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Editorial

This issue of the Journal is devoted to those papers presented during the 50th Anniversary programme of the Association in 1996. This programme consisted of three major conferences devoted to the science and economics of dairy, beef and sheep production. The contents reflect the current widespread interest amongst members in grass production and utilisation and in the future development of cost effective grass and forage based systems for ruminant production.

The publication of the original papers in full in this Journal gives members – researchers, advisers, farmers and students alike – a permanent and accessible record of valuable reference material not only on the science and economics of grass and ruminant production but also on up-to-date trends and developments in the context of EU Agricultural policy and world trade.

We continue to receive requests from libraries in Canada, U.S., New Zealand, U.K. and Europe, indicating overseas awareness of developments in grassland farming in Ireland and recognising the role of the Association in reporting this progress.

S. Flanagan

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Ireland was designed for grass production. A long growing season, rainfall averaging over three weeks per month and a dearth of summer droughts - all favour grass over grain. Yet, by 1946 we had done little to improve the grass that nature had provided. Advances in arable husbandry over the previous century had largely passed grassland by. Yields of first crop hay from grass seed sown after an arable rotation may have been the exception. Three tons per acre yield were recorded on farms and no comparative trials existed. This yield level fell away rapidly in subsequent years to the low average grass yield of the period.

In 1946 average production from Irish grassland was estimated at about 1 ton dry matter per acre per annum - 12 cow starch equivalents. Professor Michael Murphy of UCC had surveyed dairy farms in North Cork-East Limerick, an intensive dairying district. Average milk yield per acre on specialist farms was 130 gallons. National milk production for creameries and liquid milk trade totalled 220 million gallons - our national E.U. quota figure today is over 1,200 m. gallons. The New Zealand consultant, George Holmes, brought in by Minister James Dillon, found that much Irish grassland was producing the minimal possible under an Irish sky.

With this background, a group of enthusiasts formed the Irish Grassland Association in 1946. The group included progressive farmers, Rob McCulloch, North Dublin, William Bland, Laois, Harry Warren, Wexford, Edward R. Orpen, Wexford. There were also academics and industry leaders, including Henry Kennedy, I.A.O.S., Harry Spain, Department of Agriculture, Michael Gorman and Ned Sheehy, UCD. Their objective was to identify all available knowledge on grassland farming and to help in its application to Irish farm practice. There was little or no research on grass in the South at the time; pioneering work had been initiated in Northern Ireland by Pat Lenihan and John Lowe; Britain had moved; progress was seen at Aberystwyth and at the Grassland Research Centre which was in Warwickshire at the time. Progress by the young I.G.A. was initiated by identifying main areas of weakness, by observing and measuring progress on good farms and by linking with the limited amount of research results available. Guidance also came from progress in Britain and the Continent.

Soil fertility was, perhaps, the greatest limitation on Irish grass growth. For instance, early soil tests showed the general P level at 1 - we expect 9 today for good grass growth. Clinical phosphate deficiency in cattle existed. Potash was being absorbed in animals and animal products at 18 times the replacement rate. Routine liming was little practised - certainly not for grassland. We used 5,000 tons fertilizer N - 350,000 today.

An inhospitable soil means poor performing grass plants. Agrostis, with its many cousins and family members, was universal. They all gave low production, a late start in spring and poor quality, if silage was made.

Better pasture had Poa, some Holcus and a little Lolium. Ryegrass on reseeded grassland held for a short duration, due to low fertility and a low grade ryegrass variety.

Conservation of grass for winter feed was limited in quantity and quality. Hay making in a wet Irish summer spelt more failure than success. Reduced quantity and quality in a bad year meant animal stress. Emaciated cows were a spring time norm in dairying areas. Scientific starvation was the term used by Henry Kennedy at an early IGA meeting. Sufficient was fed to sustain life and no more.

In milk production, cow quality was a scarce commodity. A Department of Agriculture committee, untrained in animal breeding, had set out to design an Irish dairy cow. Their end product was a giraffe. Average yield was about 400 gallons; any cow recording over 600 gallons received a special accolade and was registered as outstanding. Progress in fat and protein was unknown.

Advances in the late forties and early fifties followed increased use of lime and fertiliser. The strong personality of General Costello, general manager of the Sugar Company, added an early impetus. He introduced ground limestone production and distribution with military detail. During the Korean war he imported phosphates in bulk, avoided shortages and cut costs. The swing from hay to silage was helped by mechanisation. The buck rake and later the forage harvester became valuable tools.

All progressive dairy farmers changed from the low yielding Shorthorn to Friesian.

In all sectors of grass farming the Irish Grassland Association provided knowledge and encouragement through organised visits to pioneering farmers and research centres in Northern Ireland, Britain and the continent. The same sources were tapped for specialist meetings, particularly on dairy development. Henry Kennedy focused the IGA on New Zealand's low cost, high output dairying. A sound philosophy of performance without expensive frills was instilled into members of the Association by visiting New Zealand speakers that included McMeekan, Mac Cooper and Alan Stewart.

Nearer home, progressive farmers in Northern Ireland had shown the possibilities of high output with well managed grass. In 1950, Sean O'Neill of Lurgan was carrying 1 cow per acre on high nitrogen input; winter feeding was silage, no concentrates. In Co. Antrim, on indifferent soil, Sandy McGuckian was producing 5.5 to 6 cwt. liveweight beef per acre - more than double the best Co. Meath target at the time.

In those years, Irish grassland research was scarcely in embryo. We benefited from trial and experience of farmers and farm research elsewhere. This left obvious gaps and weaknesses. There was need for measurement at home. Johnstown Castle had been established and was defining optimum levels for lime and fertiliser use. A team of bright and vigorous research workers was gathered. These became the nucleus on which the Agricultural Institute was established in 1958. Tom Walsh became Director and he certainly did not lack vigour or the capacity to generate enthusiasm in his young staff. The pursuit of knowledge on all sectors of grass farming became the objective.

Roger McCarrick took charge of silage development; he sought to establish farm guidance in an area dominated by confusion and perhaps emotion. The place of digestibility in silage intake and in animal performance was recognised; the higher sugar content of ryegrass was linked to good fermentation; the adverse effect of very high grass moisture was identified; acid additives were established as a means of overcoming problems; the level of N fertiliser for best yield was determined. Silage became a more consistent and reliable winter feed.

Aidan Conway at Grange established the stocking rate level for high output grass beef - 750 lb liveweight per acre was achieved.

Moorepark got underway under Michael Walshe and for the first time Irish creamery milk production was given research and measurement back-up. Despite the appalling low grade cows of the time, Moorepark went ahead in identifying optimum stocking rate and affirmed the link between stocking rate and output per farm. The commercial level of N fertiliser use was ascertained - as well as the appropriate stocking rate. Under conditions of the time clover was seen as a less profitable source of N. The research horizon widened. Fundamental work on machine milking was undertaken and principles of liner design and those of performance generally were established. These are still with us, reducing mastitis levels, cell counts and improving labour output.

Moorepark tackled the brucellosis problem at a time when the official eradication scheme was wiping out dairy herds and dairy farmers, while decimating cow numbers.

Moorepark showed that a combination of vaccination with a more refined reading of blood tests gave more accurate results, with far less slaughter of dairy cows. The new technique was adopted just before eradication started in the main dairy counties. Kerry was the last to suffer the cow losses of the old system and Kerry milk quota suffers to this day.

Work by Dan Browne of Moorepark and Willie Murphy of Johnstown Castle established the strengths, weaknesses and timing of urea, a cheap N source.

Willie Murphy also identified the place of sulphur - and the need for it on many loam soils.

Dairy farmers have seen Moorepark buffeted by administrative incompetence. Yet, its vigour has survived and certainly it retains the philosophy of accurate work and commitment to low cost commercial diary farming, all created initially by Michael Walsh.

As I mentioned earlier, progress in the early days of Irish grass development was linked to knowledge transfer from farmers and from research elsewhere. All was welcome, but we also found that precise measurement under conditions in Ireland provided a more accurate and better defined path forward. Let us search far and wide for ideas, but let us refine their application through well directed Irish research.

We now look to the next 50 years. Survival of commercial Irish farming in a world of freer trade will depend on maintaining the competitive advantage of grass based agriculture. How much progress are we making? What development is there in the pipeline?

In the past half century our greatest achievements were directly related to maximising the level of N fertiliser use and to increased stocking rates sufficient to consume all grass grown. We are now at the limit of expansion in both areas.

Where else do we go?

It is estimated that the grass plant is, theoretically, capable of producing 25 tons dry matter per ha, in our climate. Yet, it is difficult to pass 14-15 tons in best farming practice. What are the limitations? Why has our grass output been near static at this level for decades?

Should we be satisfied with the service provided by grass breeders?

Is the new technology of gene manipulation fully applied to selection for yield and length of grazing season? Should we encourage more collaboration between Irish grass breeders, North and South? Certainly the progress in maize breeding is twice the rate in grass. That alone will have its impact on competitiveness.

I may also suggest that in screening new varieties the selection progress has bypassed the animal. Yield under cutting remains the sole criterion. There must be some place for animal assessment. Even the most basic question of tetraploid or diploid has never been adequately asked of the animal.

And then, we have coming the challenge to pastures and grass strains from high merit cows with large intake demands. How do we select and manage for the grass nutrient intake demanded by such stock?

Grasses for silage: information is limited on varieties for maximum dry matter and nutrient yield, as well as persistence under a two-cut silage system. Crossnacreevy in Northern Ireland shows that very significant differences exist. What follow-up has there been?

When a superior new cultivar is identified, how can it be brought into the farm production system with minimal disturbance of the growth pattern?

Sward management of both late and early growth is another neglected area. Progress was being made by Johnstown, some eight years ago. Then, in another one of these weird administration revolutions all was stopped and little has happened since. Early spring grass is vitally important in dairying. Its production is linked to autumn management. Precision and detail are not fully established; they should be!

In grassland nutrition, can we develop a rapid soil test for available N? How much added N for maximum growth at any particular period? Such a test would be particularly relevant in autumn, in a spring such as 1996 and in periods of drought.

I raise this range of questions because our research organisations show limited commitment to our most important crop. In no way do I detract from the excellent production work at Moorepark, but it is necessary to cast the net wider in the search for knowledge. The current research budget for Teagasc is close to £24 million. I doubt if a half per cent of this sum is devoted to the growing of a crop that covers over 90 per cent of our farmland. The growing of grass merits a higher level of priority.

Maximising Profit in Creamery Milk Production Using Current Research and Technology

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Introduction

In the early '60's there were over 100,000 milk producers supplying 1,272 million litres to 650 different creameries. Today, we have 43,000 milk suppliers supplying 4,718 million litres to 38 different creameries. Behind these figures lies a story of massive structural and technological changes on dairy farms. The modern intensive dairy farm produces high volumes of milk per cow and per acre. Grassland management has improved to the extent that efficient dairy farmers require less than an acre of land per cow for a year. Fertilizer usage has increased dramatically. The main Winter feed is now grass silage, the standard system of housing is the cow cubicle and dairy herds are milked in efficient milking parlours.

Ireland's accession to the EEC in 1973 accelerated an existing trend towards growth in milk output and greatly increased the value of milk and dairy products. Milk output almost doubled in the period of 1970 to 1985. In the years prior to the introduction of milk quota systems the annual growth in milk output was about 5%. This happened despite a 50% reduction in the number of milk suppliers and Brucellosis was eradicated from the national herd. The EEC milk quota allocated to Ireland was low compared to that of more developed countries, e.g. Netherlands (1.07 vs 8.90 tonnes of milk per forage acre).

The establishment of Moorepark Research Centre in 1959 made an invaluable contribution to the development of the Irish dairy industry area over this period. The first experiments demonstrated that, with some nitrogen for silage, it was possible to stock cows at 1.2 acres per cow. Over the next 30 to 35 years Moorepark developed a 'blueprint' for milk production from grassland on many soil types. In the early years Moorepark showed that the best route to increased farm income was through increased output, and the most direct method of increasing output was to keep more cows on the farm Therefore the features of the system were high stocking rates (2.7 to 3.0 cows per hectare), rotational grazing, using nitrogen to provide adequate grass for grazing and conservation, and compact Spring calving. The 'Moorepark Blueprint' defined the farm structures and management system needed for low-cost intensive dairying. Through the '70's and '80's a series of important 'component' experiments in the areas of grassland management, silage quality, concentrate feeding levels, infertility, replacement heifers, mastitis, lameness and milking machines were inserted into the 'Moorepark Blueprint' and milk yield increased.

The introduction of EEC milk quotas in the early '80's switched the challenge to producing the Irish milk quota as efficiently as possible. For the Irish dairy farmer this implied making maximum use of grazed grass in the system since it is our cheapest feed. The emphasis has shifted from increased output from the farm to optimizing the quota available. High margins from a farm can be achieved by maximizing the receipts as well as controlling costs. Such milk production systems will need to be sustainable economically and in terms of their impact on the environment and quality of life for the farm family.

Target inputs/outputs per cow

In dry land situations, the target output from the system today is 5,450 litres of milk (1,200 gallons) per cow with a fat and protein concentration of 3.90% fat and 3.40% protein (Figure 1). This is achieved at a stocking rate of 2.80 cows per ha, nitrogen input of 320 kg per ha, and a mean calving date in late-February/early-March. The input per cow includes 500 kg of concentrates, 3.3 tonnes of grazed grass and 1.2 tonnes of silage DM. Over half of the concentrates is fed in the Spring/early-Summer with the remaining amounts fed in the Autumn (October - December). The silage requirement of 6.5 to 7.0 (18-20% DM) tonnes of silage per cow is adequate in free-draining land in the South, an extra 1 to 2 tonnes if required in more difficult wetland situations.

The milk production profile is shown on Figure 1. Therefore, a total yield of 400 kg of fat and protein per cow (300-day lactation) is possible. The key

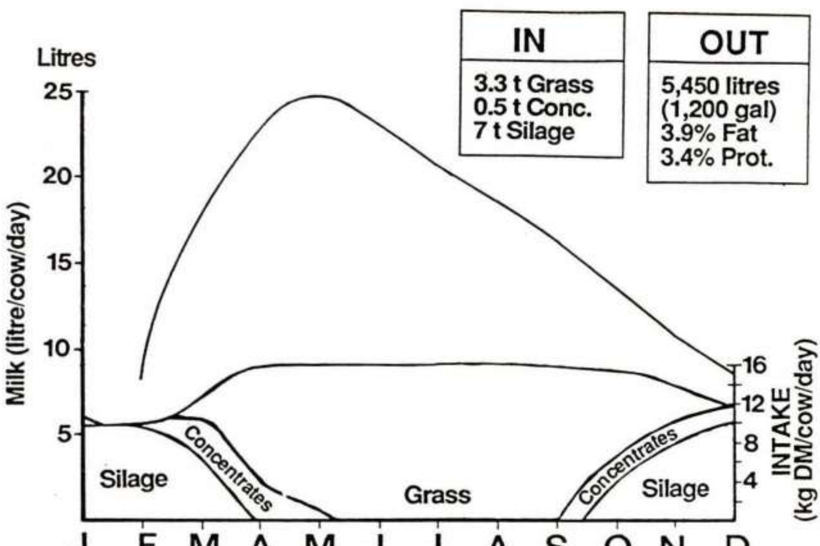

Figure 1 – The target inputs/outputs per cow for Spring milk production

elements in achieving this output are the matching of stocking rate and nitrogen use, targeting calving date coupled with compact calving, the provision of early Spring grass, silage conservation strategy and requirement, obtaining high intakes of high quality grass, introduction of Autumn supplementation when required, finishing grazing by mid-November and the use of high genetic merit animals to convert the feed efficiently into milk.

Stocking rate and nitrogen input

Increasing stocking rate may result in a small decline in herbage production but herbage utilization is substantially increased. Stocking rate was shown to be the most powerful 'tool' influencing efficiency on land area basis. In the future, with more precise control of grazing management, stocking rate per hectare may not be as important. Since the introduction of EEC milk quotas and much higher genetic merit cows, the requirement for high stocking rates are not as essential now. On most dairy farms, milk quota is generally more limiting than land area. Therefore stocking rate could be lowered with the objective of increasing the supply of grazed grass to the dairy herd. This would be important in the early Spring and Autumn period (Figure 2). Two stocking rates (2.91 vs 2.60 cows per ha) were evaluated over a three-year period (Table 1). Reducing the stocking rate by 0.31 cows per ha increased milk yield per cow by 160 litres on average over a three-year period with little effect on milk composition. The financial results showed that milk receipts increased by £45 per cow. Variable costs were reduced by £4 per cow. This resulted in an increase of £49 per cow in gross margin.

The response to increased nitrogen input is usually measured in terms of increased stock-carrying capacity. There is general agreement that, provided stocking rate is high enough (2.8 to 3.0 cows per ha) milk production responses will be obtained for the use of levels of up to 320 kg N/ha. Responses in herds with higher application levels of up to 375 kg N/ha will be dependent on high

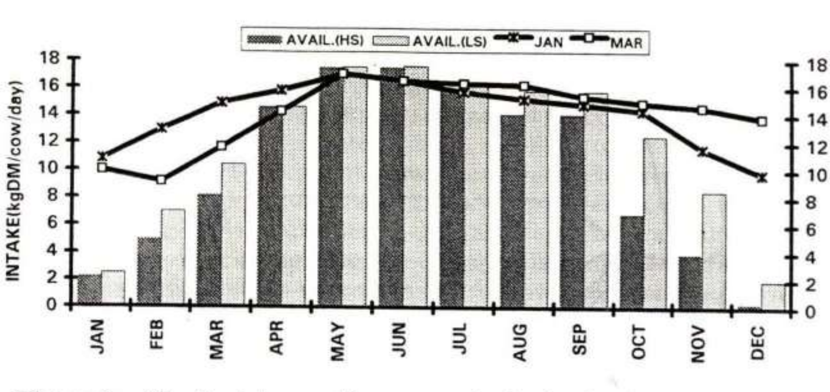

Figure 2 – The feed demand/grass supply for both mid-January and early-March Spring-calving dairy cows of both 2.90 (HS) and 2.50 (LS) cows per hectare.

stocking rates, long grazing season (early-March to late-November), ~~dry soil~~ type, and good grazing management.

Table 1
Comparison of stocking rates

			Stocking rate		Difference
			High (A)	Lower (B)	(B - A)
Calving date			15/3	15/3	–
Stocking rate	(cows/ha)		2.91	2.60	0.31
Nitrogen input	(kg/ha)		370	370	–
Nitrogen input	(kg/cow)	1990:	125	80	- 45
		1991:	305	80	- 225
		1992:	125	80	- 45
Silage	(t/cow)		7.0	8.5	+ 1.5
Milk yield/cow	(L)	1990:	5237	5628	+ 391
		1991:	5360	5292	- 68
		1992:	5237	5392	+ 155
Milk fat	(%)	1990:	3.70	3.84	+ 0.14
		1991:	3.71	3.84	+ 0.13
		1992:	3.88	3.92	+ 0.04
Milk protein	(%)	1990:	3.34	3.37	+ 0.03
		1991:	3.34	3.38	+ 0.04
		1992:	3.43	3.39	- 0.04

In the years ahead with the feasibility of milk quota being abolished, the very high stocking rates that were obtainable in the early '80's will not be feasible. The reason for this is the rapid increase in genetic merit and the quest for higher intakes of higher quality grass and grass silage in our systems. Since the late '80's, the concepts of grass quantity and achieving high DM intakes has superseded the advantages that are to be obtained from higher stocking rates. These high stocking rates will only be attainable if higher quantities of other feeds are brought into the system (farm treated as a feedlot).

Calving date and compact calving

Calving date and the compactness of calving has a large influence on the seasonality of milk supply, on cost of milk production and on farm profit. Altering the calving date changes the seasonal demand pattern for feed (Figure 2). The results of an experiment investigating the effect of 2 different calving dates at an overall stocking rate of 2.91 cows per ha is shown in Table 2. Delaying mean calving date from January 21 to March 15 reduced milk yield per cow by an average 418 L. The reduced milk yield per cow can be alleviated by either reduced stocking rate and/or increased concentrate input. In a later section (under 'Supplementation') of this paper, the periods of strategic supplementation to achieve the higher milk yields are identified. However, later calving increased milk fat and protein concentration. Concentrates fed per cow was also reduced by 435 kg per cow. Relative to March, January calving will add £44 per cow to costs. January calving will reduce margin by £23 per cow Therefore if no milk bonus payments are available, calving date should be concentrated just prior to the start of the grazing season. This will allow up to 80% of milk to be produced from grazed grass. A system of milk production that is driven by a close match of calving date to grass supply is very much dependent on compact calving. The target is 90% of the herd calving in a 9-week period. This is achieved using AI with good herd fertility management. Tail paint is used in conjunction with three observations at 7 am, before evening milking and at about 9 pm at night. This will result in an oestrous detection rate of approximately 90% of the cows in the herd. Calving should start 4 weeks prior to the expected turnout day to grass. If the expected turn-out day is in early March, then the breeding season should start in late-February.

Where turnout is much later (early to mid-April), the start of the breeding season should not be delayed beyond mid-May.

Table 2
Comparison of two different calving dates

			January calving (A)	March calving (B)	Difference (B-A)
Mean calving date			21/1	15/3	53
Concentrate input	(kg/cow)	1990:	625	125	- 500
		1991:	735	305	- 430
		1992:	500	125	- 375
Silage	(t/cow)		7.0	7.0	0
Milk yield/cow	(L)	1990:	5692	5237	- 455
		1991:	5773	5360	- 413
		1992:	5623	5237	- 386
Milk fat	(%)	1990:	3.52	3.70	+ 0.18
		1991:	3.56	3.71	+ 0.15
		1992:	3.72	3.88	+ 0.16
Milk protein	(%)	1990:	3.20	3.34	+ 0.14
		1991:	3.14	3.34	+ 0.20
		1992:	3.23	3.43	+ 0.20

In order to achieve a compact calving, a precise breeding programme requires to be set out before it starts. An example of this is shown as follows:

(1) Start pre-service heat detection — March 25
(2) Scan and treatment non-cycling cows — April 17
(3) Start AI — April 24

(4) Scan and treatment of non-served cows — May 22
(5) All cows served and not showing heat scanned at — 30-40 days
(6) AI finish — July 24.

This enables a dairy farmer to have a controlled approach to the breeding season.

Grazing management and silage conservation

Grazing grass *in situ* at a reasonable level of utilization will remain the simplest and most efficient method of converting grass to milk. It is also generally accepted in Ireland that rotational grazing is the most practical and reliable method of utilizing grass. However, it is only at high stocking rates that production increases are actually achieved when compared to set-stocking.

Efficient grazing management is facilitated by farm layout, which entails good farm roadways and paddocks with an adequate water supply. The challenge under Irish conditions is to maximise the amount grown (12-14 t DM/ha) through grazing. The annual feed budget determines the annual stocking rate linked with the appropriate nitrogen requirement, as previously outlined. The intermediate feed budget will determine the date of start of grazing, when to close-up for silage and what proportion of the farm should be closed for silage, etc.

Recommendations from Moorepark are that all of the farm should be grazed initially, with the initial grazing starting in early-March if grass supply and weather conditions permit. This may not be possible in all years on difficult wet land. Early grazing is facilitated by early nitrogen application and the correct timing of final Autumn defoliation. However, due to the low growth rate in early Spring, grass supply will not be adequate to meet the dairy cow's demand when first turned out to grass. With compact Spring calving and stocking rates of 2.6 - 3.0 cows per hectare, daily grass growth will not be adequate to meet cow demand until mid- to late-April. Therefore, up to that date and depending on turnout date, grazed grass will only constitute part of the cow's diet. It is important that the first rotation should not finish before mid- to late-April.

The first week of April is proposed as the key period for closing for first cut silage. At a stocking rate of 2.74 cows per hectare, 45 to 50% of the total area can be closed at this time, resulting in a stocking rate of about 5.5 cows per ha on the grazing area. However, depending on grass-growing conditions in any one year, this can be increased or decreased. A silage yield of 7 tonnes of grass DM per ha is achievable under good management. This will produce 28 tonnes per ha of settled silage with 20% DM cut in late-May allowing for 20% losses due to ensiling. In the grazing area, tight grazing to 6 cm during this period (late-April to end of June) is critical. Grazing management in this period is critical for the remainder of the season. The benefit of lenient grazing (8-10 cm) during this period is small (68 litres milk per cow). However, the loss in milk yield for the remainder of the season due to deterioration in sward quality is much larger (410 litres milk per cow). Another option is to top pastures to the required post-grazing sward height (6 cm) during May and June. This has been shown to be feasible and this may be an important strategy in difficult grazing conditions. Stocking rate on the grazing area is reduced to 4.50 cows per ha in mid to late-June as a result of releasing of about 10% of total farm area for grazing after first cut silage.

The second silage crop is cut 7 to 8 weeks after the first (10 - 20th July). A silage yield of 4.5 - 5.0 tonnes of grass DM per ha is achievable under good management to produce 18 tonnes per ha of settled silage with 20% DM. This will provide a total of almost 7 tonnes of settled silage (20% DM) per cow at an overall stocking rate of 2.80 cows per ha from the two silage cuts. From mid- to late-August onwards, the total farm is available for grazing. During the period (July to September), grazing pressure may be relaxed to allow a post-grazing sward surface height of 7-8 cm in order to increase milk yield per cow without resulting in deterioration in sward quality afterwards.

The grass available in early Spring is a combination of the grass carried over from the previous Autumn plus that which grew over the Winter. Results from Moorepark show that delaying closing pastures from late-October until early December reduced Spring yield of grass by 500 kg DM/ha for a removal of 300 kg in the previous Autumn. Therefore, the loss in yield of grass dry matter at turnout is not balanced by the grass harvested in the late-Autumn / early-Winter grazing. It is difficult to be precise about the optimum closing date, as it will vary from year to year, depending on grass-growing conditions. As a general guide, in an intensive Spring-calving situation, the last rotation should start in late-October, with a cessation of all grazing by mid-November.

Supplementation

Obtaining target milk production in Spring and Autumn/early-Winter period depends on getting the correct blend of grass silage, grazed grass and concentrate in the diet (Figure 1). There may be periods during the main grazing season where supplementation may be required, e.g. reduced grass supply in mid-Summer due to low rainfall levels. The level of concentrate feeding required when cows are indoors fulltime, both before and after calving, depends on the quantity of silage available. It is desirable to have cows in body condition score of 3.0 to 3.5 at calving down and it is estimated that cows in moderate body condition (2.25 to 2.50) at drying-off should be gaining liveweight of 0.25 to 0.75 kg per day. Silage-only with a dry matter digestibility of 70 DMD will be adequate to support these requirements. After calving, the desired level of concentrate feeding is dependent on milk price to concentrate cost ratio, the quantity of the silage, milk quota and milk yield potential of the cows. In a no-quota restriction, and good quality silage (70% DMD), with average genetic merit cows and present milk and concentrate prices, it will be economical to feed 7 to 8 kg per day.

The beneficial effect of including grazed grass in the diet of the dairy cow in early lactation is well recognized. The results of two studies at Moorepark (1993 and 1994) where grass silage was supplemented with concentrates and early Spring grass is shown in Table 3.

The first group were indoors full-time and on ad-lib grass silage (67 D) plus 6 kg of concentrates. The other three groups were turned out to grass, starting on 27th February in 1993, and 11th March in 1994. In 1993, the cows were

Table 3

The effect of forage type and level of concentrate feeding on the performance of dairy cows in early lactation

		Indoors Silage +6 Kg Conc.	Grazing+Silage +6 Kg Conc.	Grazing+ Silage +4 Kg Conc.	Grazing+ Silage +2 Kg Conc.
Milk yield (litres/day)	1993	21.3	24.2	22.7	21.2
	1994	22.8	26.3	26.7	24.7
Fat (%)	1993	3.63	3.60	3.75	3.69
	1994	3.61	3.82	3.80	3.75
Protein (%)	1993	3.06	3.17	3.15	3.12
	1994	2.95	3.20	3.20	3.14
Liveweight change	1993	+0.04	+0.66	+0.13	+0.29
ADG (kg)	1994	+0.14	+0.67	+0.45	+0.35

allowed to graze by day (9 am to 3 pm) and were given an allowance of 9.5 kg DM/cow/day (> 4 cm). In 1994, the grass allowance was 14 kg DM/cow/day and they were allowed to graze by night (4 pm to 7 am). These three groups of cows were allowed the same grass silage ad-libitum while indoors;

There was a large response in milk yield when animals were allowed to graze Spring grass. The overall milk yield in 1993 was lower because of a high proportion of 1st lactation cows. Cows fed 6 kg of concentrates supplemented with grazed grass and grass silage produced 2.8 and 3.5 litres of milk per cow per day more milk than their comparable group indoors full-time on 6 kg of concentrates and grass silage ad-lib. The milk had also a higher protein content. Cows fed 2 kg of concentrates, grazed grass and grass silage produced similar milk yield in 1993 and higher milk yields in 1994 than the group indoors full-time. There was also the beneficial effect of grazed grass in terrms of higher liveweight gain. The improved performance when dairy cows were supplemented with grazed grass was associated with increased total dry matter intakes.

