its
future.

Acknowledgement: The author wishes to thank Mr David Francis for his assistance
in the preparation of this paper.
Dairy industry marketing in the 80s

J.S. Parker, Executive Manager Marketing, New Zealand Dairy Board

I was asked to speak on dairy industry markets for the 80s. I've taken some license and will talk about dairy industry marketing in the 80s. I must say that we are really talking about dairy industry marketing in the 90s; planning for the 80s is largely history. I will cover the topic in several parts. I want firstly to look at the manufacturing industry, then outline the Board's general philosophy for development and some examples of how that development has gone. I'll then look at the changing direction of our dairy trade and try to predict the changes ahead in products, markets and prices and how the future might look further into the distance.

The dairy marketing industry is a very different industry today than it was 20 years ago. We've got less than 50 co-ops compared to 180 in 1960. We're nearly down to 100 factories - from 168 in 1960. Milking cow numbers have virtually stayed static in that period but there are 22,000 fewer dairy farms - down to 14,700 now. Fat per cow has increased by about 30 kilos and of course dairy farms each milk more than two and a half times as many cows as in 1960.

So what's this got to do with marketing? Cow numbers have not increased to keep pace with inflation, nor have prices - farms have simply swallowed their neighbours to produce more per unit. Our marketing task is therefore not to simply sell all that can be produced - we must add maximum value to every tonne because our task must be to maximise dairy farmers' incomes - which is a rather different objective. This brings me to our marketing philosophy.

For perhaps 10 years we have had some very clear and unchanged objectives.
To diversify our markets so as to lessen vulnerability to individual market vagaries; the "not too many eggs in one basket" philosophy. To widen our product mix; for the same reasons. Too add maximum value to what we produce; by preference in New Zealand, but alternatively overseas and to be involved in the downstream marketing and sale of our dairy produce in order to get the best prices and to take the maximum amount of downstream profit. Of course involvement in the downstream marketing (that is, being not only the exporter but also the importer, distributor and perhaps the wholesaler) automatically provides a massive advantage in market intelligence and product development.

We'll look at these last two objectives because they're the most interesting; adding value, and getting involved in the downstream marketing.

Speaking personally, it was a disappointingly slow move away from selling bulk anonymous dairy produce to selling NZ brand consumer-packed product. Now, the rate of development in these areas is extremely fast - why? The best analogy is the kid who wants to dive off the high board. It takes an awful lot of talking and a lot of looking down at the water before the dive is made. During the dive it's very quickly appreciated that; firstly, the rate of acceleration of a falling body is very fast.

Secondly, you can't change your mind and get back on the board. Thirdly, that making the dive a good one will mean a painless entry to the water. Well, we took a few years to jump, and the other three points are truly appreciated.

Let's look at some examples of what I'm talking about. To illustrate the added value idea I'll take wholemilk powder as a case. As recently as 1978 exports of milk powder in consumer pack cans was about 6,000 MT. In 1981 it will be approximately 20,000 tonnes and by 1982 about 30,000 tonnes. The investment just in can filling and can making equipment has been approximately $25 million plus another $5 offshore - and most of this in just the past three years. There's a lot of effort involved and a lot of faith required. We firstly put in packing equipment and started to pack other people's brands under contract. We then started exporting our terms of capacity, quality or price, and reluctantly, because it's not our primary business, we've put in our own tin plate lithographing and can making machinery.

Three years ago all of this was an expensive act of faith and the returns per tonne from milk powder in cans was less than for exports in bulk. In 1981 the returns will be better for our canned exports than for our bulk exports on a per tonne basis and we expect the trend to continue. Of course benefits accrue to New Zealand and not just the dairy industry. Many more people are employed; the gross export income per tonne of powder in cans is double that of bulk powder and a number of New Zealand companies were and are employed in establishing, running and servicing the plant. The evolution of this project showed a need for other products and processes so we now make and can dietetic foods, infant formula, energy foods etc.

By no means is this sort of development plain sailing. The amounts of capital required are frightening, new skills are required and establishing brands is a very expensive process. We found, for example, that our distance from markets and our speed of reaction was too slow so we've put in a smaller milk powder canning plant in Singapore to complement and supplement our New Zealand operation. We are now looking at one or more additional can filling plants in countries that virtually ban bulk imports. All in all there's a snowballing effect - remember my diving board analogy.

There are other examples of adding value. NZ will export about 17,000 MT of butter in pats in the forthcoming season - up from 6,000 a couple of years ago. Tinned butter is up from 2,000 tonnes to 6,000 tonnes and tinned Ghee from 3,500 tonnes to 5,000 tonnes. Apart from improving net returns, most of the product is in our brands and we're marketing it. When we packed other people's brands they...
could take the business elsewhere at any time and squeeze us on price whenever bulk prices fell.