After full-time turnout to pasture in the April-May period, grass growth and grazing conditions can be erratic, depending on climatic conditions. Grass intakes of 15-17 kg DM per cow per day have been measured in Moorepark with Spring-calving dairy cows over this period under good grazing conditions (1990 and 1992) on grass-only. This period also coincides with the start of the breeding season when breeding starts in late-April - early-May. To obtain good fertility performance, cows need to be in a positive energy balance at this stage. Therefore, in periods of poor growth rates/difficult grazing conditions, supplementation will be required. A supplementation study was carried out in Moorepark over this period in 1993, and 1994, which was a period of poor grass growth and difficult grazing conditions (Table 4).

The cows were stocked at 5.25 cows per hectare. The average response was 0.78 and 0.44 litres of milk, and 0.44 and 0.63 litres of milk per kg of concentrate

Table 4
The effect of concentrate feeding on the performance of dairy cows in early lactation

		Treatment		
		Grass only	Grass +2 Kg Conc.	Grass +4 Kg Conc.
Milk yield (litres/day)	1993	23.6	24.8	25.2
	1994	23.3	24.2	25.8
Fat (%)	1993	3.66	3.59	3.60
	1994	3.71	3.68	3.55
Protein (%)	1993	3.35	3.36	3.37
	1994	3.25	3.28	3.26
Liveweight change	1993	-0.52	-0.36	-0.26
ADG (kg)	1994	0.02	0.44	0.11

fed at the 2 and 4 kg feeding levels in 1993 and 1994, respectively. Milk fat and protein content were not significantly affected, but milk protein yield increased with level of concentrate feeding. The average fertility data for the three treatments is shown on Table 5.

Table 5
Fertility performance

		Grass only	Grass + 2 Kg Conc.	Grass + 4 Kg Conc.
Calving-to-service interval	(days)	60	61	59
Calving-to-conception interval	(days)	91	77	76
Submission rate 1st 3 weeks		91	82	91
Pregnancy rate 1st service	(%)	36	36	64
Pregnancy rate 2nd service	(%)	50	85	75
Services per conception		2.72	1.95	1.60
Infertile rate	(%)	18	9	9

The results indicate that in situations of poor grass supply and poor grazing conditions in early Spring that supplementation is required. The benefits to supplementation were to be obtained in increased milk yield, reduced bodyweight loss and improved fertility performance. Supplementation should be introduced swiftly and be large enough in quantity to maintain milk yields and then taken out when grass supply returns to normal.

The Autumn period on dairy farms coincides with large changes in the type and quantity of forage available for dairy cows. The milk supply pattern at this time of year can vary widely depending on calving pattern of the herd and feeding level. Table 6 gives the expected milk yield per cow for early Spring-calving cows, late Spring-calving cows and a supply pattern for herds with 40% Autumn-calving (Sept./Oct.) and 60% Spring-calving cows.

Table 6
Expected milk supply pattern per cow for early Spring, late Spring and Autumn / Spring-calving cows (litres/cow/month)

Month of Year	Early Spring-Calving	Late Spring-Calving	Autumn/Spring Calving
September	360	418	295
October	259	360	373
November	150	272	409
December	91	227	386

Yield level of 5,000 litres per cow with a good system of management

The potential milk production for early to mid-March calving herds at this time of the year should be noted. Table 7 shows the effect of two different feed allowances as measured by stocking rate on milk yield from September to the end of the year. The considerable improvement in milk yield was due to the availability of extra grass and the availability of extra silage which was fed when grass supply was less than the requirements of the herd. No concentrate was fed in these situations.

Table 7
Milk production profile for 2 herds with a mean calving date in mid-March but with two different stocking rates (litres/cow/day)

	Stocking Rate		
Month of Year	2.90 cows/ha	2.60 cows/ha	Difference
September	17.4	17.4	0.00
October	11.3	14.1	2.82
November	8.6	12.2	3.59
December	7.0	9.7	2.68

The supply of grass from September onwards will depend on current grass growth rates, stocking rates, previous grazing management, calving pattern and nitrogen application. The rapid reduction in growth rates from the end of September onwards results in feed supply being less than feed required to sustain target milk yields. The results of a recent trial carried out in Moorepark where Autumn grass was supplemented with concentrates and silage is shown in Table 8.

Table 8

Supplementation of Autumn grass with silage and concentrates (Spring-calving cows)

	Grass only	Grass +2 Kg Silage DM	Grass +4 Kg Silage DM	Grass +2 Kg Conc.	Grass +4 Kg Conc.
Milk yield (litres/cow/day)	10.9	11.4	10.5	12.7	13.6
Response (litres/cow/day)	0.0	+0.5	-0.36	+1.86	+2.72
Fat (%)	4.29	4.12	4.02	4.07	3.91
Protein (%)	3.76	3.68	3.67	3.74	3.81

Experimental period: 10 weeks (14th September - 23rd November, '92)

Grass supply was considered not to be a significant limiting factor in this experiment as the cows were not allowed to graze below 6-7 cm. The concentrate fed was 25% maize distillers and 75% beet pulp. First-cut silage was fed (72% DMD) and it was well preserved. Supplementation with silage gave little or no response in milk yield. It also had a very negative effect on milk composition. Supplementation with concentrate had a very positive effect on milk yield. The response was 1.86 litres of milk for 2 kg concentrate and 2.72 litres of milk for 4 kg of concentrate. Concentrate feeding had a negative effect on the fat content of the milk but it had a slight positive effect on the milk protein and fat yield.

Autumn supplementation would have to be economically beneficial within the overall milk quota. Systems where additional concentrates are fed and which result in increased milk yield per cow will have the effect of reducing the number of cows in the herd. In a low-cost system of production (which has high margins), then the cost of displacing a cow will be higher.

However, in many farm situations grass supply will not be adequate. In a previous experiment carried out in Moorepark, a milk yield response of 3.2 litres per cow per day was recorded over a six-week period for a silage input of 8.5 kg silage DM per cow per day. It has however a detrimental effect on milk composition. It should be noted that grazing conditions were not as good in this case and grass supply would also have been limiting. Obtaining target milk production over the Autumn / early-Winter period will depend on getting the correct blend of grass, silage and concentrate into the diet of the milking cow.

Genetic merit

Genetic progress represents a small but significant and permanent change over and above progress due to management. The rate of genetic progress in milk fat and protein yield has almost trebled (0.4% per year to 1.1%) for sires born over the ten-year period (1980 to 1990). This trend looks set to continue on and even increase in the future. These developments present new challenges to the Irish system of milk production which is mainly based on the efficient conversion of home-produced forage (grazed grass and silage) to milk.

A new research programme was initiated in Teagasc, Moorepark, in 1994, to investigate how very high genetic merit daily cows perform under an Irish system of milk production. Two contrasting genetic groups of in-calf heifers were assembled (Table 9).

Table 9
Comparison of Genetic Index

	RBI 95	Milk (Kg)	Fat (Kg)	Protein (kg)	Fat (%)	Protein (%)
Selected (S)	135	659	24	21	-0.02	0.00
Control (C)	119	151	12	8	0.11	0.05

The pedigree index of the selected group of animals (S) was on average 16 units in RBI (RBI 95), 13 kg fat and 14 kg protein higher than the control group. The selected group of heifers (S) had a lower PD (Predicted Difference) for fat % and a slightly lower PD for protein %. The sires of the animals in the control group were mainly Arend (ARN), F16 rocket, Etazon Bowi (EZB), Shinagh Rohorst belder (RSG), Nicholas Storm (NSM), and a selection of young bulls on test. The sires of the selected (imported heifers) were mainly Skalsumer Sunny Boy (SSB), Sunnylodge Sammy and Penn-Springs (MR.C.). It should be noted that the control group of heifers have a higher RBI than the national average heifer in Ireland. It is estimated that the average RBI (RBI 95) of first lactation animals in 1995 nationally (IDRC) is 104.

Three different feeding systems were evaluated with each of the genotypes. System A (Standard Moorepark System) had a stocking rate of 3 cows/ha on an input of 350 kg N/ha and a planned supplementation level of 500 kg of concentrates. In System B (High concentrate system), the stocking rate and nitrogen input were the same as in System A but the level of concentrate feeding was planned at 1000 kg/cow. In System C, the nitrogen and concentrate supplementation levels were again the same as in System A but the aim was to allocate unrestricted levels of high quality grass and grass-silage to the cows. The grass production year in 1995 was very erratic with a very poor grass growth in August / September due to a large moisture deficit. Concentrate supplementation was higher than planned as a result. The actual concentrate feeding levels were 863, 1449 and 851 kg concentrates/cow for the Moorepark, High concentrate and High grass feeding systems

Tables 10 and 11 show the production data (1st lactation) for both genotypes for the Moorepark and High concentrate feeding systems. The higher index heifers produced 19% higher milk yield or 13% more fat and protein yield in the Moorepark feeding system. This difference in milk production is very similar to that which can be predicted from their genetic index. There was no interaction between genotype of the cow and the feeding systems. Throughout the grazing season it was evident that the high merit heifers had higher intakes of grass for similar levels of utilization as compared to the medium merit cows. It is estimated that this increase in grass intake ranged from 3 to 5% over the total grazing season. There was no difference in fertility between the two groups of heifers. Overall, the preliminary results for the final year of a three-year study indicates that high merit animals can perform well in an Irish production system.

Table 10
Moorepark feeding system

		Medium merit cows (C)	High merit cows (S)	Difference (S-C)
Milk:	(Litres/cow)	5,144	6,157	1,013
Fat	%	4.02	3.68	-0.34
Protein	%	3.50	3.42	-0.08
Fat	(Kg)	212	232	+20
Protein	(Kg)	185	217	+32

Table 11
High concentrate feeding system

		Medium merit cows (C)	High merit cows (S)	Difference (S-C)
Milk:	(Litres/cow)	5,638	6,434	796
Fat	%	4.05	3.79	-0.26
Protein	%	3.54	3.44	-0.10
Fat	(Kg)	234	251	+17
Protein	(Kg)	205	228	+23

Given that genetic merit will play an important part in achieving high performance, the system of replacement rearing will be equally important. From an economic and efficiency point of view, it is essential that they calve at 2 years of age, provided that they are well grown and reach the target weight at calving. The critical target weights are 310 - 340 kg at mating and 530 - 560 kg at calving-down at two years of age. The spread in target weights is influenced by the breed of the animal.

Outputs and returns from this system

The milk production system described above works well on dry land in the South of Ireland. Adjustments will need to be made to the system to reflect the differences in soil type, location, calving pattern, etc. The principles described have general application. Table 12 outlines the receipts, costs and margins per cow and per litre obtainable with the system outlined. Milk price is based on

22p per litre. This system gave a gross margin of £1,056 per cow (20.2 p per litre of quota). The variable costs are £305 per cow (5.7p per litre). The net margin is £737 per cow at 14. 1p per litre of milk.

Table 12
Outputs and returns for Spring milk production

		£/cow	£/litre
Receipts:	Milk	1143	21.8
	Livestock	218	4.2
Total receipts		1361	26.0
Variable costs		305	5.7
Fixed costs		229*	4.4
Depreciation costs		94	1.8
Gross margin		1056	20.2
Net margin		733	14.1

*Includes some labour costs (@ £75/cow

Summary

The targets in terms of inputs, outputs and financial performances obtainable using current research and technology have been outlined in this paper. The top modern intensive Irish dairy farmers (based on Dairy MIS data) are achieving these targets. However, as can be seen from another paper in this Journal, "Production performance on dairy farms in relation to milk quotas", a large number of commercial dairy farmers are not achieving these targets. The reasons range from the lack of application of modern research and technology to quota management on farms. These issues are outlined in detail in the paper referred to above. Looking to the future, the biggest challenges are to develop milk production systems which will sustain present profit margins alongside expected lower milk prices. The use of high genetic merit cows coupled with efficient use of grazed grass and grass silage will be essential in achieving this. The milk produced from this system will have to have the correct milk composition and the possibility of being manufactured into a wide range of milk products. Lastly, the system will have to be sustainable in terms of its impact on the environment and the quality of life for the farm family.

Winter Milk Production – Opportunities for Improving Production with Grass and Grass Silage

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Introduction

Production of milk during the winter months September - March incurs higher feed and capital costs than that produced over the summer period. This reflects the increased reliance on grass silage rather than grazed grass and the capital costs associated with housing of cows during the winter months. The aim of this paper is to examine opportunities for improving the milk production potential of grass and grass silage during the winter period, thereby reducing the costs associated with winter milk production systems. The key factors which influence the efficiency of winter milk production include: cow genetic merit; proportion of grazed grass in the diet; silage quality and intake characteristics; and level of concentrate feeding.

Cow genetic merit

There has been a marked increase in the rate of genetic gain within the dairy herd in the United Kingdom (U.K.) and Ireland in recent years with Coffey (1992) reporting current rates of genetic gain of 1.3% per year in milk fat plus protein yield. The main effect of increasing genetic merit is that a greater proportion of food energy is partitioned to milk production, with less energy partitioned to body condition. For example research at Langhill in Scotland (Veerkamp et al., 1994) indicates that high merit cows (RBI_{95} 109 approx.) on a 'high forage' system produced 12.2% more milk and yet only consumed 4.3% extra dry matter compared to low merit cows (RBI_{95} 96 approx.). The overriding importance of cow genetic merit on efficiency of production was highlighted by the fact that high RBI cows (RBI_{95} 109) given 1 t concentrates per lactation produced similar milk solids yields to low RBI cows (RBI_{95} 96) given 2.5 t concentrates per lactation.

However, it is important to highlight the relatively modest genetic merit of the high merit cows in the Langhill trials and also the fact that the 'high forage' system involved feeding over 1 t of a high protein concentrate. In more recent work at Hillsborough, the effect of a wider range of concentrate levels on very high and moderate genetic merit autumn calving cows has been examined. The results given in Table 1 relate to performance over a 12 week period in early lactation. High RBI (RBI_{95} 138 approx.) cows produced 3.8 kg/day more milk than medium RBI (RBI_{95} 101 approx.) cows, irrespective of concentrate feed level. Milk fat content was higher with the high RBI cows, which also tended to have a higher milk protein content, even at the lower concentrate feed level. In line with the Langhill data, these results highlight the marked superiority of high genetic merit cows, irrespective of concentrate feed level, with high RBI cows producing an additional 0.6-1.0 pence/litre (2.7-4.5 p/gallon) margin over feed costs relative to medium RBI cows, at the same concentrate feed level.

Table 1
The effect of level of concentrates and cow genetic merit on milk yield
(Ferris *et al.*, 1996)

	Medium RBI (RBI_{95} 101)		High RBI (RBI_{95} 138)	
Concentrates (kg/day)	7.3	14.0	7.8	14.5
Silage intake (kg DM/day)	11.4	8.8	12.5	9.3
Milk yield (kg/day)	31.5	34.1	35.3	37.9
Milk composition (%)				
Fat	4.11	3.84	4.20	4.02
Protein	3.10	3.34	3.23	3.38
Margin over feed costs (p/litre)	21.5	19.3	22.1	20.3
Liveweight at turnout (kg)	603	618	626	627

High RBI cows on the low concentrate feed level consumed almost 10% more silage than the medium RBI cows. Consequently, high quality silage with high intake characteristics is critical to maintain performance with high RBI cows at low concentrate feed levels.

Grazed grass in winter milk systems

Whilst autumn calving or winter milk systems are generally perceived as 'high silage' systems, grazed grass has a major role in reducing costs in these systems. The ability to maximise use of grazed grass, particularly in autumn, is very dependent upon the calving pattern within the herd. Management of grass in autumn is considerably easier with a 100% autumn calving herd, than with a combined spring/autumn calving herd. This reflects the fact that in a pure autumn calving herd situation, dry cows can be tightly stocked during August and September allowing a build up of grass for late autumn grazing. It is much more difficult to build up a reserve of grass in the autumn where the herd contains a high proportion of spring calving cows.

Recent research at Hillsborough has shown that in order to build up sufficient grass for grazing in mid November, paddocks should be rested from early September. This means that the rotation length should be increased from early August onwards up to a maximum of 7-8 weeks by early November. The increase in rotation length from early August onwards ties in with the drying off period in an autumn calving herd. Good responses in autumn grass growth have also been obtained with nitrogen fertilizer applied up to 20 September. For example application of 60 kg N/ha on 20 September has produced grass yield responses of 7-9 kg DM/kg N when measured on 1 November, representing a cost of £40.50/t grass DM.

The effects of a three hour grazing period on performance of September/October calving cows grazing in November are shown in Table 2. Grazing for three hours per day resulted in a 38% reduction in silage intake, whilst increasing milk yield by 2.1 litres/day and increasing milk protein. The net effect was an improvement in margin over feed costs of 1.7 pence per litre (7.7 pence/gallon).

Table 2

Effects of late autumn and early spring grazing on performance of autumn calving cows

	Autumn grazing 29 Oct - 26 Nov		Spring grazing 26 Feb -16 April	
	Housed	3 h grass	Housed	$2^1/_2$ h grass
Food intake (kg DM/day)				
Silage	11.0	6.8	9.8	7.5
Grass	0	4.5	0	2.8
Concentrates	5.2	5.2	3.5	3.5
Milk yield (kg/day)	23.1	25.2	15.6	17.7
Fat (%)	4.12	4.00	4.18	4.52
Protein (%)	3.14	3.27	2.84	2.91
Margin over feed costs (pence/litre)	20.1	21.8	18.2	20.8

A major factor in determining the extent of reliance on autumn grazing is the possible adverse effect on spring growth. Data from Moorepark (Roche *et al.*, 1994) indicate that whilst grazing up to 1 December utilized 350 kg grass DM/ha compared with swards closed on 20 October, the swards closed in December had 450 kg DM/ha less herbage available in early March and 575 kg DM/ha less herbage available in late March. However, in other studies at Hillsborough swards cut to 4 cm, to simulate grazing, in October, November and December had similar yields of herbage by mid March. These data suggest that autumn grazing should cease by late November in order to ensure early turnout of cows to grass in spring.

Early spring growth is also influenced by grass variety and timing of nitrogen in spring. For example, under Northern Ireland conditions the early perennial ryegrass variety Moy produces 2.15 t DM/ha between 1 March and 14 April whereas the late variety Carrick only produces 0.7 t DM/ha during the same period (Johnston, 1993). Consideration should be given to introducing early ryegrass varieties, such as Moy, on at least part of the grazing area.

As with autumn grazing, early turnout to grass in spring results in a reduction in silage requirements and increases in milk yield, as shown in Table 2. The net effect of early turnout on 26 February was an increase in margin over feed costs of 2.6 p/litre (11.8 p/gallon) compared to turnout on 16 April.

With tight block calving, grazing management of autumn calving cows is much easier than with a spring calving herd. September-October calving cows are well past peak yield by the time of peak grass growth in April/May and this enables use of higher grazing stocking rates to control spring growth. Furthermore grass alone is more than adequate to support milk yields up to 27 litres/day during the spring and early summer period. The key factor in grazing management is to use high stocking rates (up to 7.4 cows/ha, 3 cows/acre) during the April-June period to control grass growth and maintain sward quality for late season.

Silage for autumn calving cows

High quality, high intake grass silage is critical for profitable winter milk production, given that grass silage comprises the main forage for between 4-6 months of the year. The key factors involved in producing high digestibility, high intake silage are grass quality at ensiling and ensiling technique. Grass maturity at cutting is the major factor influencing digestibility of the resulting silage. With intermediate ryegrass varieties, each week delay in cutting after mid May results in a reduction in digestibility of 1.8 units. Assuming no change in concentrate use, this decline in digestibility will normally result in a reduction in milk yield of approximately 0.6 litres/cow/day. For autumn calving cows the aim should be to ensile first cut grass by mid May, with a second cut taken six to seven weeks later. Longer regrowth intervals result in a reduction in digestibility. Furthermore, it is worth noting that reductions in digestibility in mid May occur irrespective of whether the sward is grazed in early spring. Consequently delaying cutting date to increase grass yield following grazing in early spring will result in lower digestibility material. A careful balance needs to be struck between the benefits of spring grazing of silage swards and possible adverse effects on silage digestibility if cutting date is delayed too long in May.

It has long been recognised that grass silage has lower intake characteristics than grazed grass. Results of a major research programme at Hillsborough (Steen *et al.*, 1995) indicate that intake of grass silage is primarily influenced by protein and fibre fractions in the silage and the relative rates and extent of digestion of these components within the rumen. Factors such as pH, buffering capacity, total acidity and lactic acid concentration have relatively little effect on intake. Consequently, one of the major factors contributing to the reduced intake and performance with grass silage relative to grazed grass is the lower digestibility of grass at ensiling compared to that of grazed material. The results presented in Table 3 compare performance of cows offered fresh grass or grass silage produced from either high or medium digestibility grass. Ensiling resulted in a 13% reduction in DM intake, whereas a combination of ensiling and later cutting resulted in a reduction in intake of 29%. Thus the lower intake of grass silage relative to grazed grass can largely be attributed to lower grass digestibility rather than to the effects of ensilage *per se.*

Table 3

Effect of stage of grass growth and ensilage on intake and milk production

(Cushnahan *et al.*, 1995)

	High digestibility		Medium digestibility	
	Grass	Silage	Grass	Silage
Dry matter intake (kg/day)	16.8	14.6	13.8	11.9
Milk yield (kg/day)	19.8	18.9	17.4	15.5
Milk composition (%)				
Fat	4.01	3.58	3.68	3.89
Protein	3.38	2.99	3.06	2.98

The problem in practice is that high digestibility silage results in reduced crop yield, thereby increasing the cost of producing silage. The challenge for research is to examine opportunities to prevent decreases in digestibility with increasing grass yield or alternatively to upgrade low/medium digestibility grass during ensilage.

Effects of wilting and/or additives. Steen *et al.* (1995) have shown that the key factors influencing silage intake are the protein and fibre fractions in the silage and the relative rates and extent of digestion of these components within the animal. Furthermore, they have developed a highly accurate silage intake prediction system, based on analysis of either fresh or dried silage samples. The next stage is to develop this test back to analysis of grass at cutting, to enable prediction of the feeding value of silage from analysis of the standing grass crop.

Other recent research indicates that changes in the protein fraction of grass in the early stages of ensilage, due to plant enzyme systems, have a major effect on silage intake. Work in Canada (Charmley, 1995) has shown that the activity of plant enzyme systems can be reduced either by rapid reduction in pH of the ensiled crop or by pre-wilting. In general, the more rapid the decrease in pH or increase in DM content, the greater the reduction in proteolytic activity. These observations have led to renewed interest in the use of inoculant additives and/or rapid wilting systems.

In eleven experiments at Hillsborough a range of differing inoculants have been evaluated with direct cut grass, as shown in Table 4. Inoculant treatment has consistently increased the rate of decline in pH post ensiling, although little effect on the final silage fermentation is observed. On average across the 11 experiments inoculant treatment increased silage intake and milk yield by 9.6% and 6.5% respectively.

In more recent studies the effect of rapid wilting systems on silage intake and performance has been investigated. The results presented in Table 5 indicate the effects of rapid wilting (average wilting period 39 hours) over 8 separate harvests in 1994. Wilting was carried out in good conditions with no rain at any harvest, with grass being tedded following cutting and again prior to being

Table 4
Effect of inoculant treatment on silage fermentation and daily cow performance (11 experiments)

(Mayne and Steen, 1993)

	Treatment	
	Control	Inoculant
Silage fermentation		
pH	4.0	4.0
Ammonia (% TN)	10.0	9.4
Animal performance		
Silage intake (kg DM/day)	9.4	10.3
Milk yield (kg/day)	19.9	21.2

picked up by the harvester. Wilting increased silage intake by 20% but resulted in very small increases in milk or milk solids yield. Given the increased cost of wilting systems, and the greater field losses during harvesting, the conclusion is that simple direct cut systems are much superior to more sophisticated and expensive harvesting systems. However direct cut systems must be associated with good effluent control systems. Nonetheless, investment in effluent control systems is likely to produce a better return under our climatic conditions than investment in tedders and other machinery to enable field wilting.

Table 5
Effect of rapid wilting on silage composition and animal performance

(Yan *et al.*, 1996)

	Unwilted	Wilted	
Silage composition			
Drymatter (%)	17.6	31.6	
pH	4.14	3.92	
Ammonia N (% TN)	13.0	7.4	
Animal performance			
Silage intake (kg DM/day)	10.6	12.7	+20%
Milk yield (kg/day)	21.8	22.4	+2.8%
Milk fat (%)	4.52	4.64	
Milk protein (%)	3.23	3.32	
Fat + protein yield (kg/day)	1.68	1.77	+5.0%

Alternative forages. Given the lower intake and performance from grass silage relative to grazed grass there is a growing interest in the use of alternative forages such as forage maize and whole crop wheat. Results presented in Table 6 indicate the effect of replacing up to 33% of the grass silage in the diet with

Table 6

Effect of partial replacement of grass silage with forage maize on forage intake and cow performance

	Fitzgerald *et al.*+ (1994)		Phipps *et al.*++ (1996)	
	Grass silage	Grass/maize	Grass silage	Grass/maize
Food intake (kg DM/day)				
Grass silage	9.3	6.4	10.3	8.5
Maize silage	0	3.1	0	4.1
Cow performance				
Milk yield (litres/day)	23.8	22.5	20.9	24.0
Milk protein (%)	2.93	3.07	3.03	3.14
Milk fat (%)	3.35	3.53	4.15	4.05

+ Fitzgerald *et al.* (1994) All cows received 6.0 kg/d of 25% CP supplement. Grass silage well fermented and moderate digestibility. Maize silage 28% DM and 15% starch.

++ Phipps *et al.* (1996) Cows received 7 kg/d of concentrates with higher CP content with maize silage. Grass silage well ferrnented and moderate digestibility. Maize silage 28% DM.

medium or high quality forage maize. Results from Moorepark indicate little benefit from including forage maize when similar concentrates are offered with both grass silage and a grass/maize silage mixture. However, results from England (Phipps *et al.*, 1996) suggest an improvement in milk yield and milk protein content with partial replacement of grass silage by maize. However, higher protein concentrates were offered with the grass/maize silage mixtures and part of the response to maize silage is likely to have arisen as a protein effect rather than a maize effect.

The results presented in Table 7 indicate the effect of partial replacement

Table 7

The effect of partial replacement of grass silage with whole crop wheat on forage intake and cow performance

(After Leaver and Hill ,1996)

	Grass silage	Whole crop wheat		
		Fermented	20 g urea/kg DM	40 g urea/kg DM
Food intake (kg DM/day)				
Grass silage	11.7	8.1	8.4	8.4
Whole crop wheat	0	4.0	4.1	4.1
Cow performance				
Milk yield (kg/day)	30.0	29.1	29.4	29.9
Milk fat (%)	4.19	4.10	4.07	4.14
Milk protein (%)	3.25	3.19	3.22	3.25

Grass silage 24% DM, good fermentation and moderate digestibility.
All cows received 7.0 kg concentrates/day.

of grass silage with either fermented or urea treated whole crop wheat. Whilst inclusion of either form of whole crop wheat has consistently increased forage intake, there was no beneficial effect on milk yield or milk composition relative to high quality grass silage with cows receiving 7.0 kg concentrates/day.

These results expose some of the myths associated with alternative forages. Detailed analysis of data from trials in which grass silage has been partially replaced by forage maize and whole crop cereal trials in the U.K. and Ireland indicates either no benefit or only marginal increases in performance relative to grass silage only diets when similar concentrates are fed with both diets. Indeed, these alternative forages have diverted emphasis from the primary objective with autumn-calving herds in good grass growing areas - the production of high digestibility, high intake grass silage.

Concentrate feed levels for autumn calving cows

Within a milk quota context, one of the key indicators of dairy herd profitability is the margin over feed costs per litre or gallon of milk produced. However, this figure should not be considered in isolation but alongside other indicators of efficiency such as margin/cow, margin/ha, margin/£1000 invested etc. Given the differing constraints on individual farms there is currently considerable discussion regarding the relative merits of high vs medium concentrate input systems and their effect on these efficiency indicators. An example of the effects of increasing concentrate feed level on silage intake, milk yield and composition with cows offered moderate quality grass silage and 18% crude protein concentrates are shown in Table 8. As concentrate feed level increases, silage intake is reduced and milk yield and milk protein content increases. Using these data, the effect of changes in cost of silage and concentrates and in milk price on the 'break-even' level of concentrates have been determined as shown in Table 9. These 'break-even' levels have been calculated assuming no effect of concentrate feed level on labour, housing or other capital costs. It is worth noting that large alterations in the cost of silage relative to concentrates have relatively little effect on the 'break-even' concentrate feed level. However,

Table 8

Effect of level of concentrate feeding on silage intake and milk yield

(After Gordon, 1984)

	Concentrate feed level (kg/cow/day)				
	3.8	5.3	6.7	8.1	9.4
Silage intake (kg DM/day)	10.5	10.0	9.7	9.5	9.3
Milk yield (litres/day)	21.8	22.6	24.7	24.9	25.8
Milk fat (%)†	4.00	4.01	3.99	4.03	4.07
Milk protein (%)†	3.08	3.15	3.15	3.29	3.35
Total lactation yield (kg)	5780	5980	6530	6300	6530

†Milk composition relate to average of high and low milk yield potential groups.

changes in milk price from 28 p/litre to 18 p/litre can alter the 'break-even' feed level by up to 1.6 kg concentrates/day.

Table 9

Effect of changes in cost of silage and concentrates and milk price on 'break-even' levels of concentrate feeding

Silage cost (£/tDM)	Concentrate cost (£/t)	Milk price (pence/litre)	'Break-even' concentrate feed level (kg/day)
90	180	28	6.8
90	180	18	5.7
90	120	28	7.8
90	120	18	6.2
70	180	28	6.7
70	180	18	5.6
70	120	28	7.8
70	120	18	6.7

Whilst these results are based on moderate genetic merit cows, there is no evidence to indicate that high genetic merit cows respond differently to additional concentrate feeding. Rather, as shown in Table 1, high genetic merit cows have higher levels of production than medium merit cows, irrespective of level of concentrate feeding. Consequently, these 'break-even' levels of feeding apply equally to high genetic merit cows. Feeding in excess of these levels can only be justified on the basis of savings in labour or other capital costs sufficient to outweigh the reductions in margin over concentrate and forage costs per litre.

Other research work at Hillsborough has shown that high protein concentrates (up to 34% crude protein) can be used to reduce concentrate feed levels whilst maintaining milk yield. For example this work has shown that 6.5 kg/day of a 34% protein supplement can produce similar milk constituent yields to 10 kg/day of a 17% protein supplement, providing high quality protein sources, e.g. soya bean:fish meal in the ratio 78:22, are used in the high protein supplement. Using these relationships, derived from a series of trials at Hillsborough, a range of feed options have been calculated to support an average milk yield of 24 litres/cow/day over the winter period as shown in Table 10. With low cereal grain prices (e.g. £70/t) then a high cereal, low protein concentrate, fed at high levels, results in the lowest feed cost per litre. In contrast, with high cereal grain prices, as at present, low levels of a high protein concentrate e.g. 5.0 kg/day of a 34% protein concentrate, offered with high digestibility, high intake silage, offers the best opportunity to reduce feed costs. Assuming high genetic merit cows respond similarly these results would suggest that this feeding system (5.0 kg/day of a 34% protein concentrate with high digestibility, high intake silage) could support milk yields up to 27-28 litres/day with high genetic merit (RBI_{95} 138) dairy cows.

Table 10
Feed options and costs to produce 24 litres milk/day with cows offered good quality grass silage

			Supplement protein content (%)		
			10	22	34
Concentrate intake (kg/day)			12.1	8.1	5.2
Silage intake (kg DM/day)			4.1	8.8	9.2
Costs of feed and forage per litre (pence)					
Scenario 1	Silage £80/t	Barley £70/t	5.2	6.4	6.1
Scenario 2	Silage £120/t	Barley £70/t	5.9	7.9	7.7
Scenario 3	Silage £80/t	Barley £140/t	8.5	7.8	6.6
Other assumptions					
Soya bean meal	£160/t				
Fish meal	£410/t				
Mixing cost	£15/t				

Conclusions

Winter milk production incurs higher feed and capital costs than milk produced during the summer period. The key features of profitable winter milk product\

1. Use of high genetic merit cows.
2. Specific autumn calving herds with tight block calving.
3. Maximum use of grazed grass in autumn and spring.
4. Clear focus on producing high digestibility, high intake grass silage (alternative forages are a costly diversion from the real task of producing high quality grass silage).
5. Use of moderate levels of high protein concentrates (up to 5.0 kg of a 34% protein concentrate) providing adequate, high quality grass silage is available.

Using these guidelines it is possible to reduce feed and forage costs to 6.6 pence/litre (30 pence/gallon) for winter milk production.

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Practical Grazing Management for Dairy Cows

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SECTION I – PRINCIPLES AND TARGETS

Introduction

The general framework for optimising returns from summer milk production has been described in the paper by Dillon. The paper by Crosse outlines the reality with regard to performance of dairy cows and some major structural problems with regard to the achievement of these targets. The essential features of this system are achieved by matching the appetite of the herd, as determined by calving date and spread of calving, to the pattern of grass growth. This is the optimum system of summer milk production for Ireland (with modifications for soil or location problems). Other systems have to be judged and compared with it.

It must be recognised that when the main elements of summer milk production, such as nitrogen application, calving date and compactness, supply of early grass, long grazing season, silage conservation and concentrate input, are correct on dairy farms, that the next requirement is that very good performance from the cows must be achieved. This must come mainly from grazed grass. This is one place where very many dairy farmers are falling down - they are not achieving the potential performance from their cows on grazed pasture. High yields per cow are being achieved on many dairy farms. But unfortunately the success is in many cases coming from high levels of supplementary feeding in place of grass.

This paper highlights the main features of grazing management which will allow for high intakes of grazed pasture and thereby increases in cow performance from pasture. The consequence of this will be to reduce costs of milk production and increase returns by the simple expedient of getting more grass into the cows in place of costly feeds.

Nutritive value of grazed grass

Grazed grass, when correctly managed, is of high nutritive value. Feeding value is the product of nutritive value by intake. High intakes of grazed grass are achievable. A typical analysis of grass selected by the grazing herd show the following values: crude protein, 180-230; cell wall, 350-400; cellulo-lignin, 190; soluble carbohydrate, 150-200; and ash, 80-90 g per kg dry matter. This grass has an organic matter digestibility of between 80-86%. Highest levels are obtained in March/April (84-86%), lowest in midsummer (78-80%) and somewhat higher again in autumn (79-80%). Digestibility is a key nutritive parameter and is the major determinant of metabolizable energy (ME) content. Control of grass digestibility and hence metabolizable energy content is a critical element of grazing management for milk production.

Some important response factors in grazing

Grazing experiments at Moorepark over the last 10 years have established the following responses in intake.

Allowances - an increase of 0.4 - 0.5 kg DM in intake will result from increases of 1 kg DM of daily allowance of grazed grass within the practical range of allowances.

Digestibility - a one unit decrease in digestibility of grazed pasture will decrease daily intake by an average 0.60 kg DM. At low digestibility the reduction in intake is much greater (0.8 kg DM) than at high digestibility (0.3 kg DM).

Milk Production Responses - an increase in intake of grazed pasture of 1 kg of DM will give an increase of 1 kg of daily milk yield per cow within practical limits. Obviously if the cows are grossly underfed there will be a large increase. Alternatively, if the cows are eating close to their limit of grazed grass, they cannot consume more. This response occurs in the range of 12-17 kg DM intake/day.

Cow Genetic Merit - if the potential of the herd, because of increases in genetic merit, moves by 1 kg of milk per day over the lactation - daily intake of grass will increase by 0.4 -0.5 kg DM.

Size of cow - 1.7 kg of grass DM intake extra per day is needed to maintain a 600 kg cow compared to a 500 kg cow.

Grazing management

The objective in grazing cows is to achieve high intakes of grass every day if possible. It is important to at least have high intakes over a period of time if it is not possible on a very short term basis. Major budget decisions are made with regard to overall stocking rate, N-input and conservation management that help to ration grass on a long term and medium term basis. This is because there is a limit to the amount of grass grown each year on a farm and its growth pattern is very unevenly distributed across the year. This aspect of the overall system of summer milk production is covered in Dillon's paper. The budgeting of grass in the short term is essentially offering the herd enough grass each day (or over a 2-3 day period) which will allow the herd to consume enough to sustain their yield of milk. However, because of the tendency of grass to deteriorate in quality (digestibility) if it is undergrazed, it is also extremely important to avoid offering the herd too much (i.e. leaving too high a residue in paddocks when moving on to the next paddock).

Herd demand

There are two main factors which determine how much grass cows need. Firstly, the bigger the size of the cow, the more feed she needs to maintain herself. Secondly, a cow's genetic potential will determine her ability tc produce milk. A cow yielding 301 of milk per day will consume more grass than a cow yielding 201 of milk at the same stage of lactation. A third complicating factor is the loss of weight by cows in early lactation and the gain in weight by cows from mid-lactation onwards. When cows lose weight in early lactation, they are

Table 1
Feed demand (kg DM/day) for different categories of cows

	Total lactation yield	
Average lactation weight (kg)	4000 l	7000 l
450	12.8	18.0
500	13.6	18.8
550	14.5	19.6
600	15.3	20.5
650	16.1	21.3

in effect supplementing their intake of feed in order to assist milk production. They can by this mechanism produce higher yields than is possible from their dietary intake of grazed grass. Additionally, when cows are preparing for the next lactation and gaining in weight, they require more intake of feed than is required by their output of milk and maintenance.

Table 1 shows the average daily demand for grass for two different levels of milk potential and five weight categories. As size of cow increases, demand increases by 1.7 kg DM/100 kg liveweight. As total yield over the lactation increases, daily intake increases. This represents an increase of 0.4-0.5 kg DM/day extra feed for each extra 1 kg of milk produced.

The average herd demand for grass in Ireland is around 16-18 kg DM daily, depending on genetic potential. The national RBI is around 100-105. Top dairy farmers are closer to 110 and their herd demand is likely to be about 18 kg grass DM daily/cow.

The herd appetite should decline with advancing lactation stage by a substantial amount because of declining milk yield. However, because the herd is increasing in weight (1 kg liveweight gain per day is equivalent to an extra 3 kg, approximately, of DMI) and advancing in pregnancy this change is usually not great. The ME content of grass (and net-energy-NE) is also lower in mid-season and in the Autumn than in the March to May period. Therefore, the herd needs to consume somewhat more DM to obtain the same ME (or NE) intake as in early season.

In summary, the amount of feed (as grazed grass) the herd will need each day will be about 16-18 kg DM/cow. The herd should not lose more than 0.5 kg/cow/day in early lactation. If there is insufficient grass available to allow for an intake figure of this magnitude then supplementary feeding may be necessary.

Factors affecting intake at pasture

Three important factors impact on the ability of the cow to eat enough grass.

1. How much is available and how much is offered.
2. What is the quality/digestibility of the grass.
3. Grazing or ground conditions during grazing.

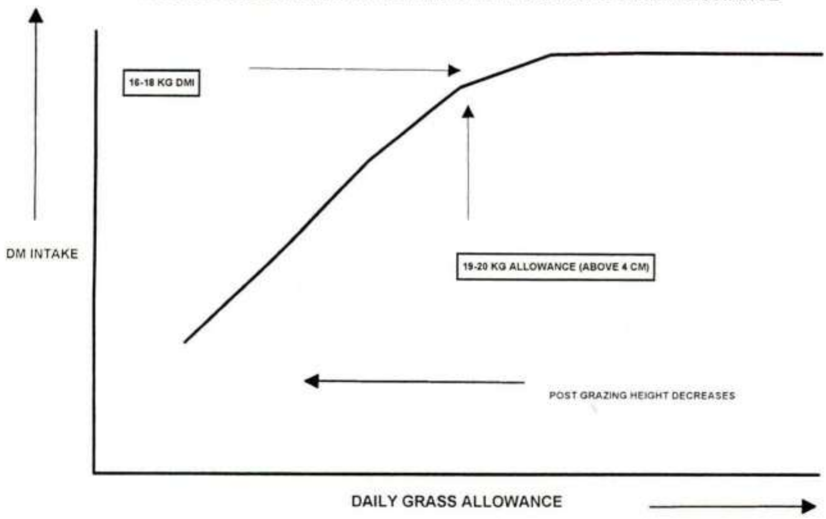
Very many Irish dairy farmers cannot judge how much pasture is available for grazing and how much was eaten in a particular paddock. In order to improve the ability of the farmer to feed the cows properly at pasture, those two basic points need to be learned. This can only be taught and demonstrated in the field and if the farmer wants to increase his skills in this regard he must spend more time studying his paddocks and assessing grass supply.

Daily grass allowance is basically the utilizable grass in a paddock divided by the number of cows grazing on that paddock and then divided by the number of days the herd stays in the paddock. It is a very important concept in grazing management. If the allowance is too low, the herds' intake will be also be low. The herd will graze out the paddock extremely well. Therefore, as daily allowance is reduced, intake falls and the amount of grass left behind in the paddock after grazing also falls. This is shown graphically in Figure 1. The well known law of diminishing returns sets in as allowance is increased. Eventually, at high allowances, very little additional increase in daily intake is got from further increases in daily allowances. The residues on the paddocks also increase enormously (i.e. the height of sward after grazing).

The optimum situation is to offer the cows just enough to allow them, by a bit of effort, to eat enough and leave the paddock clean. If the cows are offered 19-20 kg of grass DM above 4 cm, under very good grazing conditions, they can eat 17-18 kg DM daily. Very good grazing conditions mean that the cows are not marking the ground and are not soiling the grass.

To simplify matters, if the cows eat down to a post-grazing height of 6 cm in the paddock from April to early to mid-June, and are then moved on to the next paddock, these conditions will be met. This is also important for controlling the quality of the grass which will be subsequently offered for grazing in the following grazing rotations.

FIGURE 1 : RELATIONSHIP BETWEEN INTAKE AND GRASS ALLOWANCE



A post-grazing height of 6 cm implies that a mosaic of well and not so well grazed areas will appear on the paddock. These tall and short grass areas are the inevitable consequence of cattle grazing. Cattle will graze the areas around the dung deposits less severely than the clean areas. To attempt to graze the paddock so as the force the cows to eat out all of the tall grass areas will severely depress intake. The compromise is to leave the paddock grazed to a degree where the tall or partially rejected areas comprise around 20-25% of the paddock area and are reasonably well grazed.

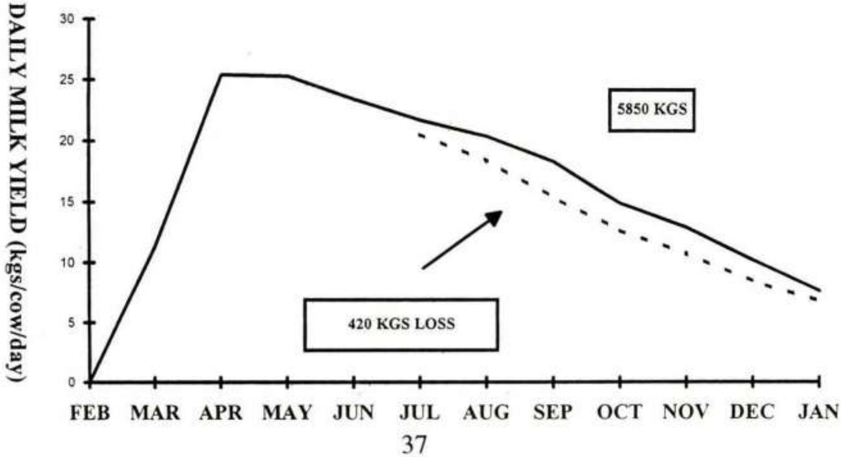
Post grazing sward height (which is equivalent to the amount of grass left behind) can be used to achieve the correct daily allowance. However, a knowledge of grass supply ahead of the cows is also very important, in order to anticipate surpluses and deficits which may be appearing.

The digestibility of grass is the quantity of it which is eaten and not excreted in the dung. It is normally very high under good grazing management (around 80%). It means that if a cow eats 16 kg of grass DM she will excrete around 3 kg of dung as DM. In reality of course, this will be 40-50 kg of fresh dung every day.

Green leaf is highly digestible. Grass will be low in digestibility when it has a lot of stem, flower heads and dead material through the pasture. The problem with this type of pasture is that intake will be low because cows don't like the material offered. They find it difficult to graze and they digest it less, i.e. they extract less nutrients from it.

One can have a very high daily grass allowance and achieve very low intakes because the sward will limit intake due to the poor quality material it contains. In late April/May/June when growth rates of grass are very high, grazing management must succeed in preventing pastures getting ahead of the cows demand and forming seed-heads. Cows will only achieve high performance on leafy pastures. Figure 2 outlines the potential loss in total lactation yield when

FIGURE 2 : EFFECT OF POOR GRASS QUALITY FROM JULY ONWARDS



cows graze pastures from mid-summer onwards that were previously undergrazed in the April to June period.

While a post-grazing height of 6 cm is recommended for the April to June period for correct feeding at that time and for controlling subsequent sward quality, grazing experiments at Moorepark clearly show a benefit in reducing grazing severity to a post-grazing of 7-8 cm from mid-June onwards. This may not always be possible on tightly stocked dairy farms. It does, however, indicate that because of the change in sward structure from mid-summer onwards that cows will benefit from being offered more grass. Figure 3 outlines the detrimental effect of maintaining too high a grazing pressure on yield per cow from this time onwards.

It is important to remember that the effects, in practice on dairy farms, of too high a grazing pressure and poor grass quality are separate. This means that if you have created leafy pastures by correct grazing in May/June, you will not derive a benefit from it, if you do not offer enough of that leafy pasture to cows from mid-June onwards. Alternatively, if you have poor quality pastures because of undergrazing in May/June, you cannot achieve the same yield from them, for the same allowance as leafy pastures. It also means that the effects are additive and the worst possible situation is to begin to graze out previously undergrazed pastures from mid-summer onwards.

Wet ground conditions

In early Spring soft ground conditions are quite antagonistic to good utilization of pastures. Even where the budgeting is done well and cows have enough pasture, intakes are often low because grass becomes soiled due to walking and poaching. In these conditions some things can be done to minimise damage, reduce soiling and maintain performance.

Cows are usually out by day only at this time. High intakes of pasture can be achieved in a few hours of grazing. Indoor feeding of silage and concentrates (at reduced rates) is happening concurrently. Cows do not need to be left in the pasture if they have achieved around 6-8 kg of grass DM intake. Cows should not be allowed to stand on grazed areas. If, because of wet conditions, or driving rain, cows are not grazing they should be moved indoors. You should not walk cows over grazed grass to get to the area you want to graze. It is inevitable that some damage will be done on some areas but it is important that some grass is included as part of the diet. It is not a requirement to graze tightly during the first grazing cycle. On the contrary, a light grazing is very beneficial as it helps to avoid excessive pasture damage and also aids recovery of the grazed pastures. At this time of year the rule should be on and off as quickly as possible until ground conditions improve.

Provision of early grass

When calving date is matched to the supply of early grass, the early grass needs to be as well managed as the calving pattern. It does not make sense to compactly calve the herd at the right time in Spring and not provide the early grass that is possible in Ireland. Introducing grazed grass to the Spring calving has a number of major advantages. It gives a very large nutritional boost to the cow because of the exceptionally high feeding value of March/early April grass. An increase in milk yield per cow usually results and milk protein content is also lifted. Cost of milk production can be reduced dramatically because concentrate feeding levels can be reduced while milk yield is maintained.

Where cows are turned out early and achieve an intake of 6-7 kg of grass DM the following benefits accrue.

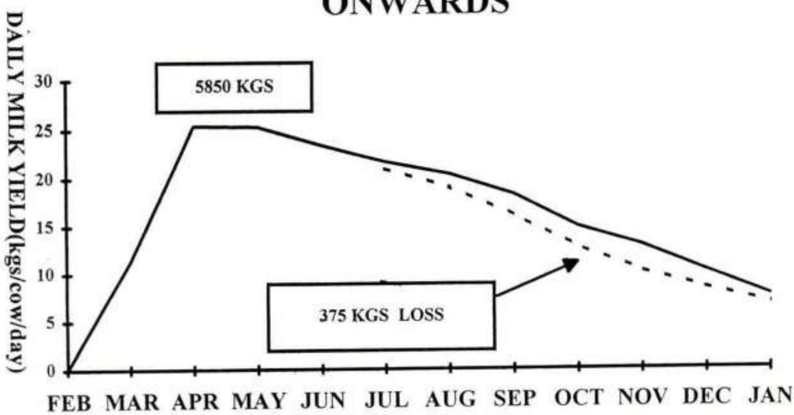
a) Compared to cows indoor full time consuming 8.5 kg silage DM + 6.0 kg concentrate, cows on grass plus 5.0 kg silage DM + 6.0 kg concentrate produce 0.6 gallons of milk more + 0.1% unit of milk protein + positive weight gain per cow

b) Compared to cows indoor consuming 8.5 kg silage DM + 6.0 kg concentrate, cows on grass + 6.2 kg silage DM + 2.0 kg concentrate produce a similar milk yield of similar composition, i.e. a saving of 4 kg concentrates.

The implications of these results are obvious. To provide for early Spring grass, the pastures need to be ryegrass dominant and the soil needs to be in an adequate state of fertility. When these conditions are met the timing and rate of Spring nitrogen and the previous Autumn closing date are all important. In a low-stocked farm the effect of Autumn closing date of pastures will not be felt too severely because there is so much land available to graze in Spring. However, on well managed farms which are tightly stocked any over extended grazing into the early winter will be most clearly seen in reduced supply of grass the following Spring. Delays in Spring nitrogen application will also dramatically reduce Spring supply of grass.

Farms that have a scattered calving pattern will not usually feel the effects of reduced Spring grass supply as acutely as those with a compact and targeted

FIGURE 3 :EFFECT OF TOO-HIGH A STOCKING RATE FROM JULY ONWARDS



calving pattern because the herd feed demand in Spring will not rise sharply due to the prolonged calving period. When the calving period becomes concentrated and the mean calving date is moved to within 4-6 weeks of turnout, the demand for Spring grass will increase dramatically and any factor which significantly compromises Spring grass supply will be clearly felt.

The recommendation is to apply 50 kg N/ha as urea as early as possible, around January/early February, and rest pastures in Autumn at least before the beginning of December.

Utilization of early grass

The grazing management during the first cycle is of critical importance to the overall management of the pastures. There is not enough grass growth at this time in Spring to provide adequate recovery if the first grazing cycle is completed too soon. It is essential to prolong the cycle out to mid-April. It should start as early as possible with calved cows without causing undue damage to the fields. Budgeting of the grass is important. The farm cover of grass needs to be assessed and the grazing of the available land area can then be planned to extend this rotation to the desired date. Silage ground can be grazed depending on turnout date, but the closing of silage ground by early April should not be compromised. In areas with a late Spring turnout the completion of the first grazing cycle often poses many problems due to the accumulation of too much grass towards the end of the rotation. The end of the first grazing cycle can be early May in many areas. This can effectively mean that it becomes increasingly difficult to graze out the last paddocks to the correct height. An earlier start to grazing will help to ameliorate this situation.

Summary

The main limiting factor affecting cow performance on pasture in Ireland is energy intake. The intake can be kept high by offering enough leafy grass to the cows. Daily allowance and grass digestibility should be two of the main concerns of dairy farmers throughout the grazing season.

SECTION II - GRASS BUDGETING

Introduction

Most dairy farmers are familiar with the concept of judging how much silage is in the yards prior to the winter. This exercise is important in order to make decisions on the rationing of that feed or to estimate how many days feeding can be achieved at a desirable feed intake level. Feed budgeting of grazed grass is a similar but more difficult exercise. It involves assessing yields of grass on the paddocks at regular intervals. This will produce information on the supply of grass and how this supply is changing over time, i.e. is it increasing or decreasing, what level of intake is being achieved and how much is growing?

Feed budgeting in practice

There are three levels at which feed budgeting of grass is done. On an annual basis, the stocking rate is matched to the production of grass. Using 300 kg of N per hectare, a stocking rate of 2.6 - 2.7 cows per hectare can be carried. The growth of grass is very unevenly distributed and silage conservation does two important things. It takes surpluses of grass and conserves them as silage for the winter. It thereby helps to control the supply of grass to the grazing cows. This intermediate or medium term feed budgeting involves 2 cuts of silage generally. These concepts and practices are very familiar to dairy farmers.

The short term feed budgeting is not as well known and generally not practised by dairy farmers. This involves a knowledge of what is happening in each paddock i.e. how much grass is on that paddock before and after grazing. This gives information on the level of intake that cows are achieving. It will also tell how severely that paddock was grazed. It will also, over a number of grazing rotations, give information on how much grass is being grown on individual paddocks.

If the farm is walked on a regular basis, say once a week, and all paddocks are assessed for grass cover, some very important additional information will be got. This information is in addition to that got when examining pre- and post-grazing grass cover in the paddocks which are about to be or have just been grazed.

Total grass on all the paddocks on the farm are assessed. Over a number of weeks a series of pictures of grass supply will be accumulated. These pictures will show if grass cover is reducing, i.e. intake is greater than grass growth, or they may indicate that grass cover is increasing, i.e. intake is less than growth. They are, in reality, forecasts of impending surpluses or deficits.

How to estimate the level of intake achieved in a paddock

This procedure is a simple arithmetic exercise when the grass yield level before and after grazing in a particular paddock is known or is estimated.

Obviously, this figure is more meaningful if done across a number of paddocks (say 5-6) as any error will be evened out somewhat. If the intake is very much out and is not a meaningful figure, it is very likely that the estimation of pre-grazing grass yield is inaccurate. In most cases the post-grazing yields will be estimated much better. A knowledge of how daily milk yields are progressing will indicate gross inaccuracies. A less likely cause is that the paddock area is wrong. However, an accurate measurement of paddock areas would help a lot.

The measurement or assessment of severity of grazing by use of post-grazing height goes hand in hand with this procedure. By assessing post-grazing yield in a paddock, a good overall assessment of degree of grazing severity will be obtained. If the grazing system is based on temporary sub-divisions of existing paddocks then a very practical system is available to the farmer to learn by experience how to assess pasture yield.

If an existing paddock is assessed for yield, and an area is allocated for a single grazing or a day's grazing and if the pre-grazing yield is underestimated, then the resulting grazing will be over lenient. If on the other hand, the pre-grazing yield is overestimated, then the paddock will be too severely grazed.

A farmer using this method will quickly learn to assess grazing yields and get his feeding levels right. The bulk tank reading will help enormously. The following is an example of how intake can be calculated based on yield assessments.

1) Pre-grazing yield = 3500 kg DM/ha (to ground level)

2) Post-grazing yields = 2000 kg DM/ha (to ground level)

3) Paddock size = 0.809 ha (2 acres)

4) Residency time in the paddock = 2 days (4 grazings)

5) Herd size = 40 cows

Then Intake/cow/day can be calculated as $\dfrac{(1\text{-}2) \times 3}{4 \times 5}$

e.g. $\dfrac{3500\text{-}2000 \times 0.809}{2 \times 40} = 15.2 \text{ kg DM}$

What is farm cover of grass?

Farm cover of grass is basically the average yield of grass on all of the paddocks being grazed. It is an average of the paddocks about to be grazed and those just grazed as well as those in the middle of the grazing rotation. Table 2 shows an example of the type of data which results from a farm walk where all the paddocks are assessed for yield. In this example the cows have grazed Paddock 1 and are going into Paddock 2. It is assumed that all paddocks are grazed down to 1600 kg DM/ha. In reality of course this will vary around that figure. The farm cover is 2443 kg DM/ha (average of the 10 paddocks). The pre-grazing yield is 3760 and the post grazing yield is 1600 kg DM/ha. As can be seen, the highest growth rates since the last defoliation in the paddocks are being achieved on the paddocks with the highest amount of grass. These paddocks are now in an active stage of recovery. The more recently grazed paddocks (8-10) have low growth rates. The average growth rates refer to that which occurred on each paddock since its last defoliation. It, therefore, is the average farm growth rate as the individual paddocks are recovering at different intervals in time.

Table 2
Grass cover data accumulated from a farm walk

Paddock Number	1	2	3	4	5	6	7	8	9	10
Yield (kg DM/ha)	1600	3760	3390	3000	2680	2400	2160	1960	1800	1680
Rest interval (days)	0	18	16	14	12	10	8	6	4	2
Growth rate since last defoliation	0	120	112	100	90	80	70	60	50	40

Use of farm cover measurements

Table 3 shows the data accumulated over 3 weeks where farm cover is assessed at weekly intervals. By combining the data from each farm cover

Table 3
Farm cover (kg DM/ha) on successive weekly intervals

Paddock No.	1	2	3	4	5	6	7	8	9	10
Day 1	1600	**3760**	3390	3000	2680	2400	2160	1960	1800	1680
Day 8	2096	1900	1752	1640	1600	**3580**	3232	2860	2560	2350
Day 15	3040	2650	2320	2050	1880	1750	1680	1630	1600	**3400**

estimation it is possible to see what is happening on the farm over time.