Now we're working on cheese, where we're way, way behind. We've made progress in diversifying varietal types. In 1970 our exports were 97 per cent cheddar. Today it's 67 per cent cheddar with the 33 per cent balance spread over 12 varieties. However, far too much is in bulk and we are putting a lot of work into consumer pack presentations under the industries' own brands. The Board has also purchased shareholding in three New Zealand processing companies to facilitate this development.

In terms of becoming more involved in the marketing there have been a number of changes. The Board has subsidiary companies in the UK, USA, Singapore and Malaysia; associate companies in Bermuda, Guatemala, Jamaica, Trinidad, Papua New Guinea, West Germany, Japan, Barbados, Mauritius, Philippines, Hong Kong, Malta and Australia and an office in Bahrain. A lot of this expansion is recent and is a natural progression that stems from getting involved in adding value and doing the downstream marketing.

You find you must be on the spot to do the selling. The people on the spot quickly get to be more expert than the people back home so the marketing decisions as well as the selling gravitates to the market. We'll wake up one day to discover most of the Board's marketing decisions are made in or close to the market place with production and policy left at home - and that's a very good change.

As a part of the development, offshore processing of New Zealand product begins to make sense in certain situations so we have milk powder packaging operations in Singapore, Trinidad and Mauritius; Ghee canning in Singapore; casein processing in the USA; butter patting the UK; cheese processing in Jamaica and Panama and a number of others.

Also, as a part of the evolution, comes the realisation that processing of other peoples dairy produce can add to New Zealand dairy farmers incomes. Recently we purchased $3 million worth of other countries dairy produce to pack under our brands for our customers. I've got to admit it pleases me no end for New Zealand dairy farmers to make a profit out of other peoples dairy exports!

I suggest that all of this makes us close to becoming New Zealand's first multi-national - a word one is hesitant to use these days because of the emotive connotations surrounding it. But, as someone recently suggested, multi-national are evil when you face them and great when you're part of them! Let's now look at changes in the market place and the changes we foresee in the direction of our trade.

I'm not going to bore you with statistics of how our dependence on the UK market has lessened by 50 per cent or the increasing number of countries New Zealand's dairy produce is sold to. I think it's more interesting to look at the general changes and their consequences.

In the long term it would be foolish to ignore a decreasing butter consumption and a tendency to replace milk fat with vegetable fat. There are also some other important, but perhaps less obvious trends. Wholemilk powder consumption and UHT milk consumption are increasing. This is at the expense of condensed and evaporated milk production that once utilised the vast bulk of our fat and milk powder exports. Protein values are increasing relative to fat values and cheese consumption is increasing. This means we want to put more butterfat into cheese, wholemilk powders, Ghee, UHT milk and the like, and lessen our dependence on bulk butter exporting, especially that part of our business that is bulk.

Looking at production trends - in terms of production for export there are
profound changes. Australia as an exporter is a shadow of its former self. From 80,000 to 16,000 tonnes of butter exports in 10 years, from 66,000 to 50,000 tonnes of milk powder in the same period and 27,000 to 12,000 tonnes of casein. Cheese has increased by 20,000 tonnes. The EEC have finally woken up to the huge cost of producing vast surpluses and then having to apply subsidies in excess of our cost of production to export the surpluses. The reduction in EEC subsidies has virtually eliminated surpluses, particularly of skim-milk powder and butter and has, of course, increased prices substantially.

Other developed dairying nations such as Australia, Canada, Sweden and Austria have a substantially smaller presence in export markets. Their governments are less inclined to subsidise exports; the standards of living are rising and the enthusiasm for milking cows is falling rapidly.

On the consumption front, interesting changes are taking place. China is importing increasing tonnages of butter and whole milk powder and consumption in Asia generally is increasing. Asia and the Pacific over the past six years has moved from taking 30 per cent of our exports by value to 40 per cent and the United States from 6 to 13 per cent. Russia is of increasing importance as a consumer. Russia imported almost as much butter last year as New Zealand made and we had a share of this business. Furthermore Russia will continue to import for the foreseeable future. Russian requirements also mean that Finland, Poland, East Germany and Rumania put all their surpluses into Russia and essentially remove themselves from the world market. Remember that a 6 per cent variation in Russian milk production is equivalent to our total annual production!

Africa continues to grow as a market but limited income and freight costs from New Zealand limit both purchasing power and our access. The Middle East, with high oil revenues is an area of dramatic growth and our exports here are increasing accordingly. Basically, our interest is to establish ourselves where we have a freight advantage over EEC exporters and this makes our area of strategic interest and major marketing effort in those countries that rim the Pacific.

In summary, this combination of EEC subsidy and surplus reductions, Russian and Middle East demand, and decreased exporting interest from a number of countries (notably Australia) has given an important boost to our dairy export income. While Russian demand could lessen in five or 10 years and the EEC could again increase subsidies, we believe these factors are unlikely events and in any case world demand will grow faster than supply so that a very good future seems probable for New Zealand dairy exports.

Frankly, my advice to any dairy farmer is to go buy another farm.