In this example, farm cover (average of 10 paddocks) has dropped from 2443 to 2357 and 2200 on days 1, 8 and 15, respectively. This means intake or level of grass utilization is greater than growth. It is clear that grass cover is decreasing. The highlighted paddocks in each week (2, 6, and 10) show the pre-grazing yields. They have decreased from 3760 to 3580 and 3400. The level of post-grazing yields is being maintained at 1600 kg DM/ha. Although, intake is greater than grass growth, performance can be maintained over the medium term by clever grazing management.

Rotation length will decrease slightly in order to maintain intake. The farmer knows what is happening. Supplements can be introduced to keep cover and performance up. Supplements can be delayed in the expectation of improvements in growth. But at least the farmer is monitoring the situation and is in control. An opposite situation can occur, of course, where farm cover is increasing. In this situation grass growth is greater than intake. This can lead to potentially serious problems of over supply of grass and undergrazing of paddocks in a short time if it occurs in May for instance. If it occurs in August it would be desirable because farm cover would be building up during a period when growth is likely to fall off.

Early spring budgeting

In early Spring the supply of grass is dictated by the timing and level of Spring nitrogen application and Autumn/Winter closing date. If the Spring has been mild and relatively dry there will be a good supply of grass. However, growth will still be low.

Grass supply on the farm must be known in order to extend the first rotation to mid-April where growth will be sufficient to provide adequate cover for the second grazing cycle.

1) Initial farm cover (March 10th) = 2200 kg DM/ha

2) Target post-grazing severity = 2000 kg DM/ha

3) Anticipated grass growth (between March 10 and April 15) = 30 kg DM/ha/day

4) Length of 1st grazing cycle = 36 days

5) Desired level of grass DM intake/cow/day = 6 kg DM.

Growth over the period (6 kg/ha) is 1080 = 36 days x 30 kg dm growth per ha per day. Intake (kg/ha) is

$$534 = \frac{36 \text{ days x } 40 \text{ cows x } 6 \text{ kg DMI}}{20 \text{ paddocks x } 0.809 \text{ ha/paddock}}$$

Farm cover on April 15 per ha

2200 + 1080 (growth) - 534
(intake) = 2746

There is also a need to know what the likely growth is going to be during this period and the level of grass intake to be achieved. The calculation shows how such a budget may be done, where 40 cows have 20 paddocks of 0.809 ha (2 acres) available to them. The whole farm will be grazed starting with the paddocks intended for silage. The initial farm cover is fairly even because of the winter rest and the low growth rates over that period. An effort will be made not to graze severely in order to help regrowths for the second cycle. Silage will be fed by night and concentrates in two feeds daily to provide 11 kg DM per day of total intake of these feeds.

Farm cover has increased by 546 kg DM/ha and growth rates are now high. It is possible to begin the second grazing cycle at a much higher stocking rate now. If a higher level of intake is required, say 8-10 kg DM/cow/day, then farm cover on April 15 will be around 2400 to 2570. This means that the higher level of grass intake achieved during the first grazing by either less supplementary feeding or tighter grazing may necessitate more supplementary feeding for a period during the second grazing cycle.

It is important to remember that the above is only an example. Conditions will vary from farm to farm and year to year. The figures or values refer to the average events during the first grazing cycle. As farm cover increases during this cycle, there is more scope to get more grass into the cows and reduce indoor feeding more. Also, initially while paddocks will not be grazed too severely, towards the end of the cycle tighter grazing should be practised.

A similar procedure to this can be used in the September period to gauge grass cover and estimate the likely impact of present feeding levels of grass on future grass supply. This is important in order to achieve a long grazing season while at the same time not compromising intakes of the cows.

Pasture mass estimation

Many procedures are available to assist a farmer to estimate pasture mass. The mechanical devices like plate meters, calibrated against actual yield estimations are usually beyond the scope of farmers. The visual assessment of pasture yield is used very successfully in Moorepark. Calibration of the eye, however, is very important because, as the sward structure changes throughout the year, the bulk density also changes. Therefore the height by yield relationship will alter drastically.

Visual assessment of pasture mass cannot be learned in the theatre or in the laboratory. It must be learned through the experience of actually rationing cows at pasture. By knowing the dry matter requirement of cows, their daily milk yield, the grass growth bulletins, the careful estimation of pre and post pasture yield and the allocated area grazed each day (or the area fraction or multiple of days) the required experience will be built up.

Summary

Feed budgeting will add precision to grazing management. Visual assessments of pasture cover are likely to be much more accurate than mechanical methods such as plate meters. Cutting grass strips is too time consuming on farms. With experience in paddock subdivision and regular farm walks, the farmer will begin to increase his skill level at yield estimation.

Target 10
An Australian Dairy Industry Approach to Making More Profitable Use of Pasture

BRUCE KEFFORD

Dairy Industry Programme Co-ordinator, Agriculture Victoria, Australia.

It is a great privilege to be invited to speak at the 50th Irish Grassland Conference about what is arguably the Victorian dairy industry's most successful extension project.

Background

Victoria dominates the Australian dairying industry producing over 60% of the milk, 75% of the manufactured products and over 85% of the exports, which go primarily to the Asia/Pacific region and the Middle East.

Dairy farmers in South Eastern Australia are second only to New Zealand in terms of the lowest cost of milk production and many are at the world benchmark[1].

A typical Victorian dairy farm is owned and operated by a family, milking 140 cows on 100 hectares and using 0.6 tonne of concentrates to yield 4,600 litres worth $A1,300 per cow per year. After expenses the typical net income is around $A50,000.

Target 10 has a big impact on this final figure.

Target 10

The Target 10 story is not about new technology. Rather, it is about a new approach, a change in philosophy, a loss of arrogance, a strong focus on industry needs and teamwork.

A number of factors combined in 1990 to stimulate the development of this project.

- Government provided extension was threatened
- Milk prices turned down
- There was a drive by industry to limit the impact - leading to a focus on lower cost of production
- Extension staff were trained in market research techniques
- Recognition of the need to justify the effectiveness of extension and influence a greater number of farmers in tangible ways
- Need for industry funding of extension
- Other extension models (e.g. fee for service) were not successful

Philosophy change

Marketers see the defining of customers' needs, wants and aspirations as fundamental to the design of any product and the gaining of customer support.

In adopting this approach, we have moved from the potentially patronising and arrogant model of "supply push" to the more inclusive one of "demand pull".

In other words, we moved from **deciding what was good for the industry to listening and working with industry.**

Target 10 was established using this approach and over two years of solid groundwork it gained strong industry support and goals were agreed. Our staff were active in this phase and argued in favour of increased pasture consumption as a key goal. Although this goal was accepted, many others were also identified by the industry as important.

The principle goal of Target 10 has been to increase pasture consumption by 10% on 50% of Victoria's dairy farms within five years.

Industry representation

Another important component was the active involvement of all the key stakeholders in the industry:

- Farmers
- Service providers
- Factory field staff
- Agricultural consultants

All of these groups contributed through regional Target 10 committees, which organise the project at a local level, and/or in project delivery.

What is Target 10?

The best way I can illustrate this is by showing you a video (5-6 min) which outlines the principles of the core component of Target 10. This grazing management course aims to increase pasture consumption. Why? Pasture consumption is an important profitability indicator for Victorian dairy farmers.

Has Target 10 worked?

Extension projects are notoriously difficult to evaluate because so many external factors influence the end result and it is very difficult to quarantine the "treatment" group so that comparisons with the "control" can be made validly.

Bennett's hierarchy[(2)] is a useful tool for this purpose as it segregates the process into seven steps which allows progressive analysis of the project as it is implemented and it evaluates progress at each stage:

1. Inputs
2. Activities
3. People
4. Reactions
5. Knowledge, Aspirations, Skills and Abilities
6. Practice change
7. End result

Inputs

In three years the project has cost approximately \$A6m and involved 35 people full time. The grazing management courses have reached 2786 farmers (26%) (i.e. approximately \$A2,000/farm).

These resources are contributed from Victorian State Government 60%, Dairy Research Development Corporation 30% (1/2 dairy farmer levies and 1/2 Federal Government), and 10% "in kind" from industry.

Activities

CORE ACTIVITIES

ACTIVITY	OUTPUT
1. Grazing Management Courses	149 courses 2786 farmers
2. On-farm Management Discussion Groups	140 groups 2450 meetings 2128 farmers

These core activities provide for intensive farmer interaction with extension staff over an extended period of time. The quality of this interaction is a major factor in achieving adoption of improved grazing management.

SUPPORT ACTIVITIES

ACTIVITY	OUTPUT
1. Grazing Management Field Days	151 field days 5937 attended
2. Target 10 Conferences	2 events 1150 attended
3. Other Farm Managemen/Field Days/Seminars/Workshops/Courses	160 events 6406 attended
4. Launch Activities (16 special events)	2210 attended
5. Publications	50 publications
6. <u>Media</u> Articles Newsletters Video "Grazing Dairy Pastures"	 At least 550 articles 4 regional newsletters 144 editions 255,000 copies 600 copies
7. <u>Management Aids</u> Grazing Ready Reckoner Pasture Estimator Grass Budgeting Computer Program Farm Feed Back Computer Program	 1500 distributed 2786 course participants to course participants trial underway
8. <u>Supporting Programs</u> Animal Health Dairy and Seminars Fertility Trial and Seminars Water on Water Off Dairy Cow Nutrition 3 day course	 340 farmers participated 2300 diaries distributed 4 seminars 300 farmers participated 6500 manuals distributed 25 courses 600 farmers attended
9. Reports	7 Major project reports

TOTAL ATTENDANCES (Core and Support Activities) 23,000

These support activities reinforce the key messages of the core activities and allow regional committees to adapt the project to local needs..

People

Market research of our customers to date shows that they are:

- Younger
- New to farming or have spent a lot of time away from farms in different occupations
- Information seekers
- Seeking performance improvement and self improvement
- In debt with significant financial pressures
- Believe that they can always improve their performance
- Outgoing
- Pro Agriculture Victoria
- Independent
- Feel they can learn something from everyone
- Innovators
- See farming as a business

This information is vital in designing new products and targeting new audiences.

Reactions

We regularly seek feedback from participants to check our performance.

"It's good to go out and get a few ideas from other people and then use them on your own herd and property"

Glenn Allen, dairy farmer, Milawa.

"...we came away from the (Target 10) day with the thought that maybe it would be worth putting the nitrogen on, it just sort of ticked over in our minds".. (Four tonnes of DAP cost $1500 but the Millers estimate they saved about £3000 in supplementary feeding costs).

Glenn and Graeme Miller, dairy farmers, Charleroi.

"You know that something has been successful when others start to copy what you have been doing. It's interesting to see that the approach used by Target 10 is now being taken up and adopted by many other industries"

Jenny Earles, dairy farmer, Garfield North

"Target 10 has been an enormous success. I am extremely pleased and proud of what it has achieved for the diary industry in Gippsland"

Graeme Andersan, Foundation Chair of the Gippsland Target 10 Committee

Knowledge, Aspirations, Skills and Attitudes

Attending activities is one thing, but did anyone learn anything?

Faced with a sudden reduction in pasture growth, participants suggested an increase in the rotation length as an important part of their strategy while non-participants chose a strategy relying on grain supplementation. This suggests a better appreciation of the dynamics of the grazing system amongst participants. Our evaluation also indicates:

- 85% of participants were motivated to seek further information
- 60% intended to change fodder conservation practices
- 80% were motivated to milk more cows
- 60% intended to alter the paddock subdivision
- 93% could identify where pasture waste was occurring

Practice change

Knowing what to do is not the same as **actually doing it.**

In a recent survey of 205 dairy farmers, 93% were aware of Target 10, 43% had attended activities and of those 62% had changed management practices as a result.

Program participants have changed grazing practices, feeding practices, farm subdivision and fertiliser use. Consequently farm performance has improved. Our evaluation estimates that participants involved in the grazing management courses discussion groups (over one year) achieved:

- 14.5% more pasture consumed
- 2.5% more cows milked
- 10.5% more butterfat per hectare
- 6.6% more butterfat per cow
- 40% less supplement

End result

Economic evaluations have been carried out using these evaluation data. The estimated internal rate of return of the project investment is 140 to 150%, based upon the grazing management component of the program only. The estimated Net Present Value is between $38 million and $68 million and benefit:cost ratio is between 5 and 10 to 1.

It is notable that if this performance was compared to that of companies of the Stock Exchange the Target 10 share price would no doubt be very high.

Summary outcomes

In the three years to date, 26% of Victorian dairy farmers have participated in the "core activities" of Target 10 and many more in the support activities.

The **tangible** benefits of these core activities (pasture course and discussion groups) alone were estimated at 14% improved pasture consumption and 40% less use of concentrates. This is worth more than $15,000/year.

There are also many intangible benefits accruing from Target 10 including:

- A well established infrastructure of management and **delivery** of extension now exists throughout the Victorian dairy industry as a result of the planning, development and delivery of the project
- Substantial trust and respect is established and from this a **genuine** working partnership exists between all the parties
- A very high level of **commitment** of all parties in continuing and further developing the project for the future

- Substantially increased participant **confidence** in managing a more productive system
- Increased **desire** of participants to learn

Because of the confidence gained by the successful implementation of the first phase of the project, the industry funding contribution has been significantly increased for the next phase.

Future challenges

While the Target 10 team can be justifiably proud of the progress to date, there are many challenges ahead:

- Expanding the number of farmers participating from 30% to 50%
- Improved and extended evaluation
- Servicing the established groups and offering them the next level of information while starting new groups
- Managing the Target 10 brand name
- Establishing true industry ownership, responsibility and accountability
- Improving project management skills

Key success factors

With the wisdom of hindsight we can now see that the establishment of Target 10 was a mixture of good timing and good management. A number of factors have been very important in making the project possible:

- Urgent need for change by industry and extension providers
- Philosophy change to "demand pull"
- Focus on industry needs
- Broad industry involvement
- Excellent industry leadership
- Strong support from Dairy Research Development Corporation
- Congruent goals
- Coordinated team approach focused on achieving outcomes
- Tolerance and genuine goodwill
- Confidence that extension delivers tangible results
- Strong desire of industry to take their future into their own hands

Conclusion

In presenting Target 10 to you it has not been my intention to represent it as an ideal extension project or a recipe that could be adopted unchanged by the Irish dairy industry. Target 10 has been a significant success for the Victorian dairy industry although there are still many challenges ahead of us.

I hope there may be something of use for you in our experiences. Thank you most sincerely for the opportunity to share them with you.

References:

1. Dairy Research & Development Corporation (1993). *International Benchmarking in the Australian Dairy Industry.* Boston Consulting Group report.
2. Bennett, C. S. (1976). *Analysing Impacts of Extension Programs.* U.S. Department of Agriculture, Washington, DC, USA

Quotas by Other Names

A NATION

Editor, "The Stockman Grassfarmer", Mississippi, U.S.A.

I come to you today as "The Ghost of Christmas Yet to Come." I am here to warn you that the road Irish dairying is headed down leads to financial ruin. The road I am talking about is one toward increased capitalization. By capitalization, I mean anything that comes between the cow and green pasture.

In North America, we've been on the capitalization road since the late 1950's. In fact, we have gone so far down that road we have dairy cows that are born and die and have never seen a green pasture in their whole life. Many of you assume this situation exists because we can't grow dairy quality pasture in the United States but this is certainly not the case.

It is true, because of our large land mass, we tend to have a much greater extreme in temperature variation from winter to summer than you do. However, we have found this not to be as great a problem as it was formerly thought to be. In fact by utilizing New Zealand grazing techniques and autumn-saved pasture, there are very few areas of the United States where we cannot produce at least a nine month grazing season and in the lower third of the country we can graze virtually year around. Our problem is more cultural than climatic.

Our primary agricultural paradigm has been arable grain production. As a result, we tend to be the most equipment-mad farmers on the face of the earth. Many of our farmers would milk their cows from the seats of their tractors if they could do it. A common attitude is that pasture exists solely to keep you from "spitting into Hell." As it is currently structured in North America, dairying has very little to do with pasture, or even cows and milk. It is a materials handling business. Feed is hauled in. Manure is hauled out. Mechanization is thought to be "efficient." However, we have discovered that efficiency and profitability are very poorly linked. In fact, today in some states, the return over all costs is less than a dollar per hundred pounds of milk produced.

With an average capital investment of $6000 per cow, at our current milk prices the average American dairyman would double his return on capital if he sold out, put his money in a Government long-term bond and just went fishing. While some Irish dairymen would argue that the capital investment per cow is about the same in Ireland due to your much higher priced land, I assure you it is not the same. Investing in a non-depreciating asset such as land is far different than putting your money in buildings that deteriorate and machinery that wears out and must constantly be repaired and replaced. Today, most American dairymen can't sell their farms for anywhere near the investment they have in them. In the majority of cases when it comes time to sell, farm "improvements" are valued at zero and only the underlying land has any worth at all.

Capitalization creates a situation where the young cannot get in and the old cannot get out. On average our dairymen are twice the age of New Zealand's dairymen. We are seeing older dairymen who have poured a lifetime of blood and money into concrete and silos, barns and tractors, and when they reach the end of their productive lives find they have accumulated nothing. Their whole life's work has been lost to rust, rot and depreciation.

Also, capitalization is terribly skewed against the smaller dairymen. If an industry is built around materials handling, the man with the biggest shovel always wins. Whatever size you are is never big enough because there is always someone able to buy an even bigger shovel than yours. We now have highly-capitalized dairies in Florida with 4000 to 6000 cows losing money. What hope is there for a man with 40 cows under such a scenario?

How did this happen? Why did our dairymen lose all sense of cost control? It happened because the American dairyman put his faith in the politicians. It was the dairyman's belief that no matter how deep a hole he dug for himself, the government would come pull him out of it. Dairymen fell victim to what we call the "rich kid syndrome." In America, it is said that the most dangerous and irresponsible person is a rich man's kid. He knows that no matter what kind of trouble he gets himself into, his Dad will bail him out of it. For several decades, the American dairyman just totalled up the cost of all of his newest boy-toys (machinery) and took it to Congress who then pegged the price of milk high enough to pay for them.

Unfortunately, if we subsidize anything at a price higher than break-even it always produces a surplus and that soon happened. Soon America was awash with butter and cheese. It was hard not to notice that dairymen were only .0005% of the American population and vote.

So, our Congress called a new deal. Dairy would be subsidized only at a price **below** the average cost of production. In other words, the dairyman's guaranteed milk price would fall in response to the amount of surplus production the government had to buy. For the dairyman, this in effect provided an umbrella only so long as it didn't rain. During the 1990's the support price fell from nearly what yours is today to what is, in effect, the world price. Today, even this minimal support level is to be phased out over the next seven years and we are now going to a free-market system for all of American agriculture.

In other words, the American dairyman will soon have to live or die selling at the same price level as New Zealand and Australia, but with a production cost structure that is nearly double Ireland's. As the editor of a magazine called *The Grass Farmer,* I would like to be able to tell you the American dairyman has finally come to his senses and now realizes a pastured cow gathering its own feed and spreading its own manure is the lowest cost method of producing milk. Unfortunately, this is not true. The average American dairyman is in acute denial. In a time when you would expect rapid change, most are just hunkering down in hopes someone else, somewhere else, will come to their rescue. It is a law of physics and human nature that people prefer to keep going in the direction they are headed - even if it leads off a cliff.

It is true that about 10% of American dairy producers are actively trying to shift back to pastured dairying, but we are finding that the dairy skills and cow genetics that work well in confinement dairying are poorly suited for a pasture-based dairy. For maximum profitability a pasture-based dairy has to be designed from the ground up as a pasture-based dairy. Everything has to be in sync with the pasture. This particularly applies to cow size and breeding. We have been unable to find an easy way to return to a grass-based dairy from a highly capitalized, confinement dairy situation. It appears that bankruptcy and starting over is by far the quickest and perhaps the least painful.

The old political observation that those who lead the revolution are never the ones who lead the counter-revolution appears to be true in our dairy industry about-face as well. We are starting to see a parallel, low-capital-input, pasture-based dairy industry develop from people who were never invested in the high-capital paradigm. This trend is largely being driven by New Zealand management in combination with non-agricultural capital. These people are primarily attracted by the very high return-on-investment numbers produced by grass dairying in the United States. Today, a minimally capitalized grass dairy in the long-growing season regions of the United States can return a profit on its total capital investment in excess of 35% per annum. This high return is primarily because of the very low cost of land in much of the United States.

Many of these investor dairies are being designed along the share-milker lines of New Zealand and I believe this is very healthy. In a share-milker situation, a young man can get in and with nothing but sweat equity, own a farm by the time he is 35, and retire by the time he is 50. I believe that is absolutely essential that an industry provide a career path for the young and an exit path for the old for it be to competitive.

Now, what does this have to do with you here in Ireland? I know this is going to sound very chauvinistic, but you are tied to the United States economy with a very short chain. As the world's largest economy, when we decide to change direction we drag the rest of the world with us. You have all read about the huge restructuring our economy is going through with huge cutbacks in government expenditures, massive layoffs and wage deflation. Europe will soon go through this as well. If we balance our budget, you will have to balance yours to protect your currency. If we go to a free and un-subsidized agriculture, you will have to do so as well or your manufactured products will be frozen out of the loop of world trade. I know most of you don't believe this will happen.

From my previous visits to Ireland, it appears that most Irish dairymen believe that the way it is today is the way it will be tomorrow. As one Irish dairy leader told me, "I just cannot believe we will be abandoned by Europe." I understand this feeling. It would take an extraordinary person to believe that in the midst of a European dairy boom, today's price levels and quotas might soon end. But, they will.

I should warn you that it was our experience that politicians do not like to forecast bad news even when they know it is inevitable. They prefer to wait until there is some fiscal "crisis" and then spring forth a plan they have been working on in secrecy for years. I suspect the same will be true in Europe. When your quota system ends, it will end quickly and without warning. Our pasture-based dairymen are trying to mesh the best of the world's pasture varieties, grazing techniques and genetics with our harsh and varied climate to come up with American prototypes that can increase profits in a lower milk price world. You need to do the same. I urge you to stop going to high cost countries to study dairying and to start going to New Zealand, Australia and other low cost producer countries in the southern Hemisphere. We can always learn a profitable lesson from studying a farmer who is selling on a lower price schedule than ourselves.

For example, because Ireland is a lower-cost milk producer than the United States, we Americans are coming here to study your methods and have found a lot of good ideas here. It is said an idea is the only thing that if I give you mine and you give me yours we both leave with twice as much as we came. I have no doubt that in a few years you will find the United States a good source for low-cost, pasture-based dairying ideas you can use in Ireland.

The end of subsidies in the United States and Europe will cause the world price of grain to rise. This will greatly increase the value of pasture. The Irish dairy industry, as it is currently structured, is the lowest-cost dairy producer in the Northern Hemisphere and is still predominantly pasture-based. As a result, you stand to benefit more from world trade liberalization and from higher grain prices than any country north of the Equator. Ireland could be, should be, the cream pitcher of Europe.

In conclusion, I would urge all of you to take a very serious look before you leap into increased capitalization. Today's milk price is unlikely to be tomorrow's and the road back from capitalization is very steep and difficult. Keep Ireland green, pasture-based and low-cost and your future will be a prosperous one.

Dairy Policy Alternatives

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This part of the study provides estimates of the effects of policies on dairy markets and is divided into two sections on the basis of time scale. Section I deals with the period of the GATT Uruguay Round 1995-2001 while Section II deals with the longer term when the possibility of ultimate free trade has to be considered.

In evaluating policy alternatives, an economic model of EU/world dairy markets was used to provide estimates of market prices, output, trade and gross revenue. The estimates were based on a wide range of assumptions, including long term growth rates in EU/world consumer demand and milk supply, responsiveness of consumers and producers to changing prices, rates of decline in EU export refunds and internal subsidies, and increasing productivity in milk production. However, fluctuations in exchange rates or changes in exchange rate regimes were not considered in the analysis. While results for many alternative sets of assumptions were estimated, just one sample of results based on a "plausible" set of assumptions is presented. It should be noted that providing estimates of future prices and quantities is an extremely hazardous exercise, however it is hoped that the economic model at least provides a concrete framework for discussion, even if the actual estimates turn out to be incorrect.

1995 - 2001

The key policy questions for Section I (1995-2001) are the identification of the most appropriate EU response to the GATT Uruguay round and the desirability of introducing B quotas in the period before 2001. Estimates were made of the impact of the Uruguay round when the full consequences take effect in its final year. The GATT Uruguay Round involves (a) increased EU market access; (b) reduced subsidised exports; and (c) a switch from variable import levies to fixed tariffs and their general reduction. Unless there is exceptional growth in EU demand for dairy products in the EU by Year 2000, the combined effects of (a) and (b) are estimated to be equivalent to an increase of close to 4% in milk supplies in the EU or about 4 million tonnes. Three policy responses were considered:

(a) Combined Quota/Price Adjustment: a 2% quota reduction, as per CAP reform, combined with a price reduction to clear the internal market.

(b) A price reduction only, leaving quotas unchanged.

(c) A quota reduction only (-4%), leaving price unchanged.

It was estimated that a 2% quota cut by Year 2001 to accommodate the volume transfer would need to be combined with an internal price reduction of about 8% in order to clear the EU internal market. Alternatively if there was no quota cut, an estimated EU price reduction of about 16% would be required for market clearance. The third alternative of leaving prices unchanged and relying on quota cuts would result in quota reductions of about 4% for market balance.

With regard to Irish dairying, the effect of these three policy alternatives clearly shows that quota cuts rather than price reductions minimise revenue loss to the dairy industry (Table 1). These estimates depend crucially on the assumption made regarding the responsiveness of EU consumers and the distribution sector to lower prices at manufacturing level. In practice, the two policy extremes of exclusive quota or price cuts are perhaps least likely, and indeed optimists observing the 1995 market buoyancy may hope that such buoyancy will continue through to 2001 and perhaps obviate the need for any cuts.

The factor with the most fundamental long term consequences in the GATT Uruguay round was the switch from variable import levies to fixed tariffs and their reduction by 36% for most products. In the short term however, to 2001, the effect should be very limited due to the choice of a very favourable base period for estimation of initial fixed tariffs (1986-88).

The B Quota Proposal

The B Quota, as described by the Danish Dairy Board, DDB (1994) involves the production of

> "certain limited quantities in excess of the A Quota (present quota), without triggering any supplementary levy, if exported without subsidies. The volume of B quota milk can be adapted to the market potential. As a minimum, access to volume securing the present position of the EU on the world market should be opened up. This will mean a B quota volume corresponding to 2-5% of the present EU milk production".

Given that the increase in import access and reduced subsidised exports under GATT has been earlier estimated to be equivalent to a net 4 million tonnes addition to the EU market, and that EU policy options discussed earlier include a 4% quota cut, or a 2% cut combined with a price cut, it seems reasonable to consider a limited number of B quota volumes as follows:

(a) minus 2% A Quota replaced by 2% B Quota
(b) minus 2% A Quota replaced by 4% B Quota
(c) minus 2% A Quota replaced by 6% B Quota
(d) minus 4% A Quota replaced by 4% B Quota
(e) minus 4% A Quota replaced by 6% B Quota.

As B Quotas would be sold solely on the world market, their *primary* effect is on world market prices and quantities, with of course secondary consequences for the internal EU market. Given fixed tariffs under GATT, the level of world market prices is crucial in determining whether B quotas, which will lower world market prices, would also force EU internal support prices downwards. World market prices fluctuate very widely, being affected by many supply and demand factors and by fluctuating exchange rates. The estimated effects of B

Table 1
Estimated Effect of Policy Alternatives on Gross Revenue from Irish Milk Product Sales, Year 2001

	Policy Alternatives	*£ mill.*
(1)	Quota Reductions Only (- 4%)	- 52
(2)	Combined Quota (- 2%) and Price Reduction	- 116
(3)	Price Reduction Only	- 184

quotas inevitably show that increasing levels of B quotas lead to lower world market prices, an increased world market size due to buyer response to lower prices, and an increased EU world market share.

The five B quota policy alternatives would also have differing consequences for export refunds, degree of tariff protection, dairy industry gross revenue and costs and GATT commitments such as reducing budgetary expenditure on export subsidies by 36% over six years. While estimates were made of these various effects at EU level, this paper concentrates on the consequences for gross revenue

Table 2
Estimated Effect of B Quota Policy Alternatives on Gross Revenue from Milk Product Sales, (Farm and Manufacturing)

	(a) GATT Policy Alternatives	**£ mill. p.a.**	
(1)	Quota Reduction only (-4%)	- 52	
(2)	Combined Quota (-2%) and Price Reduction	- 116	
(3)	Price Reduction only	- 184	
		£ mill. p.a.	
	(b) B Quota Alternatives	***Specific***	***Overall***
(4)	minus 2% A Quota replaced by 2% B Quota	+ 12	- 104
(5)	minus 2% Q Quota replaced by 4% B Quota	+ 23	- 93
(6)	minus 2% A Quota replaced by 6% B Quota	+ 32	- 84
(7)	minus 4% A Quota replaced by 4% B Quota	+ 23	- 29
(8)	minus 4% A Quota replaced by 6% B Quota	+ 4	- 48

of Irish dairying.

Under the assumptions made, the specific effects of the five B quota alternatives on the gross revenue of Irish dairying range from +£32 million to +£4 million (Table 2). (By specific effect is meant the additional impact of the B quota per se.) These values may seem somewhat small, however a B quota of say 4% in Ireland is little over 40 million gals which would be sold at world market prices, say around 50p per gal, and 40 million x £.5 = £20 million. In one case, it was estimated that the largest B quota (+6) would result in a lower specific benefit than a smaller B quota, as under the assumptions made, a large B quota would lower world market prices to such a level that the year 2001 tariff would not protect the EU support price and, subject to the GATT safeguard clause, a support price reduction would ensue. Combining the A and B quota policy alternatives, the best option emerging re gross revenue was to combine a quota reduction rather than a price reduction on the A quota with a limited B quota (Table 2).

The overall conclusion from the model calculations was that B quotas would be positive for gross revenue in Irish dairying, but their size would have to be limited at EU level lest they cause world market prices to fall to levels which, with fixed tariffs, would create pressures for reductions in A quota support prices. It is also clear that it would be desirable that B quotas would be flexible, given the likelihood of large fluctuations in world market prices and exchange rates.

Further considerations, including the timing of policy changes, the possible loss of windfall gains with B quotas, the risk to the A quota, product differentiation, world market shares, are discussed in Keane and Collins (1995).

Longer term policy options

With regard to longer term options post-2000, the starting point is consideration of world agricultural trade policy beyond the Uruguay Round. A key component of the Uruguay Round was the establishment of fixed tariffs and their general reduction by 36% (S.M.P. by 20%) by the end of the round. While the impact of this may be limited over the period of the Uruguay Round, if it is accepted that the tariffs will continue to be reduced, then this reduction will be a primary determinant of EU internal prices post-Uruguay Round, with world market prices plus tariffs establishing an effective upper limit to EU internal prices. (The continuation of the safeguard clause or a market stabilisation scheme would be even more important in any new round.) Thus the rate of tariff reduction is crucial. In order to conduct an analysis some assumptions are necessary about the rate of reduction and a date for ultimate free trade.

Assumption on tariff reduction

The basis for the assumption on tariff reduction is that the initial tariff at the beginning of the Uruguay Round is equivalent to about 90p/gal in Irish terms, and that this is reduced by up to 36 or to 60p/gal at the end of the round, a reduction of about 30p. Given the reduction in tariffs of 30p in the 1990s under the Uruguay Round, it is initially assumed that the remaining 60p approx. equivalent tariff is eliminated in two subsequent trade rounds, resulting in free trade in 2020. The assumption envisages:

(a) a trade round over the period 2001 to 2010 (WTO I) in which the tariff is reduced from 60p to 30p equivalent. This might involve a period of negotiation 2000 - 2003, and a period of implementation 2004 - 2010.

(b) a trade round in 2010 - 2020 replicating the above with free trade at the end.

The policy alternatives considered were:

- continuation of quotas with reducing tariff protection until free trade in 2020
- abandonment of quotas with reducing tariff protection until free trade in 2020.

Again many alternative sets of assumptions were considered with results below confined to one "plausible" set. The assumptions cover a wide range, such as growth in EU and world demand and in EU and world supply, gradual reductions in EU internal and export subsidies, responsiveness of EU and world producers and consumers to price change, etc.

Results

Results for Part II are presented in the form of percentage changes in price, output and gross revenue from the base year at overall EU level. Taking the initial set of assumptions, the results show that with a continuation of quotas, EU prices would fall by about 10% in the first decade and by a further 10% approximately in the second decade to free trade (Table 3). With quotas unchanged, estimated gross revenue for dairying (farm plus manufacturing) would also fall by about 20% over this period.

Table 3
EU gross revenue estimates, base year 2000 = 100

	Price	Quantity	Gross Revenue
	(a) Overall EU with quotas		
Base Year 2000	100	100	100
2010	90	100	90
2020	81	100	81
	(b) Overall EU without quotas		
Base Year 2000	100	100	100
2010	79	113	89
2020	70	115	80

If quotas were abandoned, estimated EU output would expand and, with fixed tariffs, prices would be correspondingly lower. Initial estimates indicate a fall in price of about 20% in the first decade and a further 10% in the next decade or about 30% overall (Table 3). Estimated EU output however would rise by close to 15% in the first decade and tend to increase much more modestly subsequently as producers react to lower prices. In terms of gross industry revenue (farm plus manufacturing), the estimates without quotas involve a fall of about 20% over the two decades, which is almost identical with that for retention of quotas (Table 3). Gross revenue estimates with the abandonment of quotas obviously involve lower prices being multiplied by higher volumes, giving the almost identical results shown.

Profits from dairying depend on costs and likely compensation payments, as well as on gross revenue. In the above comparison the higher output with the abandonment of quotas inevitably involves higher costs, so that profit would be lower if quotas are abandoned. However levels of compensation payments may also be a factor. These issues are not further discussed in this part of study.

While one might conclude from the above that there is a case for long-term retention of quotas, there are strong counter arguments favouring abandonment of quotas, or at least modification of the current rigid quota regime, at some point before free trade. Firstly retention of quotas would mean that Ireland/EU would have a smaller, weaker and less competitive dairy industry on entry into the free trade era. The benefits of economies of scale would not be fully achieved, the share of the world market would be lower and dairy companies supplying Irish products would thus have fewer established market positions in the free trade era.

The position of Ireland relative to the remainder of the EU if quotas were abandoned must also be considered. Given the generally lower production cost base, as shown by Fingleton (1995), it is reasonable to assume that, with no quotas, Irish output would grow at a more rapid rate than the EU average. Thus, taking the above estimates, gross dairy industry revenue for Ireland would probably be higher without quotas than with retention of quotas, given the equality estimate for the EU as a whole. (Some very preliminary estimates for Ireland were made under alternative assumptions.)

Limited production at world market prices

Limited production at world market prices (B quotas or suchlike), side-by-side with the current A quotas are a further alternative between the two extremes of continuing A quotas and unrestricted output. Some preliminary estimates were made of the effect of a limited B quota, as an alternative to just an A quota or total abolition of quotas. Inevitably, the producer pool price lies between the two more extreme policies.

At a more general level, a B quota policy may have considerable merit, as it would mean that production could expand in a controlled situation. Uncontrolled abolition of quotas could involve, for example, much higher EU output, especially in "good" years (climatic etc.). The world dairy market is fragile, and if these years coincided with surges among other suppliers to the world market, world prices could slump. A flexible B quota regime could help in avoiding such problems, while at the same time permitting Irish/EU exporters to maintain and develop market positions in third countries. It would also enable Irish/EU producers to expand, gain scale and technology benefits, and directly experience the competitive forces associated with free trade. This would help to ensure that the generation of producers who will experience free trade would not inherit a small, weak and uncompetitive industry in global terms.

PART 2: The impact of quota and price adjustments on incomes from dairying to year 2000/01

The main objective of this part of the study is to measure changes in the net income from dairying which would result from specified changes in milk quota production and in milk prices up to the year 2000/01. Initially the outcomes of the changes were calculated excluding the option of B-quota milk production and subsequently the B-quota option was included in the calculations.

The evaluation model used to estimate the net income changes arising from

Effect on net income from dairying from quota and/or price changes due to GATT

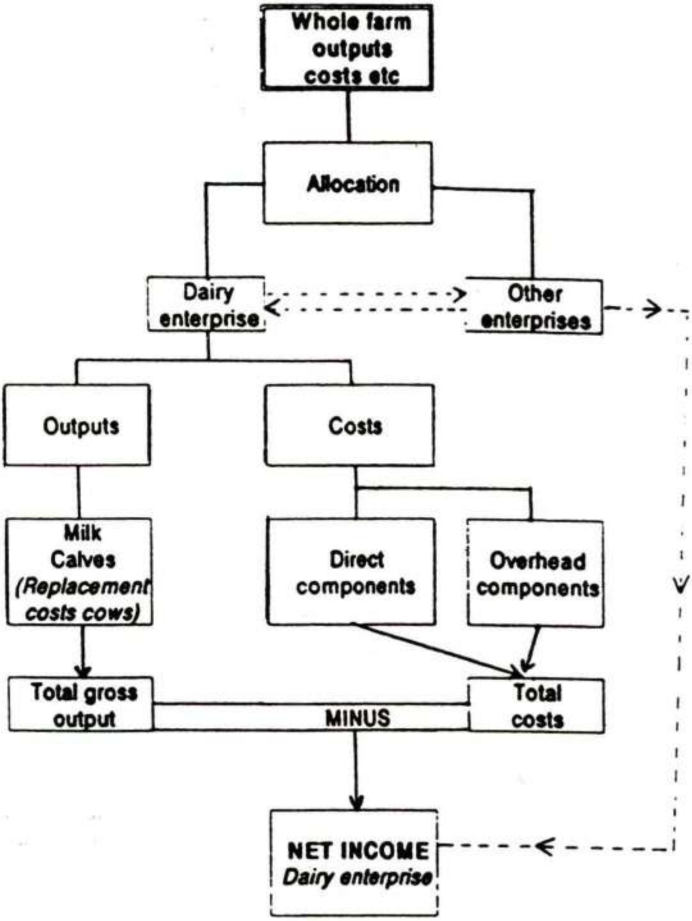

Fig. 1 – Production evaluation model

quota and price adjustments is depicted in Figure 1. It is essentially a representative farm type model. The specified price and/or volume adjustments were applied to the relevant components of the outputs and inputs and the resultant net income from the dairying activity was then calculated. The change in income from other enterprises was independently calculated and included in the net income change for the dairying activity.

Only explicit costs, as conventionally measured in the National Farm Survey, are included in the cost estimates and thus imputed charges for family labour, owned land or other 'owned' capital invested in the farm business are omitted. Total costs, as indicated in Figure 1, are defined as the sum of direct costs and overhead costs. Lower unit costs of milk production arising from the expectation of lower milk prices in the future, or the ability to avail of the possible option to produce B-quota milk, will be strongly influenced by the level of unit production costs on any particular dairy farm.

Initially a number of scenarios were explored for milk quota and/or milk price changes which may be required to satisfy GATT commitments by the year 2000/01, without including the B-quota option. Base year productivity and efficiency relationships were assumed to remain unchanged. These assumptions and adjustments to them are discussed later.

The outcome of changes in net income were calculated for the following scenarios:

S1 A quota cut of 4%

S2 A price cut of 16%

S3 A quota cut of 2% combined with a price cut of 8%

S4 A quota cut of 4% combined with a price cut of 10%

The basis for the first three scenarios has been briefly discussed earlier in Part 1. The fourth scenario is the published expectation from a study by the Danish Dairy Board of the adjustments required in EU quotas milk prices to meet the terms of the GATT Uruguay Round by the end of the period covered by the agreement. Of the four scenarios, the authors consider the combination of a 2% quota and a price of 8% to be closest to the expected final outturn.

The resultant effects on net income compared with the base year for the four scenarios are shown in Table 4 for 'all herds,' 'larger herds' and 'smaller herds.' Dealing with 'all herds' first, the least damaging adjustment to net income is that under S1, which results in a 5% fall in net income. Relying on a price cut only of 16% (S2) would cause the largest drop in net income from dairying (-33%). The Danish expectation (S4) would cause net income to fall by 25% whilst the 'more likely' 2% quota cut combined with an 8% price cut would result in the net income decline of about 19%.

The same calculations, for the four scenarios as specified, were also carried out for specialised dairy farms with smaller herds (10-30 cows) and with larger

Table 4

Effect of quota and/or milk price changes on net incomes (dairying) for smaller herds, larger herds and all herds. (From base year 1993/94 = 100 to year 2000/01)

Scenario	Smaller herds (10-30 cows)	Larger herds (60 cows +)	All herds
	Net income change (%)		
S1	-5	-5	-5
S2	-31	-34	-33
S3	-18	-20	-19
S4	-23	-26	-25

Note: See text for specifications of scenarios S1 to S4 herds (60 cows +). The resultant changes to net incomes were not substantially different for each scenario compared to the results discussed above for 'all farms' (Table 4). There was a tendency for larger herds to show marginally greater income reductions where price cuts were included in the scenario specified.

Effects on net incomes including the B-quota option

The B-milk quota option as proposed by the Danish Dairy Board was described in Part 1. The most critical questions at farm level to be answered, if B-milk quotas were available, concern the producer price expectations for B-milk and the effect on basic A-quota prices, if any, of varying amounts of EU dairy product exports derived from B-milk production. Using the results from the economic model (see Part 1), the alternative quota and price changes were defined as follows:

Alternative 1: 2% A-quota cut replaced by 2% B-quota **and** A-quota price reduced by 8% with a B milk price of 54 pence per gallon.

Alternative 2: 2% A-quota cut replaced by 4% B-quota **and** A-quota price reduced by 8% with a B milk price of 50 pence per gallon.

Alternative 3: 2% A-quota cut replaced by 6% B-quota **and** A-quota price reduced by 8% with a B milk price of 46 pence per gallon.

Alternative 4: 4% A-quota cut replaced by 4% B-quota **and** no change in A-quota price with a B milk price of 50 pence per gallon.

Alternative 5: 4% A-quota cut replaced by 6% B-quota **and** A-quota price reduced by 3% with a B milk price of 46 pence per gallon.

Changes to dairying net incomes for the five alternatives, including B-milk production, are shown in Table 5. The first three alternatives result in very similar changes. In all three cases, the reduction in net incomes is close to 18% compared to the base situation. Alternative 4 gives the best result, where no change in A-quota price is anticipated due to a 4% cut in A-quota, which in turn is replaced fully by a 4% B-quota. The decline in net income is limited to 4% of the base

Table 5

Effect of quota and milk price changes on net incomes (dairying) including options for B-quota milk production (from base year 1993/94 = 100 to year 2000/01)

Alternative	Smaller herds (10-30 cows)	Larger herds (60 cows +)	All herds
	Net income change (%)		
Alt. 1	-17	-19	-18
Alt. 2	-17	-18	-18
Alt. 3	-17	-19	-18
Alt. 4	-4	-4	-4
Alt. 5	-9	-10	-10

Note: See text for specification of alternatives with B-quota included

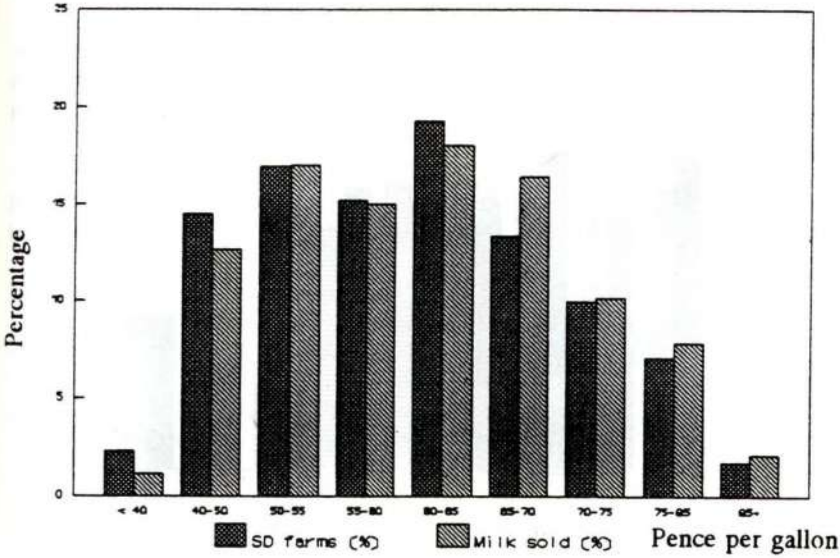

Fig. 2a – Distribution of farms and milk sold by level of <u>total costs</u> per gallon produced (pence per gallon)

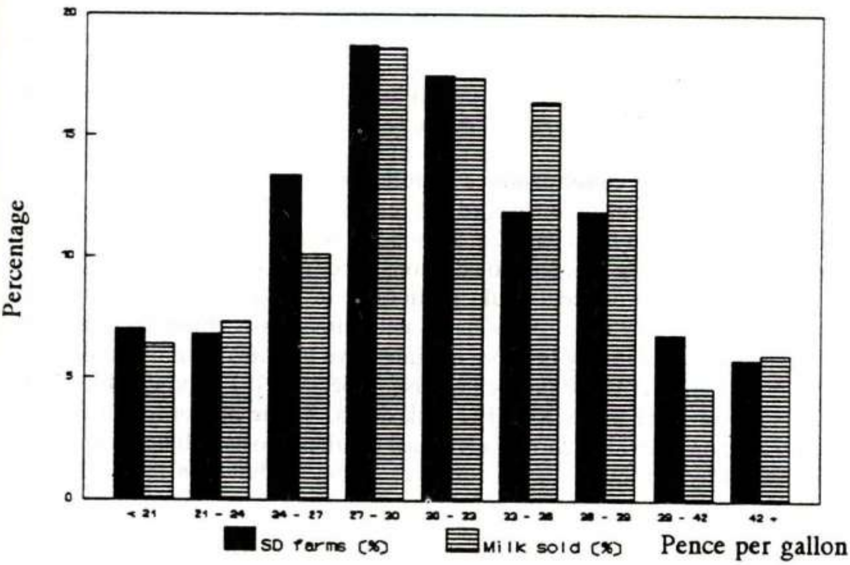

Fig. 2b – Distribution of farms and milk sold by level of <u>direct costs</u> per gallon produced (pence per gallon)

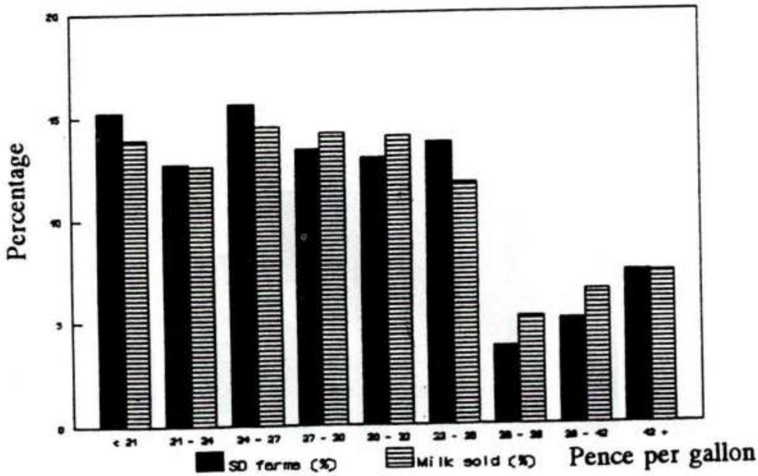

Fig. 2c – Distribution of farms and milk sold by level of overhead costs per gallon produced (pence per gallon)

net income. In the final alternative (5), as a 4% cut in quota is more than replaced by a 6% B-quota, the A-quota price is forced down to maintain EU tariff protection against imports. This, together with the lower B milk price from world markets, results in a net income reduction of 10% overall. Also, it is shown in Table 2 that there are only marginal differences between the changes in net incomes for smaller, larger and all herds groupings with regard to each specified alternative that includes the B-quota option.

Which dairy farms could produce B-milk quota?

This question can be answered by reference to the unit costs of milk production as shown in Figures 2a, 2b and 2c. Where the quantity of B-quota produced is relatively low, and no additional overhead costs are incurred, then virtually all milk producers could participate in the production of B-milk. However, for up to 25% of dairy farms with direct costs above 36 pence per gallon (see Fig. 2b) it may be more remunerative to forego B-milk production in favour of an alternative farm enterprise, especially if EU production of B-milk is 6% or more of the total EU milk quota. As the proportion of B-milk is increased on individual farms, additional overhead costs will be incurred, so that eventually the level of total costs per gallon as shown in Figure 2a will apply. In this situation only the most cost- efficient farms, probably not more than 15% of all farms, may find it feasible to produce B-quota milk. Even on the more cost-efficient farms, it would be advisable to assess whether the resources employed in B-milk production could be more profitably used in an alternative farm enterprise .

The B-milk price available to the producer will be critically dependent on whether the EU level of B-milk is produced *only* for unsubsidised dairy product exports, and whether the amount of B-milk purchased by an individual milk processor will incur *only* marginal processing costs or something more. Therefore, the proportion of Irish dairy farmers which could participate in B-milk production will be estimated with greater confidence when the EU B-milk production possibilities are more clearly established, and when the milk processors are able to clarify their additional product costs.

Estimated changes in aggregate net income from dairying

An attempt was been made to calculate the aggregate change in net income from dairying for each of the four scenarios and five alternatives (with the B-quota option) outlined earlier. The assumption was made that the effects of price and quota changes, as determined for specialist dairy farms, would on average be the same for those farms with milk production which were excluded from the base representative sample. The estimated aggregate net income changes for the four scenarios and five alternatives are shown in Table 6. These changes reflect not only the volume and price changes in the types of milk quota produced (A and B), but also include adjustments both to costs of milk production, where appropriate, and to the net income from other farm enterprises when quotas produced exceed or fall short of the base period.

Table 6
Estimated changes in aggregate net income (dairying) for four scenarios and five alternatives with B-quotas (year 2000/01 relative to base 1993)

	IR £m
Scenario 1	- 24
Scenario 2	- 167
Scenario 3	- 96
Scenario 4	-124
Alternative 1	- 91
Alternative 2	- 89
Alternative 3	- 92
Alternative 4	- 21
Alternative 5	- 50

Note: See text for specifications of various scenarios and alternatives

Clearly the most favourable outcome, excluding the B-quota option, is where a 4% cut in the basic quota, without price cuts, satisfies the commitments under GATT. This gives a reduction of IR£24 million relative to the base year. Relying totally on a price cut results in a massive reduction of IR£167 million in aggregate net income. The two combinations of quota and price cuts specified also result in relatively large reductions in aggregate net income of IR£96 million for Scenario 3, and IR£124 million for Scenario 4.

When the Scenario 3 specification is combined with B-quota options of 2%, 4% and 6% in Alternatives 1, 2 and 3, respectively, the reduction in aggregate net income is slightly reduced. There is little difference between the outcomes for the first three alternatives, with Alternative 2, a marginally more advantageous option where a 2% cut in A-quota is replaced by a 4% B-quota.

Alternative 4 gives the best overall result, where no price reduction applies to A-quota and the 4% cut in B-quota is matched by a 4% B-quota option. The loss in aggregate net income is only IR£21 million. Under Alternative 5, where a 4% in A-quota is replaced by an increased level of B-quota of 6%, the loss in aggregate net income is substantially higher, at an estimated IR£50 million. This again underlines the extremely adverse effects on net income from dairying, both at farm level and in the aggregate when the price of the basic quota is reduced.

OTHER ISSUES FOR CONSIDERATION

(a) Productivity gains and cost efficiency

The results presented with regard to income changes from adjustments to quotas and milk prices were based on the assumption that base year productivity and efficiency relationships remained constant, i.e., at base year levels. In practice this assumption is unlikely to hold over time. It is normally the case that farmers who want to maintain their real income levels and survive in farming must achieve growth in their businesses over time. An ability to increase productivity on dairy farms will be needed to offset or negate the reductions in net incomes set out earlier.

To demonstrate the relevance of productivity gains in relation to the maintenance of incomes, the effects on net incomes of three achievable rates of productivity growth are shown in Table 7. The three growth rates of 1%, 1.5% and 2.0% were applied only to a selected number of the quota and price change alternatives evaluated earlier. It should also be noted that a specific increase in input prices was included in the calculations (see note with Table 7).

Table 7

Net income changes arising from increasing productivity under selected scenarios and alternatives of quota and milk price changes.*

Productivity increases per annum	1.0%	1.5%	2.0%
		Net income change (%)	
Scenario 1	-2	+6	+15
Scenario 2	-17	-9	-1
Alternative 2	-15	-7	+ 2
Alternative 4	-1	+8	+17
Alternative 5	-7	+2	+11

* In the calculations are expectations that total costs, with the exception of purchased concentrates, will grow by 2% per annum over the period. The scenarios and alternatives selected are as specified earlier.

Achieving the lower growth rate of 1% per annum in productivity would not make major inroads towards removing the negative effects on income from the GATT; gains of 1.5% to 2% are seen as necessary to maintain real incomes on dairy farms.

On many dairy farms there is substantial scope to reduce the unit costs of milk production and in these situations incomes may be more effectively protected through pursuing cost efficiency measures. On the basis of current input-output relationships on dairy farms, a reduction of one penny per gallon in milk production costs would result in about a 2% increase in net income from dairying.

(b) Compensation for price cuts

In the results shown earlier in Tables 4 and 5, the most negative effects on net income were always due to a reduction in the price of basic (A) quota milk. Given the outcome of CAP reform for other farm products, it seems legitimate to expect that compensatory payments would also be made for income loss arising from price reductions needed to fulfil GATT commitments. If this were to apply, it would probably enhance the introduction of a small but flexible level of EU B milk production.

(c) Quota asset values

Milk quotas have currently acquired very significant asset values. The introduction of B-milk quota to replace a reduction in A-quota milk would almost certainly diminish the asset values of standard quotas. In general, this would be advantageous to milk producers who intend to continue long-term in dairying. Under the present system, capital is being continuously drained from dairy farming and anyone expanding in, or planning to enter, milk production has to carry a major additional financial burden when acquiring milk production rights.

(d) Competing for B-quota production with other EU countries

A close examination of the Danish B-quota proposal suggests that if the B-quota option was introduced by the EU, the distribution of B-quota rights would not necessarily be directly proportionate to the current national distribution of the EU milk quota. The Danish preference is for B-quota to be distributed 'according to historic export quantities with refunds' under 'an EU-based license system'. On this basis, potential allocations to certain EU countries would be very limited.

If on the other hand, the option to produce B-milk was freely available to dairy farmers in all EU countries, the question of which country's milk producers would be best able to compete for B-milk production rights would be strongly influenced by comparative production costs. The results of a recent study on the comparative costs of milk production in EU countries, indicate that Irish dairy farmers produce milk at the lowest average cost, apart from Belgian milk producers, Fingleton (1995). Even when the higher milk prices to other EU producers were taken into account, the unit net margins from Irish milk production were still very favourable in comparative terms.

Conclusions

- A number of policy alternatives were evaluated to determine the most appropriate response to the GATT Uruguay Round and the desirability of introducing B milk quotas. A required quota reduction of up to 4% on its own to meet GATT commitments would best maintain dairy industry gross revenue whilst using price reductions only (-16%) would seriously erode gross revenues in the Irish dairy industry.
- It was shown that from an industry point of view there should be some scope for B milk quotas in the EU provided the quantity allowed was limited and flexible with respect to world market conditions.
- In regard to longer term dairy policy alternatives, the retention of quotas would lead to lower reductions in prices compared with the abandonment of quotas. But if quotas were abandoned, milk production would increase and, as a result, the gross revenue of the dairy industry could be very similar to that under a continuation of quotas.
- If, as was assumed, future world trade agreements will ultimately lead to free trade in dairy products then the abandonment of quotas, at some stage, may be necessary to promote a stronger and more competitive dairy industry to meet that challenge. In this situation, the production of B-milk quotas, in a controlled and flexible way, could thus play a valuable transitional role.
- To meet GATT commitments, net incomes from dairying would be better protected through quotas cuts rather than price reductions.
- The B-quota option could be marginally beneficial in terms of net dairy incomes. But the quantity of B-milk production must be limited so that the price of A quota is not adversely affected.
- Most Irish dairy farmers could participate in B-quota production if relatively low quantities are involved but only a minority of cost efficient producers could consider B-quotas if additional overhead costs are incurred.
- Productivity gains in excess of 1.5% per annum would be required to maintain net incomes from dairying in the medium term. Assuming a continuation of quotas, more efficient use of inputs may provide the best strategy towards achieving such gains.
- The results shown in the body of this paper were derived from inputting the 'most plausible' set of assumptions into a relatively simple economic model and therefore results are sensitive to changes in these assumptions. The authors also recognise that many other issues need to be researched which would bring greater clarity to debating and selecting the most desirable policy options to pursue in the best interests of all involved in the Irish dairy sector.

The authors wish to acknowledge the generous support received from the Irish Dairy Board and also the contribution made by Irish dairy farmers from the Dairy Levy Fund.

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Production Performance on Dairy Farms in Relation to Milk Quotas

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Introduction

The profitability of dairy farming is affected, not just by prices and unit costs, but also by the amount and structure of inputs used, their technical productivity, and the physical output levels attained. This aspect of the farm business should have been particularly relevant in the quota era, since the constraints on production should have focused attention much more on technical aspects of resource use and on finding the most efficient structure of inputs to produce the permitted output. Dairy farmers in Ireland have been exposed to the quota system for over a decade now. The major realignments which were necessary to work in this new reality should have been made for some time now on farms. In this paper, the economic returns from Dairying using the Moorepark Blueprint for efficient milk production are presented. The focus is on systems of production based on spring-calving. The performance on commercial dairy farms was also considered to see whether this optimum system of milk production is evident on commercial dairy farms.

Current milk production system

Optimum system of milk production

The optimum system of milk production for a given quota is not immediately obvious. The shape and place of the production function, the return from alternative enterprises and the costs of feed and other inputs as well as milk price play a decisive role. The basis for analysing economic optimality in milk production is the production function and the cost function derived from the production function.

Figure 1 shows a typical cost function for milk production with a given number of cows in the herd. The top of the figure shows the total costs of production (TC) as a function of milk production.

These costs can be divided into three groups:

1) Feed costs, i.e. costs which vary both with feed input and with the number of cows.
2) Other production costs, i.e. costs which vary only with the number of cows. Costs of breeding, veterinary services, labour and interest on the herd capital are examples of such costs.
3) Fixed costs. i.e. costs which are fixed even if the number of cows is reduced. These costs include book interest, depreciation and maintenance of buildings and machinery. Whether these costs are fixed or not, naturally depends on

the time horizon. In the short run, they are fixed costs, but in the long run it will be possible to adjust these costs to the number of cows.

The bottom part of the figure shows the marginal costs (MC) and the average production costs (APC) as a function of milk production. The average production costs are defined as the sum of "Feed costs" and "Other production costs" divided by the milk production.

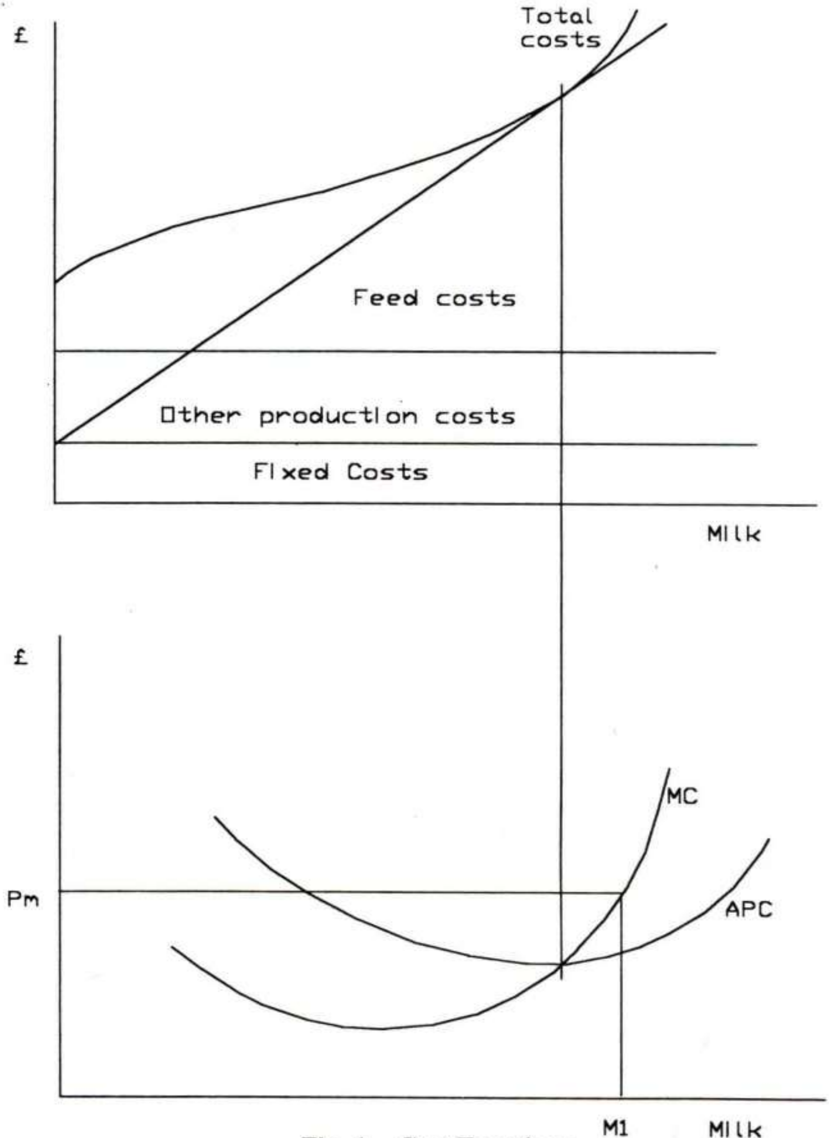

Fig. 1 – Cost Functions

With a milk price of P_m and without any quota restriction, the optimal milk production is Ml. With this amount, profit is maximised.

But with a milk quota Q (Q < M1) the milk production has to be reduced. This can be done by reducing feed input or by reducing the number of cows. Naturally a combination is also possible. The criterion, according to which a given reduction should be carried out, is that costs should be reduced as much as possible. By reducing feed input, feed costs are reduced. This reduction depends on the marginal price per feed unit. By selling cows, the cow-dependent costs (i.e. "Other production costs" including feed for those cows), are reduced. This reduction depends on the value of cows (interest) and the expenses on breeding and veterinary services.

Under the assumption that all the cows in the herd have the same milk production function (this is not the case in practice), the optimal solution to the problem is given by the following adjustment procedure: Reduce feed input until the point where the average production costs (APC) are at the minimum. If further reduction is necessary, sell cows until the quota is reached. The optimal adjustment procedure is shown in Figure 2. First the milk production per cow is reduced from M_1 to M_2. If further reduction is necessary, cows are sold. Of course, if the quota is reached before the production is reduced to M_2, the reduction should only be carried out to the point, where the quota is reached, and no cows will be sold.

The adjustment procedure described so far refers to short run adjustment. The short run is characterised by the fact that some of the costs are fixed, i.e.

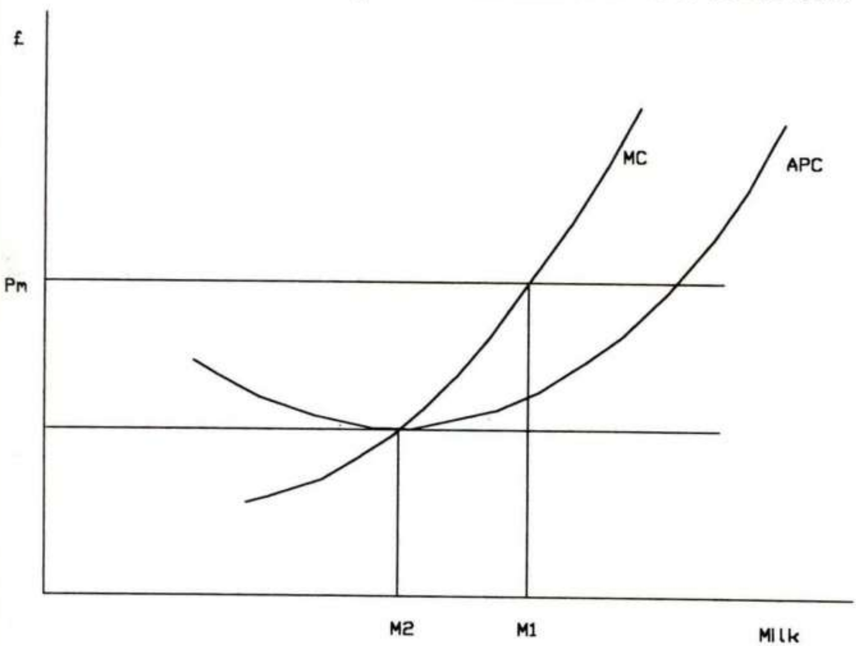

Fig. 2 – Adjustment of Milk Production

will not change even if the number of cows is reduced. Capital costs and sometimes also labour costs are examples of such costs. In the long run, it is possible to adjust these costs. Therefore, in the long run they should be considered as variable costs, and should be taken into account in calculating the average production costs. On the other hand, once the farm conditions are adapted towards the new requirements and the farmer has to make decisions about next year's production, investments are fixed and costs are therefore to be seen from the short run perspective again and thus split in fixed and variable costs.

Current milk production costs

The current costs of inputs and current prices were applied to the current recommended milk production system defined from production research taking cognisance of the issues discussed above. The computer system incorporating these relationships is called 'The Dairy Planner'. This computer programme allows the returns from various production systems, including different combinations of inputs, to be determined quickly. In summary, this computer system incorporates all the physical inputs of the dairy system as well as the financial parameters. This program was used for much of the financial analysis in this paper.

Model farm used to determine the optimum system of production

A model farm was used in this analysis to determine the optimum system of production under various scenarios. This model farm represents a typical dairy farming system in Ireland now where milk quota is usually limiting before land and where there has to be a combination of enterprises to use the land available. This allows the opportunity cost of capital to be evaluated versus profitability of other farm production areas. The main assumptions used for the model farm are given in Table 1. The amount of capital used varied depending on whether the quota or no quota scenario was considered. Capital was not a constraint as was Quota and farm size. Capital did however influence the final solution because different levels of capital were used for the various systems.

Table 1
Assumptions used in model farm

Quota size	40,000 gallons
Farm size	60 acres
Enterprises	Dairying and Beef

A number of options were considered where quota constraints were applied and where no quota constraints were applied. High milk price and low milk price scenarios were also considered. It is argued that in the short term, the two milk price levels chosen would not result in any significant change in the current recommendations for milk production. The effect of milk price paid to farmers on the industry in the longer term is outside the scope of this paper. It was considered that these were the main driving components of the dairy system and should give direction as to the optimum system that should be adopted by dairy farmers depending on the economic policy options employed. This analysis is mainly focused on the potential for profit. It is recognised that detailed financial analysis involving cash flows, etc. is needed before the 'good strategies', derived from this analysis, can finally be adopted on farms.

Effect of quota size on farm profitability

The effect of varying quota size from 25,000 to 50,000 gallons was considered. The effect of quota size on the increase in farm profitability is shown in Figure 3. It has to be recognised that as the quota size increases or decreases, the number of dairy cows and beef animals also vary.

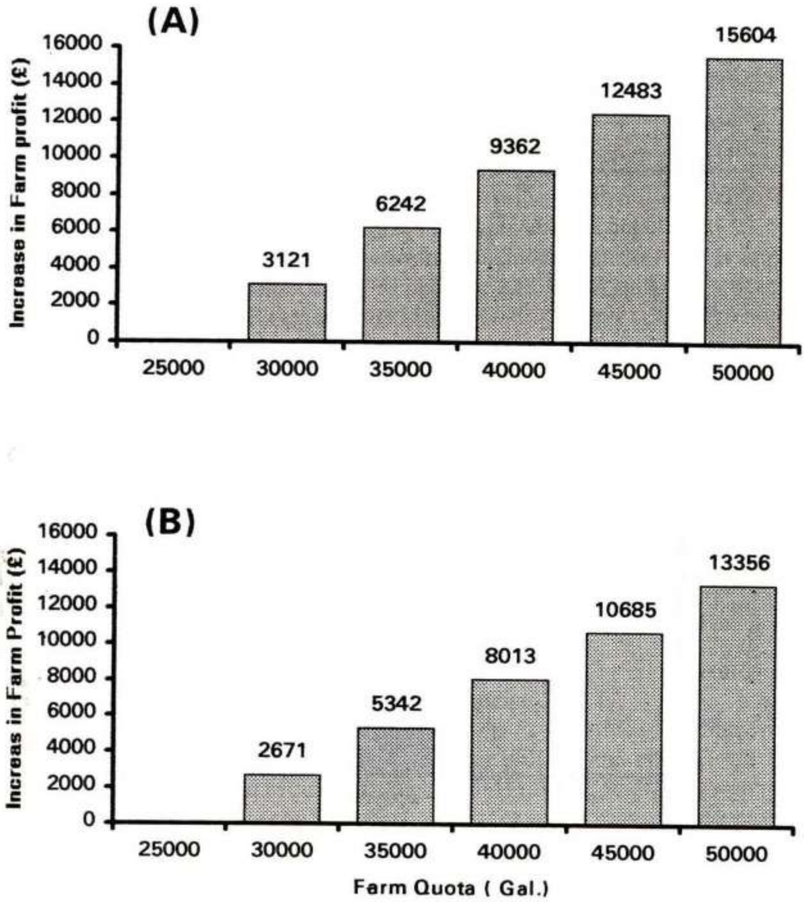

Fig. 3 – Effect of quota size on farm profit for, (A) high milk price (103p/gal), and (B) low milk price (83p/gal)

Increasing milk quota from 25,000 to 50,000 gallons increases farm profitability by £15,604 in a high milk price situation (£624/1,000 gallons of quota) and by £13,356 in a lower milk price situation (£534/1,000 gallons of quota). Quota size has a very large effect on farm profitability. Single indicator

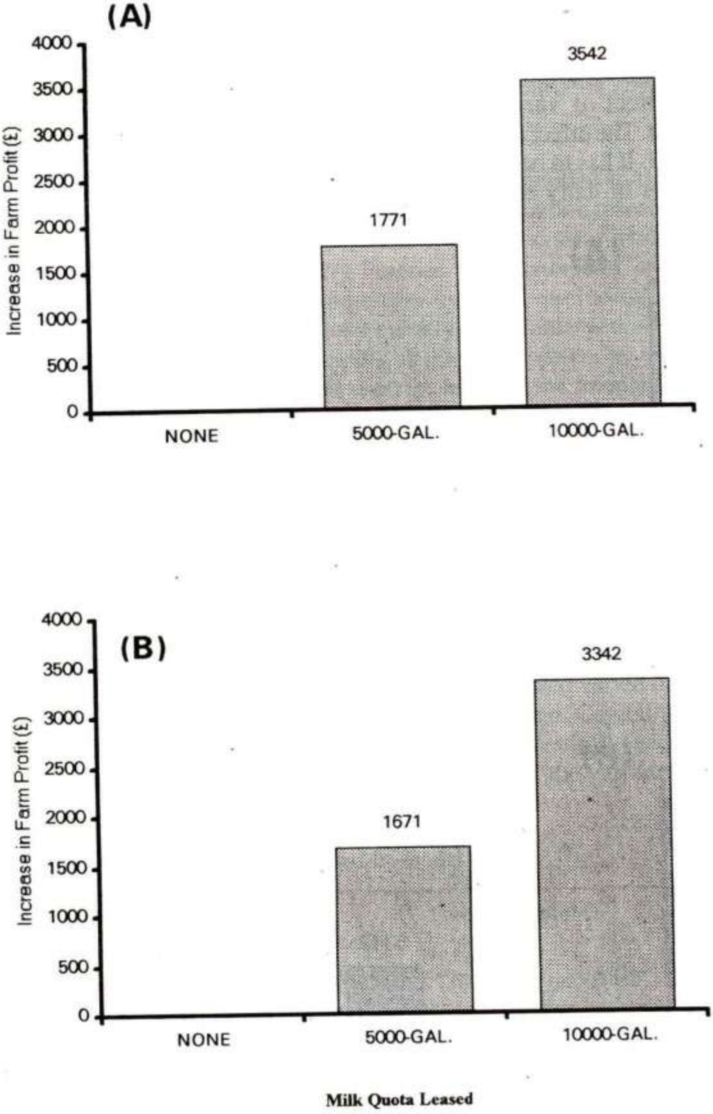

Fig. 4 – Effect of leasing quota on farm profit for,
(A) high milk price leased @ 27p/gal, and (B) low milk price leased @ 20p/gal

factors, such as farm gross margin per cow, per acre or per gallon, are of limited use in assessing the importance of quota size. The relative change in farm gross margin was similar for both the high and the low milk price situation. The relative change in farm net margin is however different for the two milk price scenarios. Of particular importance is the level of fixed costs on the farm. Size of quota has also a large influence on the optimum proportion of cows and beef cattle on the farm (or alternative enterprises).

It is important to consider parameters such as net margin when assessing the importance of factors such as quota size. It is recognised, that fixed costs may not be constant over the range of quota size considered here. The analysis does show, that fixed cost structure has a very important effect.

Effect of leasing additional quota

The milk quota size on the farm has a large influence on farm profitability, as seen in Figure 3. Many farmers lease additional quota in order to improve farm profitability. The effect of leasing 5,000 or 10,000 gallons of additional quota (@ 27 p/gallon and (@ 20p/gallon) was considered. The results are shown in Figure 4.

Leasing 5,000 and 10,000 gallons of milk quota increased farm profit by £1,771 and £3,542 respectively in a high milk price situation and by £1,671 and £3,342 for a lower milk price scenarios. This represents an opportunity to increase farm profit by 35 and 33 p/gallon of additional quota on the farm. It is important to recognise, that the opportunity to produce additional milk is as financially rewarding for a low milk price situation as it is for a high milk price situation.

Effect of milk price on farm profitability

The effect of milk price on farm profitability is shown in Figure 5. Like quota size, milk price has a large effect on farm profitability, whether measured in terms of gross margin or net margin, thus explaining the attention that is paid to milk price. An increase of 10 p/gallon of milk results in an increase in farm margin of £4,113 in a quota situation and £5,400 in a no-quota situation. The absolute profit for any level of milk price is, however, much higher in a no-quota situation because a much higher level of milk production is sold from the farm. The level of inputs should not change over the range of milk price considered in this analysis.

Interaction between quota size and milk price

In a falling milk price situation, farm profit is reduced as shown in the previous section. Normally, the dairy farmer will try and compensate for this by increasing the scale of his farm business. If quota constraints were relaxed then the drop in income can be compensated for by increasing milk production on the farm. The interaction between quota size and milk price on farm gross margin is shown in Figure 6. In this situation an additional 7,800 gallons of milk quota needs to be produced on the farm to compensate for a 10 p/gallon drop in milk price. There is great scope for increasing milk output on many farms, as the quota size is limiting production more than land and capital. An

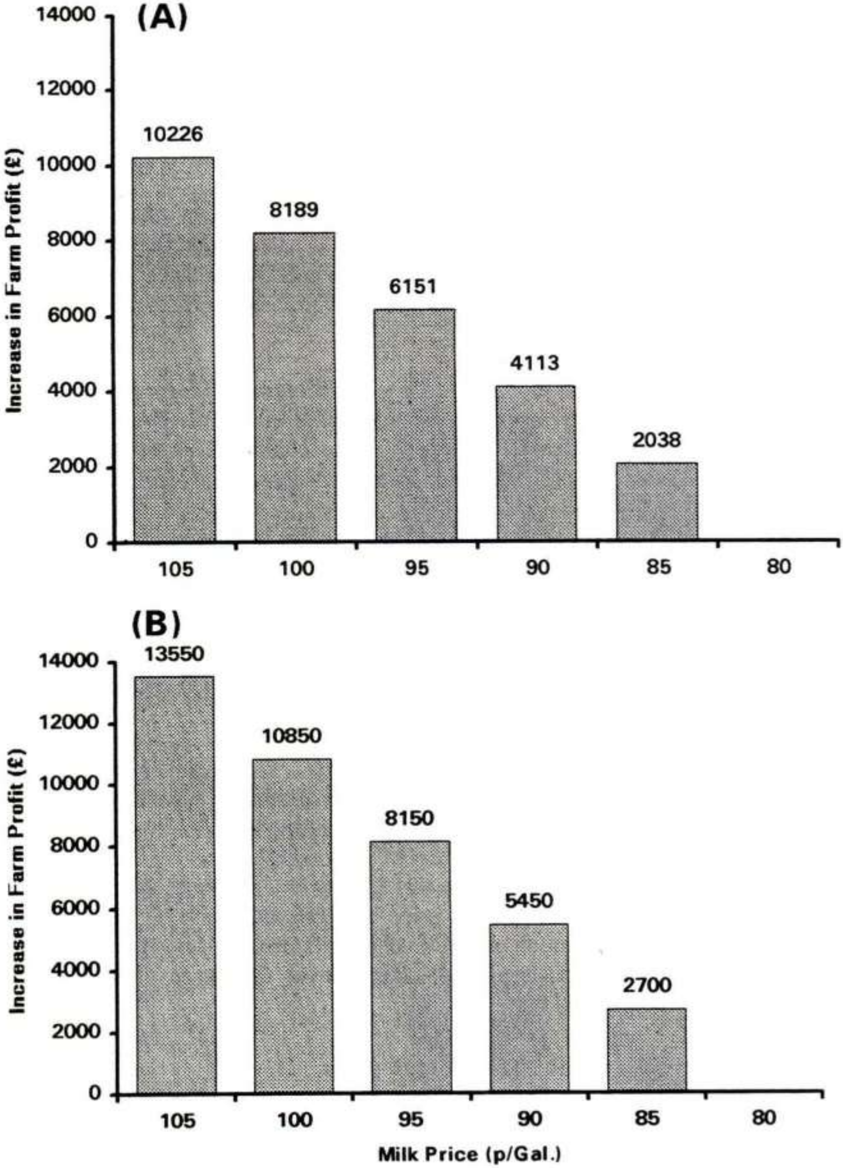

Fig. 5 – Effect of milk price on farm profit for, (A) with a quota, (B) without a quota

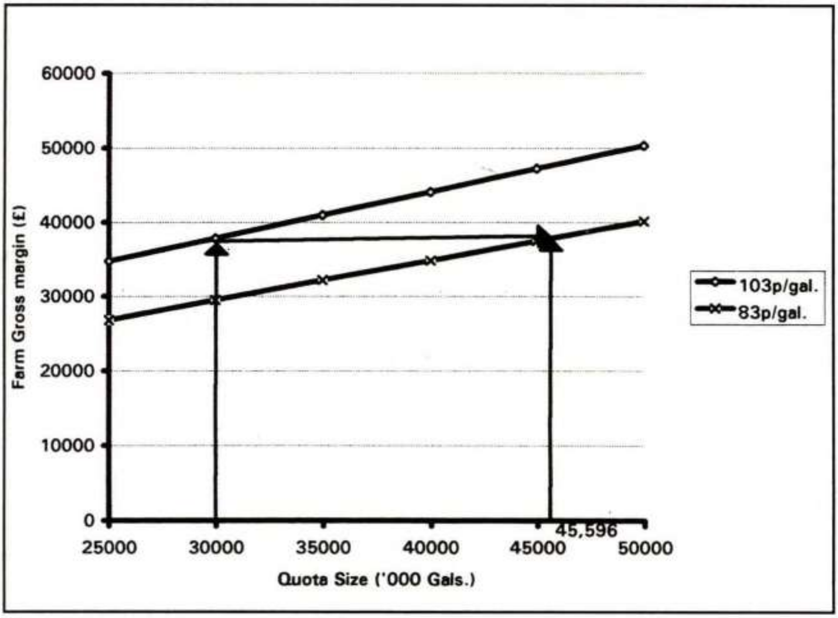

Fig 6 – Interaction between quota size and milk price on farm Gross Margin

increase in output can also be obtained with little change in costs, because there is untapped potential in many herds, which have not been exploited, because of quota constraints.

Effect of milk yield per cow on farm profitability

The importance of milk yield per cow in determining farm profitability in a quota situation has received much debate in recent times and has been the subject of much confusion. Much of the confusion relating to the importance of milk yield is due to the fact that it can vary with many of the inputs associated with Dairying. Here we consider the importance of milk yield under an optimum system of milk production. The effect of milk yield per cow on farm profitability under a quota and no-quota situation and under a high and low milk price situation is shown in Figure 7. In a quota situation, increased milk yield per cow results in increased farm profit in a low milk price as well as in a high milk price situation. The greater advantage is however for the high milk price situation. The benefit to increased milk yield declines as milk yield per cow increases. This follows the principle of economies of scale and is mainly found because of the change in the proportion of other costs and outputs associated with the cow. As milk yield per cow increases, the number of cows required, to fill the quota, decreases. In a non-quota situation, improved milk yield per cow has a far more beneficial effect. The effect is linear in this situation. This is because

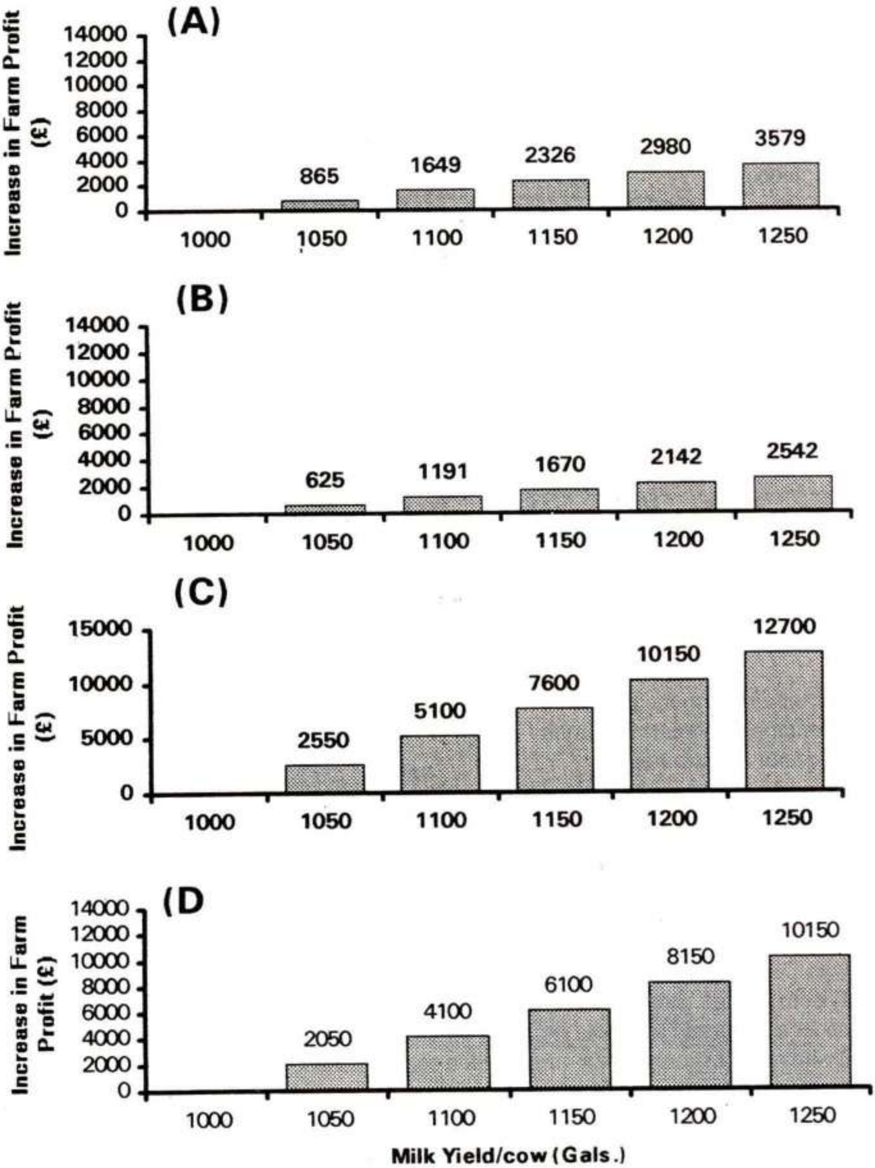

Fig. 7 – Effect of yield per cow on farm profit for,
(A) high milk price-Quota, (B) low milk price-Quota
(C) high milk price-No-Quota, (D) low milk price-No-Quota

the number of cows on the farm does not change. In farm practice, this scenario is a little academic, because additional feed will be required for the extra output of milk. This contrasts with a quota situation, where the opportunity cost of allocating more feed (grazed grass) to the dairy cow is less. The results do show however, that milk yield per cow is an important measure of productivity on dairy farms.

Summary of current milk production system

Some of the more important factors influencing farm profitability were considered in the above sections. It is evident that Quota size and milk price have a major effect on farm profitability. Policy strategies which control these two parameters are dictated outside the farm gate. It is obvious then why they receive so much debate. The policy environment does however have an influence on the optimum system of milk production at farm level. The outcome of an aggressive breeding programme to improve the profitability of the herd can be very different depending on whether a quota or no-quota scenario applies. This is true also for many other technical innovations which can be applied at farm level. It is arguable that many dairy farmers are not aware of this when they are assessing the strategies they are adopting on their farms.

Performance on commercial dairy farms

Farms used for analysis

The farms used for this analysis were selected from the sample of farms used by the National Farm Survey (NFS). The National Farm Survey (NFS) and its predecessor, the Farm Management Survey (FMS), have been conducted annually since 1972 on a representative sample of Irish farms to monitor trends in farm output, costs, incomes and performance. The farms chosen for this analysis were specialist dairy farmers. The objective was to see how individual farms are performing relative to the optimum system of milk production as described earlier. It is recognised that these dairy farms are of different sizes, are located on different soil types around the country and have various systems of milk production. The farms were categorised into small, medium and large farms based on size of farm.

Measurement of performance on dairy farms

The primary financial measures conventionally used in assessing the performance of dairy herd management are the margin over concentrates and margin over feed and fertiliser and the gross margin. The former has indicative value because concentrate feed costs tend to represent such a significant proportion of the total variable costs and are susceptible to specific control in the management of a herd. The gross margin provides the widespread standard upon which herd performance can be measured for comparison with herds producing under similar systems (herds with similar fixed cost structures), since it represents the sum available to meet those fixed costs and yield a residual net income. Because many fixed resources in Dairying are specific to that enterprise (and many dairy farms are largely specialised towards milk production anyway), it should be possible to specifically allocate fixed costs and so calculate a net margin also. This is the equivalent at the enterprise level of the 'management and investment income' calculated for the whole farm; it represents the residual available to cover the operator's management and capital used in the enterprise. The National Farm Survey (NFS) data allowed computation down to net margin level. This is one of the reasons why this data set was used for this analysis.

Measurement of performance on farms relative to target values

Many of the methods described above were used on the sample of farms used for this analysis. The mean value for various parameters is often used for this type of analysis. The mean is however, often composed of values with a wide range and the data often has a skew distribution. The target values were derived taking cognisance of the issues discussed earlier and are realistic if the technology outlined earlier is applied on farms. It is argued that the distribution of results from target values is a better method for getting an understanding of what is happening on farms. A summary of some of the target values used are shown in Table 2. The data are presented on a per cow basis because the cow is the main cost driver on a dairy farm.

Table 2
Target values used in analysis expressed on a per cow basis

Year	1994
Gross output (£)	1294
Variable costs (£)	253
Fixed costs (£)	317
Total costs (£)	570
Gross margin (£)	1041
Net margin (£)	724
Milk yield (gals)	1200
Concentrate fed (kgs)	500
Stocking rate (cows/acre)	1.0
Nitrogen use (units/acre)	350

Note: Replacement heifer costs are not included in this Table. Herd depreciation is included as per the NFS data base.

Gross output

An analysis of the deviation of output parameters from target values gives a much better understanding of farm practices. The distribution of farms relative to target value for gross output per cow of milk is shown in Table 3.

A relatively low percentage of farms have a gross output per cow higher than the target values. Most of these were in the larger farm category. A very high percentage of the farms are however below the target. The proportion of farms with very low output per cow is particularly evident on smaller farms.

Table 3
Distribution of farms relative to target values for gross output £/cow

Farms	% Farms			
	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
Over target	3.46	7.67	22.2	8.53
£0-£100 less than target	1.73	10.62	15.71	8.63
£100-£200 less than target	11.66	16.29	19.69	15.37
£200-£300 less than target	22.27	20.85	23.07	21.62
£300-£400 less than target	22.04	16.69	5.98	16.75
More than £400 less than target	38.84	27.87	13.34	29.10
Total	30.94	54.18	14.88	100.00

Gross output values greater than £100/cow below target represent a very significant reduction in output. Much of this is due to poor productivity per animal.

Variable costs of production

The most significant element of variable costs in milk production is undoubtedly that relating to feed. A significant element of variable costs come from concentrate and fertiliser use. In terms of the cost of concentrate and fertiliser, the ratios in terms of their costs relative to milk price have remained very favourable over the years. They have improved over the last 4-5 years (see Figure 8).

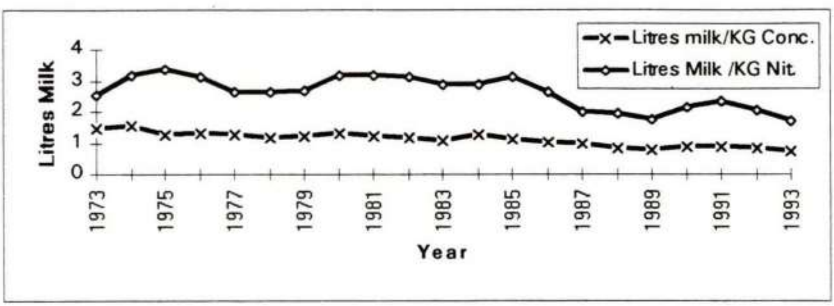

Fig. 8 – Litres of milk required to purchase one Kg concentrate or one Kg of nitrogen

There is also great variation in the variable cost levels recorded on farms. The data in Table 4 show the distribution of farms in relation to feed cost per cow and the data in Table 5 show the distribution of farms in relation to total variable costs per cow.

Table 4
Distribution of farms relative to target values for feed costs/cow

Farms	% Farms			
	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
Greater than £100 over target	11.66	12.69	19.83	13.44
£50-£100 over target	16.63	17.34	23.2	17.99
£0-£50 over target	16.63	25.48	26.55	22.90
£0-£50 below target	28.29	25.48	23.07	25.99
£50-£100 below target	21.6	16.62	7.35	16.78
Greater than £100 below target	5.19	2.39	0.00	2.90

It is difficult to reconcile the range in feed costs recorded on farms. A large percentage of farms are greater than £50 per cow or less than £50/cow from the target values. Feed cost of £50-£100 over target represents a cost of 4.5p to 9p per gallon of milk produced per cow. Low feed costs per cow is not necessarily desirable. The data would suggest that a large number of herds are underfed. This is particularly so for the smaller sized farms. A low level of feeding is associated with low performance per cow. Feed costs per cow should be within a narrower range.

Table 5
Distribution of farms relative to target values for total variable costs per cow

Farms	% Farms			
	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
Greater than £200 over target	10.16	17.41	21.83	15.82
£100-£200 over target	16.63	23.48	28.05	22.04
£50-£100 over target	10.16	15.74	22.93	15.08
£0-£50 over target	31.31	22.85	16.08	24.46
£0-£50 below target	23.77	14.69	6.49	16.28
£50-£100 below target	4.52	5.11	4.61	4.86
Greater than £100 below target	3.46	0.72	0.00	1.46

In relation to variable costs per cow, a large proportion of farms have a variable cost structure greater than the target. There is considerable scope for reducing costs on many of these farms. Because there are variable costs it should be possible to adjust the costs in the short term. After more than a decade with the quota system, variable costs per cow should be much more uniform across herds and certainly should be much closer to the target value. The presence of a significant number of farms with variable cost structures much below the target set would suggest that the input level to these herds is too low. It is unlikely that they are purchasing the inputs at very low prices. A focus on very low cost systems can result in low productivity from the herd. A number of farmers are leasing milk quota. This results in an increase in variable costs per cow but this can be compensated for by an increase in farm milk sales.

Gross margin

Gross margin analysis is a useful method for comparing farms. Since gross margin is the difference between gross output and variable costs, it will be greatly influenced by those factors. The average gross margins recorded on farms were significantly below the target values for each year. This was due to a combination of a lower gross output per cow and higher variable costs per cow. The distribution of farms in relation to gross margin per cow is shown in Table 6.

Table 6

Distribution of farms by gross margin relative to target values

Farms	% Farms			
	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
Over target	0.00	1.84	2.74	1.40
£0-£100 less than target	0.00	1.28	8.86	2.01
£100-£200 less than target	3.46	10.95	12.97	8.93
£200-£300 less than target	16.85	19.97	29.92	20.49
£300-£400 less than target	39.34	24.20	25.68	29.10
Greater than £400 less than target	40.35	41.77	19.83	38.06

A relatively small number of farms have a gross margin in excess of the target chosen. The data suggest that there is a considerable profit opportunity lost on many of these farms. The gross margin represents the sum available to meet fixed costs and yield a residual net income. Because dairy farmers have been operating under the quota system for many years now, the proportion of farms with gross margins much closer to the target values should be increasing. This is not the case. The margins are also particularly poor for the smaller farrns.

Overhead costs and total costs

It is difficult to compare farms in relation to overhead costs because the farms may be at different stages of development. Overhead costs are however, very important not only in relation to the level of overhead costs but also because if they are high they are difficult to change downwards in the short term. The distribution of farms relative to target values for overhead costs are shown in Table 7.

Table 7
Distribution of farms on overhead costs relative to target values

Farms	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
		% Farms		
Greater than £100 over target	3.24	3.51	7.86	4.07
£0-£100 over target	4.97	6.07	16.22	7.24
£0-£100 less than target	38.45	28.59	40.52	33.42
£100-£150 less than target	25.06	35.15	18.82	29.59
Greater than £150 less than target	28.29	26.68	16.58	25.68

The overhead costs were also much lower than the target set. This is a major benefit provided it is not reducing the potential to increase gross margin per cow. The target value of £317/cow includes a cost of £94/cow for depreciation, £75/cow for paid (part time) labour and £50/cow for interest payment on borrowings. These together represent £219/cow of the fixed cost used as a target. It has to be recognised that these types of payments can vary widely between farrns as discussed earlier. However, the distribution of farms relative to this target is of interest. Approximately one third of farms were £0-100 less than the target value and similar proportions of farms £100-£150 and greater than £150 below target. A relatively large number of farms have very low overhead costs which suggests low levels of borrowing, old farm structures and heavy dependence on family labour.

The distribution of farms relative to target values for total costs per cow is shown in Table 8.

Table 8
Distribution of farms relative to target values for total costs per cow

Farms	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
		% Farms		
Greater than £100 over target	15.13	24.04	32.43	22.53
£0-£100 over target	19.86	16.86	24.94	18.99
£0-£100 below target	25.05	27.08	24.67	26.1
Greater than £100 below target	39.96	59.11	17.95	32.39

The total costs of production are below the target set. This is mainly because many of the farmers have fixed costs lower than the target set as discussed earlier. A very large percentage of farms had total cost values of over £100 below the target values set.

Net margin

The distribution of farms relative to target values for net margin are shown in Table 9.

Table 9

Distribution of farms relative to target values for net margin

Farms	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
		% Farms		
Over target	1.73	2.56	5.48	2.74
£0-£100 less than target	3.24	8.23	11.1	7.11
£100-£200 less than target	18.58	25.24	24.94	23.14
£200-£300 less than target	27.45	24.69	32.53	26.71
£300-£400 less than target	14.9	24.04	14.85	19.84
£400-£500 less than target	19.87	9.74	1.87	11.70
Greater than £500 below target	14.23	5.51	9.23	8.76

The data show that a very large number of farms have very low net margins even though milk price is relatively good and the milk price, concentrate cost and fertiliser cost ratio is relatively good. This is mainly because of the low gross margin per cow.

Quota management and herd performance

The performance level of the herd, which is mainly dictated by milk yield per cow, is an important determinant of productivity on dairy farms. The data for milk yield per cow is shown in Table 10.

Table 10

Milk yield per cow and distribution of farms relative to target milk yields per cow

Farms	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
Target milk yield/cow (gallons)	1,200	1,200	1,200	1,200
Actual milk yield/cow (gallons)	838	936	1029	920
		% Farms		
Greater than 200 gals/cow over target	0.00	0.00	2.37	0.35
100-200 gallons/cow over target	1.73	1.67	1.37	1.65
0-100 gallons/cow over target	0.00	3.67	13.84	4.05
0-100 gallons/cow below target	3.46	9.99	13.34	8.47
100-200 gallons/cow below target	14.9	24.2	29.42	22.10
200-300 gallons/cow below target	27.45	19.64	17.08	21.68
300-400 gallons/cow below target	22.04	15.67	13.34	17.29
Greater than 400 gallons/cow below target	30.41	25.15	9.23	24.41

The average yield per cow is much lower than the target value. The target value chosen (1200 gallons/cow) should now be the norm for the vast majority of farms if the recommended technology is applied. Mean values can be distorted by variation in the data and the type of distribution of this data. The data in Table 10 shows that very few farms have exceeded the target value chosen. A very high percentage of farms have yield levels well below the target values. Low technical productivity as measured by milk yield per cow is particularly bad for the smaller farms.

In order to produce a 'high' yield per cow, one important prerequisite is to have sufficient quota per cow available. The distribution of farms in relation to milk quota/cow is shown in Table 11. This milk quota per cow includes leased quota.

Table 11
Distribution of farms in relation to milk quota per cow

Quota Size	% Farms			
	Farms (< 20 Ha)	Farms (20-50 Ha)	Farms (> 50 Ha)	All Farms
Less than 600 gallons/cow	16.41	6.23	3.24	8.93
600-700 gallons/cow	11.66	10.79	3.24	9.93
700-800 gallons/cow	17.91	19.9	10.10	17.82
800-900 gallons/cow	18.81	21.32	23.44	20.86
900-1,000 gallons/cow	18.58	22.04	24.81	21.38
1,000-1,100 gallons/cow	9.71	13.90	15.21	12.80
1,100-1,200 gallons/cow	5.19	3.44	15.21	5.73
Greater than 1,200 gallons/cow	1.73	2.39	4.75	2.54

It is evident that a very small percentage of farmers have the level of quota per cow to achieve the targets set. This problem is particularly evident for the smaller farms. It is very apparent from the data that farmers are keeping too many cows for the quota available. This will inevitably result in short lactation's, poor nutrition (so as to reduce milk yield) and other measures to keep within quota. The opportunity cost of this strategy is also high as a considerable amount of capital is associated with these extra cows. Quota management is a major problem on farms and this is evident from this data. An analysis of the data over time suggests that farmers are not adjusting their dairy enterprise so as to get a better balance between cow numbers and quota.

Concentrate use

Concentrate and fertiliser use make up a large proportion of the variable costs on farms. Their efficient use will consequently have a large influence on farm profitability. The data in Table 12 show the level of concentrate use on farms together with the distribution of farms relative to the target value set for concentrate use.

Table 12
Distribution of farms by concentrate use relative to target values

Farms	Farms (<20Ha)	Farms (20-50Ha)	Farms (> 50Ha)	All Farms
		% Farms		
Greater than 1000 kg over target	0.00	5.90	9.73	4.65
800-1000 kg over target	3.46	1.28	8.22	2.99
600-800 kg over target	8.20	5.28	5.62	6.23
400-600 kg over target	16.63	15.74	19.46	16.57
200-400 kg over target	6.47	17.97	28.05	15.91
0-200 kg over target	27.01	27.31	17.45	25.75
0-200 kg under target	21.37	18.69	10.10	18.24
200-400 kg under target	15.12	7.11	1.37	8.74
Greater than 400 kg under target	1.73	0.72	0.00	0.93

The actual level of concentrate feeding was higher than the target set. The data show that there is wide distribution in the level of concentrate feeding on farms. Approximately 44% of farms are within 0-200 kg of concentrate above and below the target. There is a high percentage of farms feeding a high level of concentrate feed. This is especially so for the larger herds. This results in increased feed costs and consequently in increased variable costs per cow. There is a significant number of herds with very low levels of concentrate feeding. This is equally undesirable if it is not replaced with excellent quality forage. The consequence can be lower than expected herd performance.

Summary

The analysis carried out on this section shows no evidence that dairy farmers are influenced to any large extent by the economic principles governing production. Dairy farmers are now operating under the quota system for over a decade and should have made the necessary adjustments by the time period over which this analysis was carried out. It is argued that quota management is a major problem on farms. Farmers are keeping too many cows for the quota available. The application of the quota system in Ireland is partly responsible for this. Over a number of years, many dairy farmers were able to produce milk in excess of their quota without paying any appreciable super levies. It is understandable why dairy farmers would get involved in this strategy because of the effect which quota size has on overall farm profitability. The wide distribution of farms relating to the many issues described in this section shows that there is considerable room for improvement. There is no evidence from this type of analysis over time that dairy farmers are focused on these issues. The low fixed cost structure on farms is an advantage. This is due to a large extent on the use of family labour and low depreciation charges. The analysis of the farms in this section relative to the model system described earlier shows that there is considerable income foregone on many dairy farms.

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Milk Quotas Likely to be Abolished Shortly After 2000

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Abstract

The size of the tariffs protecting the EU market are falling each year under the Uruguay Round Agreement (URA). However, the calculations are contrived in such a way that the reductions are not yet affecting farm-gate prices. The next trade agreement to follow the URA in 2001/02 will presumably continue the reductions in tariffs. At that time the levels will already be so low that any further reductions are likely to cause farm-gate prices and some commodities, including milk, to fall. In these circumstances, quotas on milk production will quickly become redundant.

The EU is committed to retaining quotas to the year 2000. Anticipating the next trade round, the EU will have cogent reasons to abolish quotas soon after 2000. Such a prospect would not be as threatening to the Irish economy as many believe, as it would be accompanied by substantial compensation. However, that compensation would hardly be as generous as under the MacSharry reforms, because the EU's trading partners would probably insist on it being decoupled from commodity production, and the EU itself would be likely to curtail its scale and duration. In the longer term the important consideration would be the competitiveness of the Irish dairy industry in a free trade world.

1. Introduction

The experience with milk quotas in the EU since 1984 is first reviewed in Section 2 of this paper. The EU is committed to continuing with a quota policy up to 2000, so the next opportunity to assess the quota approach will arise around that time. Since this will coincide with negotiations for a new trade round to follow the URA, these trade rounds provide the policy framework for analysis of future milk policy options as reported in Section 3.

2. Quotas versus prices to-date

The EC Commission's proposal in July 1983 to introduce a quota system to control milk production initially caused shock and confusion in Ireland. The opening negotiating position adopted was to reject the very concept of quotas for the obvious reasons that:

(i) they would freeze the expansion of the profitable and dynamic milk sector in Ireland, which had been growing at 5% per annum over the previous decade; and

(ii) they would create a new barrier to entry and expansion at individual farm level.

However, the existence of a serious crisis in the EC dairy sector was generally accepted, so that some action was necessary to tackle it. The ideal action from Ireland's point of view would have been penalties on other Member States with exemption for Ireland. While this was widely advocated in Ireland, it never had any hope of being accepted in Brussels. It quickly became clear that the only realistic alternative to the quota approach was to cut prices. The Commission suggested that a 12% price reduction would be needed (COM(83)500 final, par.4.8), but this would only be for openers. Given static demand, any subsequent expansion after the initial price cut - and despite it - would lead to further price reductions in the following years.

Once farmers realised that the choice was between quotas and price reductions, a consensus quickly developed in favour of the lesser of the two evils. And this continues to be the basic rationale for quotas today. If quotas were now suddenly abandoned there would undoubtedly be a big upsurge in milk production, which again could only be curtailed by cutting the price. Nobody knows how large a price fall would be necessary. But it is well known that both the demand for and the supply of milk are not very responsive to declining prices. This means that a relatively large price reduction would be necessary to stimulate demand and curtail supply by enough to clear markets in the absence of quotas. If one assumes that output would increase by 15% at present prices on the removal of quotas, and if one further assumes optimistically that price elasticities of demand and supply at farm gate are -0.5 and +0.5, respectively, then the price fall necessary to restore market balance would be 15%.

Another way of viewing this price cut is to consider by how much milk prices would have had to fall in the EU since 1984 if the quota approach had been rejected in favour of the price approach. Real milk prices have actually fallen by 20% between 1983 and 1995, even with the operation of quotas and a cumulative reduction of 9% in the aggregate EU quota. In the absence of quotas, the 20% price fall would have had to be augmented by the 15% cut suggested above *plus* a further 9% reduction to achieve the equivalent of the 9% quota cut. Therefore, real milk prices would have had to fall by an extra 23% (1-(0.85 x 0.91)) on top of the 20% actually recorded. In other words Irish farmers would be receiving around 75 pence per gallon now. If the true elasticities are less than those assumed above, then prices would have had to fall even more, and Irish milk prices now - in the absence of quotas - would be proportionately less than 75 pence per gallon.

In the debates on the relative merits of quotas versus reduced prices, some people argued that Irish dairy farmers could fare better under a price approach by increasing productivity to offset the effects of price reduction.

To enable a farmer to break even as between the price and quota approaches with the optimistic elasticities assumed above, production would have had to grow faster than the 5% annual growth of the pre-quota decade, and it would have to do this in an environment of sharply falling prices. If the elasticities were less than those assumed above, the annual growth rate to break even would have had to be much greater. These simple calculations illustrate the great difficulty for farmers to offset the adversity of falling prices by increasing productivity. And they highlight the advantages of a quota approach for farmers despite its restrictive and bureaucratic aspects which curtail structural adjustment and damage the efficiency of the industry (Brennan, 1994).

3. Milk policy options after 2000

The URA, which came into operation on July 1 1995, spans the six years 1995/96 to 2000/01. There are three commercial dimensions to the agreement, namely, reducing domestic support, increasing market access and reducing export subsidies. In each of these areas all participating countries are committed to achieve quantified targets which will begin to open up heavily protected markets to international competition. However, the targets are contrived in such a way that the degree of trade liberalisation will be minimal in the course of this round.

The limited impact of the URA and the apparent remoteness of the next trade agreement in 2001/02 have generated a degree of complacency regarding the future course of agricultural policy. While the URA will not have major short-term effects, its real significance is that it has put in place a foundation which will be built upon in the next trade round. In other words, it is the first step towards free trade.

The EU has decided to continue with quotas up to the year 2000. Along the way the aggregate quota will probably have to be cut, but the rate of reduction will be modest, averaging about 0.6% per annum. In contrast, the price of milk within the quota does not have to be reduced because of the URA, though of course the Council of Ministers may decide to reduce it for other reasons.

To identify and analyse the feasible milk policy options after 2000, it is necessary to define the shape of the next trade round. This is attempted by projecting forward into the next round the URA reductions in protection, at the same rate as is occurring under the URA. It is argued that other exporting countries are unlikely to settle for less in the next round, especially since their bargaining position will be stronger. Such projections would lead to rapidly falling prices caused by continuing reduction in domestic support and, more particularly, by further tariff reduction.

The second programme relates to the future of direct payments. It is argued (Sheehy 1996) that the EU's trading partners will insist in the next trade round on further decoupling of these payments from current production to minimise the impact on trade. Further decoupled payments would be based on historic production and would have no link to current production. The McSharry payments are decoupled from additional production beyond base period quantities but are fully linked to production within these quantities. This degree of decoupling was reluctantly accepted by the US and other trading partners towards the end of the Uruguay round negotiations. At that time the US, as well as the EU, made such payments a significant part of its policy. Now the US has further decoupled its payments in its 1996 Farm Bill. They are now linked only to land on which farmers are free to produce whatever they please. In other words they are transformed into Area Aid. It therefore appears that the EU will be pressurised in the next trade round to modify its direct payments accordingly.

It is clear that the ultimate result of these trends will be free trade. Therefore, any policy option in the next trade round will merely be a transitional one over a period of time until free trade is reached.

Given this framework the main feasible options for milk policy appear to be:

1. Continuing with quotas but with falling prices for quota milk - called the Quota/Price Approach; and
2. Abandoning quotas - called here the Price Approach. While continuing with the present policy of quotas with high prices is not considered feasible, it is worth exploring how it might be done and why it is unlikely to be acceptable. It is called the Quota Approach.

Within these three approaches there is a great number of possible variations. In particular, the role of Quota B milk (unsubsidised milk for export), the prospect of compensation, and the necessity to absorb new members into the EU are key issues. The Quota B proposition is first considered, before turning to analyse each of the three approaches in turn.

3.1. Quota B milk

Quota B production has been advocated as a possibility even during the present trade round (Danish Dairy Board, 1994). This would enable milk beyond a basic Quota A to be produced for export without subsidies. It is argued that it would enable the EU to retain world market share in competition with other exporters, who are free to expand and increase their market shares - New Zealand and the US in particular. The merit of retaining a market share during the URA, which would probably be lost as trade liberalisation progresses in the next round, is far from clear.

It is also claimed that Quota B milk would enable efficient farmers and processors to increase their incomes/profits from the extra production involved. But advocates of Quota B production also emphasise that its extent would have to be very restrictive and carefully monitored to minimise adverse effects on dairy markets. Large supplies of Quota B milk onto world markets would push down world prices, thereby reducing revenue for Quota A milk from those markets. In addition, as tariffs continue to be reduced into the next trade round, the internal EU market will become sensitive to the level of international prices, and lower world prices then would also mean lower internal prices. A small Quota B volume could have only a small impact on income - amounting to no more than a trivial 1% for farmers according to one estimate (Teagasc, 1995, p.34).

Furthermore, monitoring production over time would be very difficult, as production could not be switched on and off to match the vagaries of international markets. Indeed, it is not at all clear how Quota B production could even be segregated from Quota A.

Finally, there is the matter of getting World Trade Organisation approval for such an approach. While there is no explicit bar to Quota B milk in the URA, other world traders would almost certainly challenge an initiative which would allow the EU to increase competition on world markets.

The case for Quota B production is therefore not very convincing. It is not likely to be adopted during the present trade agreement; nor does it have much of a role in the next trade agreement in any of the policy approaches considered below. Only in the Quota Approach - the least likely approach to be agreed - and in an environment of high world prices would it have much merit.

3.2. The Quota Approach

Probably most EU farmers would opt for the Quota Approach, by which they would wish to continue the present quota policy through the next trade round, and thereby continue to maintain high prices for production within the quota. This could only happen if the reduction in domestic support and in the level of tariffs, which is proceeding under the URA, were to be abandoned in the next round. But the prospect is for a much more aggressive attack on agricultural protection in the next round rather than any abatement of pressure. All other agricultural exporters, including the Central European Countries (CECs), will push for full free trade in agriculture as quickly as possible. The freezing of domestic support and tariffs in that framework seems most unlikely. Slowing down the rate of reduction, as distinct from freezing it, is possible but not considered probable in the circumstances.

Even if the retention of high prices were somehow agreed by EU's trading partners, it would pose enormous problems for the accession of the CECs. They would have to impose a quota system in their countries and they would have to raise prices towards EU levels, neither of which they would want to do. In fact if they were forced to do so, no sooner would they have them in place than they would have to dismantle them again, as the world continued to move towards free trade.

3.3. The quota/price approach

Already in the URA tariffs on milk products are falling at the equivalent of about 5 pence per gallon per annum (Keane, M. et al, 1995). However, this is having no impact on trade, because the initial tariffs were set so high in the Uruguay Round negotiations that even after cutting them they are still high enough to prevent access to EU markets. This situation will change when tariffs have fallen to levels that will influence trade. If world prices remain at current levels, that will have happened at about the end of the present trade agreement. However, if world prices rise by that time, it will be postponed for a period. If, as is most likely, world prices continue to fluctuate, declining tariffs will provide effective protection in times of high world prices but will allow EU prices to fall in periods of low prices.

Projecting forward the tariff reduction occurring under the URA, while retaining the quota system, would thus mean an average annual price fall at farm gate, either early on in the next round or during it, of about 5 pence per gallon. In addition, EU prices would become exposed to fluctuations in world prices, as the tariffs under the URA are fixed sums unlike the variable tariffs which they have replaced. There is however a safeguard provision which would allow additional duties to be imposed if either the volume of imports or the price of imports exceed defined limits. This would protect against extreme fluctuations only.

The volume of quota production could possibly be maintained in this scenario, even as subsidised exports were reduced and minimum market access increased, because EU consumption would be boosted by the price reduction.

The issue of EU compensation for price and quota reduction will be an important concern in the next round, as it is in the present round. There are reasonable prospects of adequate funding within the CAP budget ceiling to pay full compensation (Matthews, 1996), but as argued above that compensation is likely to have to be decoupled from commodity production by using area aid linked to land only.

Decoupling from commodity production would be a radical initiative in agricultural policy. It would have serious implications for the volume of production, as farmers would no longer be required to produce to qualify for payments. The extent to which farmers would then cut back their crop and livestock output, given that such cut-backs would not affect their entitlements, would be a concern for upstream and downstream industries whose activities would decline accordingly.

In addition to these direct effects of further decoupling, there would also be important indirect effects. Once decoupled from production, the rationale for such payments could only be either (i) as income supplements, or (ii) as payments for the production of "public goods" (goods which society is willing to pay for but which markets fail to produce, such as, clean environment and rural viability). In both cases the payment of large sums to large farmers would be difficult to justify, and capping payments per farmer would be likely to ensue. In so far as the payments would be compensatory, it would be argued that they should be phased out over time as farm resources were redeployed to other activities. Furthermore, the case for central EU funding would be weakened and the threat of renationalisation enhanced. The potential adverse consequences for the Irish economy of each of these changes are obvious.

With respect to enlargement, the Quota/Price Approach would not pose such great problems for the CECs as the Quota Approach. If support and tariff reductions force down prices as fast as projected here, the declining prices would rapidly approach the level of free trade prices, which should be rising as international markets are freed up. CEC quotas might not then be necessary for the short transitional period to free trade.

3.4. The Price Approach

The Price Approach would involve abolishing quotas, either immediately after 2000 or at the beginning of the next trade round in 2001/02. Associated with this, the price of milk would be forced down by an upsurge in milk production, as farmers rushed to expand and utilise their pent-up capacity. The extent of the price reduction is impossible to estimate, but a reduction of 15% was suggested in Section 2 to maintain market balance. This may sound severe, but in a situation where milk prices would be falling rapidly, it would merely be bringing forward reductions which would take place anyway a few years later.

With this approach, EU price levels would be determined by the level of world prices plus the declining tariff. The tariff would finally disappear, at the rates of reduction projected, some 12 years after 2001/02 when full free trade would prevail, subject only to safeguard provisions. Of course, faster or slower tariff reduction would bring forward or delay that event.

Abolition of quotas would not be as disadvantageous to farmers as many now fear. Budgetary capacity should be sufficient to allow more sizeable compensation, though again it would probably be further decoupled, capped and digressive as described above. While the price reduction would not be welcomed by farmers, the restoration of freedom to individual farmers to enter and expand dairying as they pleased would be attractive, even though this would then be occurring at lower price levels.

As far as EU enlargement is concerned, the Price Approach is by far the most compatible. Prices in the EU would fall rapidly towards free trade levels, and new Member States would not have to raise their prices to any significant degree; nor would they have to adopt quotas. They would be free to farm according to profit signals from international markets.

Anticipating the requirements of the next trade round and of enlargement, the EU will have cogent reasons for abandoning quotas either ahead of, or at the beginning of, the next trade agreement in 2001/02. Indeed, the Commission has already stated so in its Agricultural Strategy Paper as follows:

> Among the different possible options, the Commission clearly favours developing the approach that was started successfully with the 1992 reform. This implies a reduced reliance on price support, compensated where necessary by direct payments, whatever their concrete form may be. Furthermore, it implies a better integration between market policies, rural development and environmental policies. Such an approach would have the great advantage of facilitating the CECs accession for both sides (EU Commission, 1995, p.36)

The implications for Ireland of abolishing quotas would depend on the compensation payable and on the competitiveness of the Irish dairy industry in a free trade world.

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Essential Requirements for a Competitive and Profitable Industry – A New Zealand View

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When contemplating this topic two fundamental questions kept coming to my mind:

Which dairy industry?

Profitable for whom?

It is my intention to focus on what I believe to be the essential requirements for a competitive and profitable dairy in a generic sense - not just what makes a profitable industry in New Zealand, nor what it may take in Ireland. But what I believe dairy farmers, from whichever hemisphere should appreciate if we are to have a prosperous and secure future.

In the past there has been an unhealthy preoccupation amongst policy makers and dairy industry leaders, with making the dairy industry profitable in their region at the expense of the dairy industry in other places.

In New Zealand we have felt this acutely because what has been done to support the competitiveness of the dairy industries in Europe, in the United States and in Japan has been at our cost.

For too long we have been denied the opportunity to compete in many markets, which have been reserved exclusively for the domestic suppliers and in open markets where we have been able to market our products we have faced debilitating and unfair competition from subsidised exports from the over production in those protected places.

Regardless of whether you agree or not about that being the mould in which the international dairy sector has operated, it is surely not going to be the pattern for the future.

In New Zealand we believe that the ways things have been done in the past have not been in the best interest of dairy farming families and in many instances have lead to a dead end.

In Japan, the most highly paid and protected industry in the world, dairy farmer numbers are reducing at an enormous rate - 115000 farmers in 1980 down to 55000 in 1992 and still dropping fast.

You as Irish Dairy Farmers will understand what I mean because of the restrictions you face with the milk quota system and other artificial distortions that the European Union's market support system has brought you. Despite being low cost efficient producers in Europe you are restricted to just 5% of the total.

The new era dawning is one in which there will be a progressive liberalisation of markets; where the distortions on imports and the subsidies on exports will be rolled back.

The Uruguay Round agreements were a step in this direction, but the first step only. Others will surely follow.

In the future, as dairy farmers, we are going to need to pay very much more attention to what is going to make our industry truly competitive and profitable

- In a real commercial sense
- On a long term sustainable basis
- and - on a basis that is not dependent on government intervention and support, and as a result, vulnerable to the whims of political decisions.

So what are the essential requirements for a soundly based commercial dairy industry?

1. Customers

Customers are where it all begins.

Customers who want our products now and in the future.

Customers with real money.

Without customers there is no business. A producer, whether he is a manufacture, a farmer or the provider of a service, has no future without customers for his products.

Fortunately there is a large natural customer base for milk and dairy products. Milk is a wonderful product, one of nature's most basic foods and an eminently flexible raw material for a whole range of processed food products and other goods.

However, we cannot assume that customers will come queuing at our door nor should we take customers for granted or be complacent about their needs. There is a dramatic shift in the retailing of dairy products, supermarkets everywhere are gaining market share. In most European countries the top 3 supermarkets have 30% share and in some places dominate with 70%. This represents a unique challenge to dairy manufacturers and marketeers requiring increases in scale and cost savings.

We must be constantly seeking to ensure that we are satisfying those customers we already have and working to broaden our customer base. There are significant opportunities in the growing markets in many parts of the world, notably in the dynamic economies of South East Asia and Latin America as the populations of these regions and countries grow, and more importantly their incomes and standards of living improve.

These growing markets need careful nurturing and developing especially those where milk or milk products are not their food of first choice. This accounts for almost all of North and South East Asia.

2. Products

Satisfying customers is all about delivering them products which they want, when they want them and in a form that they require.

In a highly competitive world there are substitutes for everything. We must realise and accept that milk and dairy products are no exception. Our competitor industries, in beverages and foods, are constantly placing before the customers new choices with innovative products and new presentations of long established items. These efforts are to maintain the support of their customers and to attract customers who have been consumers of dairy products. This has to be matched, and requires large investment.

To maintain and develop the business, investment is required in:

- product development
- process technology
- raw milk production, including: quantity, quality and composition.

3. Competitive prices

There are many ways to compete and be competitive. Our approach to marketing must be as sophisticated as our competitors

- in product innovation
- in promotion
- in advertising

But we can never overlook the most basic element of competition in the markets which is pricing. Creating cost leadership through economies of scale, cost control and high productivity and achieving competitive advantage without reducing product or service quality must be the goal.

Prices have to be competitive with substitute products. While this doesn't necessarily mean having the lowest prices in the market, it does mean recognising, for example, that if butter is double the price of margarine then despite all butter's quality attributes the simple fact is - less butter would be consumed and shoppers will move to using more margarine.

4. Low costs

If competitive prices are to be translated into profits, costs must be pushed to the minimum. In just the same way that we must constantly strive to satisfy our customers, there must be equal effort and commitment to reduce costs. Failure to control and reduce costs at any step of the production chain will quickly extinguish any gains made in the market place.

This is evident in New Zealand right now as we, the farmers, encouraged by the prospects of improving prices and a desire to improve our herds productivity, have increased the costs of producing milk to the point where overall farm profitability has been compromised.

While the on farm costs are extremely important in the profitability equation and have a particular emphasis at this conference, this is only the first step and we need to push hard for cost savings in all the links of the chain:

- in processing
- in administration
- in transport and storage
- in marketing and distribution

5. Technology and Innovation

The major key to success in all these areas is the successful development and application of new technologies and techniques.

Creative marketing demands a constant flow of new ideas, new products and new marketing techniques.

Innovation is critical, innovation at all steps of the value chain, new ways of doing things on our farms, increasing productivity with better cows and better operating practices, lowering costs by finding more efficient ways of managing our resources, improving quality with better technology and animal health.

Innovation in milk transport and processing. Finding better ways transporting milk at the lowest possible cost yet protecting its quality and composition. Processing in plants that give economies of scale, employing technology that improve yield and enhance the attributes customers require.

Innovation in distribution and marketing, making as short as possible the order to delivery cycle. Finding smarter packaging and more efficient handling and storage systems.

Innovation is the key to sustained competitive advantage. New ideas, new techniques, new products being constantly available are essential ingredients for success in the market.

Technology does not just mean having scientists at laboratory benches or on research farms. All the most elaborate research in the world is useless unless it is relevant and is then adopted and applied. Technology transfer, getting the new methods into practice, is the vital ingredient in any research and development strategy and much easier achieved if the technology plan is focused and integrated.

I turn now to the second question; profits for whom?

After the efforts put in to be competitive and profitable we need to take some time to think about the question - profits for whom?

I find there are many definitions of "profit". For the sake of this discussion I will describe profit as pecuniary gain - excess of returns over outlay.

Business is made up of many stakeholder groups all working together, within that grouping there will always be the cardinal stakeholder. It is the cardinal stakeholder who drives the business and takes the profits, all other stakeholders' needs are taken care of within the operation and counted as a cost to doing the business.

So as dairy farmers where do we fit in the equation?

There is nothing particularly special about producing milk. It is an endeavour as old as time and thanks to the tolerance of the dairy cow it is not all that difficult. Milk is produced in all environments in the world. From the heat of the tropics to the coldest regions. In one environment the cows are kept cool while in the other they are kept warm, in both instances the feed is brought to the cow and she obliges and makes milk! Milk is a highly perishable product, produced daily and loses its value very quickly unless processed into a commercial, storable form.

It would be easy to assume that a milk producer had little future beyond being a commodity producer. These facts have encouraged dairy farmers all around the world to be actively involved in the marketing of their produce outside the farm gate, in a way that is not seen in many other primary agricultural industries.

The importance of the cooperative system, farmer ownership and control, of milk processing and marketing to the dairy industry is demonstrated around the world.

In New Zealand our cooperatively controlled, integrated, cow to customer business model is very dear to us as dairy farmers. It ensures we are the cardinal stakeholders and the 'profits' of the investments and the effort, flow to us in the best possible milk price. We do this by capturing the advantages that only the cooperative structure can offer. Because the owners of the business all belong to the same interest group - Dairy Farmers - we are able to look beyond the needs of only our individual Company Shareholders and cooperate in the development of technology and marketing endeavour; then compete as independent companies to ensure the most efficient and innovative use is made of the cooperative effort, thus enhancing the results for all. This model has proved successful for us. I believe that we are yet to reap all the potential of it and am very optimistic about what can be achieved for the benefits of dairy farming families in the future.

There is an air of anticipation in New Zealand now as our dairy industry out-performs our sister pastoral sector industries of meat and wool. Although this is very much a relativity issue as in real terms our milk returns are not as good as they have been in the recent past, there is an increase in production of around 4%. The national herd is growing and existing farm productivity is improving stimulated by the constant adoption of the latest technologies. In our region there is a large shift in land use to dairy farming. We are being required to increase the capacity and scale of our cooperative to manage the increasing numbers of farmers wishing to join. We have modernised the structure of our co-op. to cater for the large amounts of capital being required, a "growth funds growth" policy is seeing capital that would have been paid to retiring meat and wool farmers when their land is sold for dairy conversion, now being paid to the co-op. to provide equity to develop the business. This concept is providing clear ownership of the processing and marketing infrastructure beyond the farm gate and generates a higher level of interest in all aspects of our industry. This is the New Zealand solution for securing the future for the dairy industry.

Potential Milk Production from Grass and Limiting Factors

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Introduction

It is important within any industry to provide a long term look towards the future, particularly in relation to setting targets for the industry and establishing principles in relation to the best way of striving to meet these targets. This paper, which is mainly set within a theoretical context, will attempt to set the scene in relation to what production might be possible from grassland and then consider how far these targets might be achieved in the future. It will also aim to highlight the factors which are likely to limit progress towards meeting these targets. The paper will not attempt to address specific and detailed management issues, as numerous other papers will more appropriately address these. It must also be remembered that while this paper is specifically addressing the issue of production potential from grassland, any system which is employed at farm level must be examined within an economic framework as well as production potential. The impact of the continuing influence of milk quotas must also be addressed.

Milk production from grassland is driven through three main channels:

(a) The quantity of grass produced.

(b) The grazing efficiency of the animal and

(c) The conversion efficiency of grass to milk within the animal.

While these are shown above as stand alone effects, and in a rather simplistic manner, there are many interactions and these cannot be ignored. For example the quantity of grass grown can be influenced by the grazing efficiency (stocking rate). In addition there are also major conflicts across areas. For example the objective of improving the conversion efficiency of grass into milk within the animal implies the need for high milk yields per cow, yet this conflicts with grazing efficiency.

Potential grass production

At the outset it is necessary to establish a potential target for grass growth, but before we consider this we should be clear about the varying processes which are taking place within the grass sward at any point in time. The nature of these processes and the relative importance of each, is shown in Table 1, derived from Parsons (1988). While Parsons (1988) presented his data in terms of tonnes of organic matter, for uniformity in this paper these have been converted into dry matter terms.

Table 1
An example of the growth processes within a sward defoliated at intervals (Parsons 1988)

Total photosynthesis within the grass plant	65.0 t DM/ha (26 t DM/acre)
Respiration (nutrients used by plant)	
Shoot	27.6 t DM/ha (11.2 t DM/acre)
Roots (including growth)	8.1 t DM/ha (3.3 t DM/acre)
Shoot decay	16.3 t DM/ha (6.6 t DM/acre)
Harvested yield	13.0 t DM/ha (5.3 t DM/acre)

This demonstrates that although the sward initially produces the equivalent of 65 t DM/ha because of the loss processes in the system the yield eventually harvested is only some 20% of this. A key component of this loss is death and decay within the sward, and this is an area which must be minimised. There is obviously considerable scope for improvement. Wright (1978) suggested a potential yield of 30 t/ha was possible and the same author has recorded a yield of 24 t/ha from experimental plots in Northern Ireland. Cooper and Breese (1971) have recorded a top yield of 29 t DM/ha (11.3 t DM/acre). This level has not been achieved at the field level, nor is it likely to be, because gone are the days when we can afford, either financially or environmentally, to use the levels of plant nutrients which would be necessary to move towards such targets.

However within a more practical context high levels of grass dry matter production have been produced within Ireland. In a 5-year field scale cutting experiment at Hillsborough, using an Italian ryegrass sward receiving around 600 kg N/ha, a mean yield of 18 t DM/ha (7.3 t/acre) was produced. Brereton (1995) also quoted grass yields from Moorepark in 1988 of 18.4 t DM/ha (7.4 t/acre) with 600 kg N), and in work at Grange a mean yield of 15 t/ha (6.1 t/acre) was recorded with a 4-cut silage system. The potential for grass growth is clearly high, and if grass breeders can continue to progress at a rate 0.5% increase in yield per year then by the year 2000 there is a clear potential in grassland for yields approaching 20 t DM/ha (8.1 t/acre).

While these figures are given to indicate a 'field potential' it is recognised that there are major differences between sites and years in grass DM production. Brereton (1995) has developed a model for grass growth, in which the rate of growth is proportional to the solar radiation received at the surface of the crop and the efficiency of use of this radiation is related to the air temperature. The impact of moisture deficit is also taken into account. Figure 1 (Brereton 1995) shows how this model predicts grass output for the different regions within Ireland, showing yields varying from over 15 t DM/ha (6.1 t/acre) in the Southwest to 11 t/ha (4.5 t/acre) in the Northeast of Ireland.

There are also major differences between years, with data from Moorepark over a 10 year period showing a mean yield of 13.4 t/ha (5.4 t/acre) with a maximum of 18.4 and minimum of 10.9 t/ha. Brereton (1995) clearly suggests that these regional and annual variations, must be embraced in any management system which is developed.

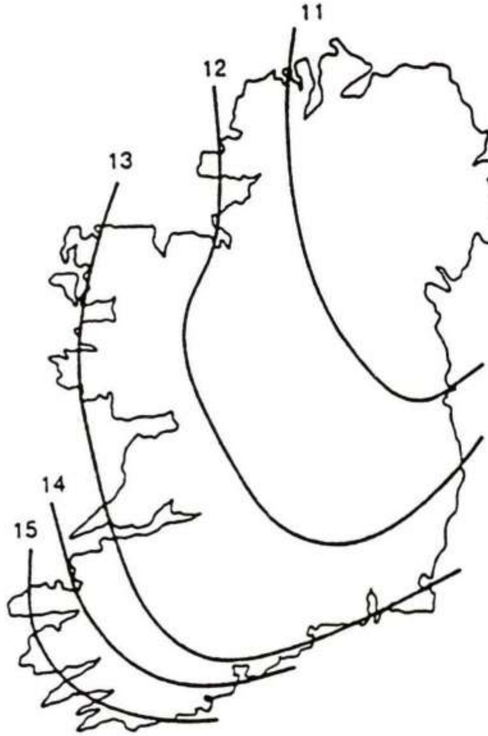

Fig. 1 – Model estimates of annual dry matter grass production (t ha^{-1}). Brereton (1995)

Converting grass into milk

In the previous section a range of targets was established for grass production within a cutting environment. It is recognised that the introduction of the animal is likely, although not necessarily, to result in a reduction in the yield of dry matter. The extent of any reduction will be related to issues such as the intervals which can be adopted between defoliation's, how quickly the animal defoliates the pasture and the severity of defoliation. Severe defoliation, due to very high stocking rates, are likely to considerably depress grass growth.

Notwithstanding the above comments and taking as a starting point the quantity of herbage which we should be able to grow, and the feed requirements for animals, we can provide theoretical targets for potential outputs per hectare. For example the calculation in Table 2 is based on a grass DM yield of 18 t/ha (7.3 t/acre) and a dairy cow giving 5000 kg milk over a 305 day lactation.

This simplistic calculation in Table 2 makes a number of important assumptions, with the key ones being: (a) that grass yield of 18 t DM/ha can be achieved; and (b) the dairy cow giving 5000 kg milk can be sustained on a diet solely of grass and grass silage, with no meal feeding. Neither of these in themselves are unreasonable targets but no one has yet put them together into

Table 2
Theoretical potential output from a grassland based system using cows giving 5000 kg milk/year (1070 gal)

Grassland output/ha	18 t DM
Metabolisable energy (11 MJ/kg DM)	200 GJ
Cow requirements 5000 kg yield	50 GJ
Stocking rate	4.0 cows/ha (or 1 cow/0.62 acres)
Overall efficiency of energy use	33%
Milk output/ha (t/ha)	20.0
(gal/acre)	1420

a system. Certainly the production per cow targets are very modest when compared with the potential performance which can be achieved from our animals under controlled feeding conditions.

Why have these targets not been achieved? Firstly from the cow standpoint no one has really explored the true potential of grass alone in our environment. Work in 1984 and 1985 at Hillsborough, with late spring calving cows, resulted in a mean lactation performance of 4,600 kg/cow. Similarly later work with autumn calving cows resulted in a mean yield of around 4200 kg/cow. However in neither of these systems did we really set out to totally exploit the full potential of grass and silage. For example, no concessions were made to the production of an improved quality silage. Meeting the grass growth, and hence stocking rate target may be much more difficult - i.e. a stocking rate of 1 cow/0.62 acres. However if the grass yield is set at 14 t DM/ha (5.7 t/acre) then a target stocking rate of 3.1 cows/ha (0.8 acres/cow) becomes much more achievable.

Table 3 shows how these simplistic calculations would alter as we increase cow yield in the system - but still making the same assumptions with regards to the potential to produce all the requirements for the differing animals within the grassland/forage system.

Table 3
Effect of changes in cow yield on potential output in a grass/forage based system (assuming cow intakes can be achieved). Based on a grass yield of 14 t DM/ha

Milk yield per cow (kg/year)	5000	7000	9000
(gal/cow)	1070	1500	1920
Forage energy/ha (GJ ME)	154	154	154
Energy required per cow (GJ ME)	50	60	70
Stocking rate achievable (cows/ha)	3.1	2.6	2.2
(acres/cow)	0.80	0.96	1.12
Efficiency of feed use (%)	33	39	42
Milk output (t/ha)	15.5	18.2	19.8
(gal/acre)	1340	1575	1710

This set of theoretical data (based on 14 t DM/ha) demonstrates that if we could meet the animals feed requirements from within a totally grass/forage environment then increasing milk yield can have a major effect on output of milk per hectare or per acre. However the data above have been purposely taken as very wide extremes in yield (1070-1920 gal/cow, an increase of 80%) yet you should note that the improvement in output per acre is much more modest, at 27% (This concept must not be missed in any thinking about the impact of yield per cow). The key element here in this calculation is that we assume that grass supply/intake is controlled according to animal needs, i.e. that we have stocked our lower yielding cows at a sufficiently high level to ensure full efficiency of grass use. When we do this, more minor and realistic changes in yield (eg from 5000 to 6000 kg- 1280 gals) would result in approximately a 9% increase in milk output per acre.

Bringing realism into the targets

While the previous theoretical calculations have provided a background target it is obvious that there is a need to inject realism into some of the figures. For example the calculations suggest that the nutritional needs of both the 5000 and the 9000 kg cow can be equally met from grass/and silage diets. Obviously this is not true, and Table 4 provides some guidelines in terms of what might be possible to achieve in a practical context.

Table 4

Theoretical calculation on meeting the cow needs for nutrients from grass and silage

Milk yield (kg/cow)	5000	7000	9000
(gal/cow)	1070	1500	1920
Av daily ME required (MJ)	137	164	192
Daily intake of DM required (kg)			
At grass (11 MJ/kg DM)	12.5	14.9	17.5
On silage (12 MJ/kg DM)	11.4	13.7	16.0
Achievability of target	Easy	Possible	Impossible?

Basing the calculations on average intake of DM required per day the intake of grass DM required during grazing for the 5000 kg and 7000 kg cows are well within accepted figures for intake at pasture. McGilloway (1996) in a review of herbage intake concluded that intakes of up to 17.0 kg could be achieved with medium merit cows grazed under good conditions. Some recent French work (quoted by Mayne and Peyraud 1996) suggested that 19-20 kg DM/day may be possible with high producing dairy cows grazing swards in early season. The target therefore set for the 5000 kg cow at pasture should be easy to achieve. The target for the 7000 kg cow is also achievable in terms of intake at pasture.

In relation to the indoor feeding period Cushnahan *et al.* (1995) at Hillsborough have shown that the primary reason for low intakes of ensiled grass is the late stage of growth at which grass is harvested, and that the more minor effect is that of the ensiling process. In this work they have recorded mean DM intakes with high digestibility silage of 14.6 kg/day, a level which will support both the 5000 and 7000 kg cow if silage ME is 12 MJ/kg DM. In the major intake study of silages from farms in Northern Ireland (Steen *et al.*, 1995) the best intake recorded in that study was equivalent to 15.6 kg DM/day. In the present winter at Hillsborough we are feeding a silage which has a mean intake of 14 kg DM day when given with a concentrate level of 3 kg/day. This would equate to a DMI of at least 15 kg/day if fed alone. These data indicate that with good silages intakes of 16 kg/day are potentially achievable, provided we are prepared to leave behind our existing mind set in terms of conservation practices - mainly through harvesting material at a much leafier stage of growth. All these data indicate that we have the potential to easily meet the needs of the 5000 kg cow on a year round basis, and indeed the potential to strive towards a mean yield of 7000 kg from a grass and forage only system. However I see no prospect of achieving the targets necessary for the 9000 kg cow.

In assessing the above targets, the fluctuating needs of the dairy cow over lactation have not been considered, and these are obviously important. However it is more important to ensure that we can meet the total energy requirements of the cow over the year before we concern ourselves about the issues the individual stages of lactation. The cow has a remarkable capacity to buffer itself across lactation (indeed this is the basis of flat rate feeding or feeding a single complete diet across the lactation) and in my mind if we are to exploit the full potential of grass, which we recognise has a limited intake potential and will never meet the needs of the high yielding cow in early lactation, then our objective must be to achieve a constant high intake every day over the total year. This is much more important than worrying about peak lactation and then setting out to starve cows at other periods of lactation.

Being realistic about the above figures I see the possibility of achieving an animal production target of 6000 kg milk/cow as realisable from grass and silage alone with minimum inputs of other feeds. Such additional feeds should only be to provide for any imbalance of nutrients by the animal (e.g. minerals or rumen undegradable protein).

The constraints to achieving these targets

While it is easy to set potential targets there are many constraints which may apply at farm level. These constraints may be of a technical nature, or an economic nature, or even an environmental nature and it is impossible to cover these in this short paper. However some attempt will be made to highlight some of these from my viewpoint.

(a) In such systems is increased yield (genetic merit) a worthwhile goal?

The calculations presented earlier have shown benefits in terms of efficiency of converting food energy into milk as we increase milk yield. These theoretical benefits have been widely demonstrated in indoor feeding systems (Langhill and Hillsborough) and in the grazing environment (Bryant *et al.*, 1986 and Dillon personal communication). There is no doubt that if you can feed two animals the same quality of feed and achieve greater efficiency in feed use by one than the other then the more efficient animal is the one to use. This is what the above feeding studies have clearly demonstrated. However as soon as you move away from this scenario, of being able to provide equal quality feeds to both animals, then we must be very careful in making assumptions that the same approach will provide the same benefits to those outlined earlier. In other words if the higher yielding cow requires an improved quality of diet (assuming increasing quality results in increased cost) to be sustained on a year round basis, then this may result in any blind drive for improved efficiency resulting in a reduction in overall herd profitability. This is particularly true if we have to replace a cheap feed, such as grazed grass, with a very much more expensive feed. (Ironically my argument does not hold so much weight when we are in a winter feeding situation in which silage and concentrates are much closer in terms of relative costs and hence replacement of one by the other has not such dramatic effects). Indeed it could be argued that if we are in a cheap feed situation (such as grazed grass) then there are only minor financial benefits to be gained by striving to marginally improve the efficiency of conversion of feed into milk, and certainly this should not be to the extent that we need to improve the quality of feed through the use of high cost supplements. It is possible that in this scenario we should not breed animals for improved feed efficiency (which means lower DM intake per unit of milk produced) - rather we should breed to maximise intake as this will allow greater quantities of bulk feeds to be used to meet the animals' needs.

(b) Is pursuing maximum intake at pasture a worthwhile goal?

As the milk yield of the cow increases then we become increasingly concerned about trying to maximise their intake, and hence performance of the individual cow at pasture. This is a very understandable position but we must be careful with the conclusion to which this leads us. The major factor controlling intake at pasture is the amount of herbage allocated per cow (Meijs and Hoekstra 1984). Figure 2 provides a representation of how the intake of the dairy cow increases as the quantity of herbage offered per cow is increased. Some calculations derived from the data used to produce this figure are presented in Table 5.

Table 5

Effect of increasing the quantity of grass offered to cows on their intake and the efficiency of utilisation of this additional grass (from Meijs and Hoekstra 1984)

Grass offered (kg DM/d)	Grass intake (kg DM/d)	Efficiency of harvesting the extra grass (by the cow)
10	7.8	—
15	11.0	64%
20	13.4	48%
25	15.2	35%
30	16.2	21%
35	16.6	7%

When the quantity of grass offered per cow is low then the efficiency of grazing will be high (efficient utilisation of available herbage), the quality of the regrowth will be high and the sward will not deteriorate over years. However as we offer the cow more grass, in an effort to improve performance, then very quickly the additional grass consumed by the cow is only a fraction of the additional grass offered. This becomes a totally inefficient system. It not only results in inefficient grass use at the point of grazing but also to later problems in terms of the quality of the pasture regrowth. This can also cause deterioration in the sward from year on year. It is recognised that some of this difficulty may be overcome by pasture topping mid season (Stakelum 1991). Nevertheless I would question the logic of going too far down the road of using higher allocations of herbage as a route to improving animal intake and performance. If it is going to take 5-6 kg additional grass allocated to result in 1 kg additional intake then might we not be better either accepting the consequences of the lower intake or using the cheapest possible supplements to achieve the same end result in terms of intake.

(c) Supplementation at pasture

A few years ago we were all clearly of the view that when pasture availability was adequate then supplementation at pasture was an ill founded practice. However as milk yields have increased, many have become more reconciled to feeding supplements at pasture. We must all clearly ask on what basis we do this:- (a) is it necessary to sustain our system, such as getting cows in calf or for long term animal survival? or (b) is it an attempt to provide an enhanced economic return through the response to supplementation. The data available at present would certainly suggest that there is considerable interaction between the benefit we get in total intake and performance from supplementation at pasture and the amount of herbage on offer (Meijs and Hoekstra 1984). For

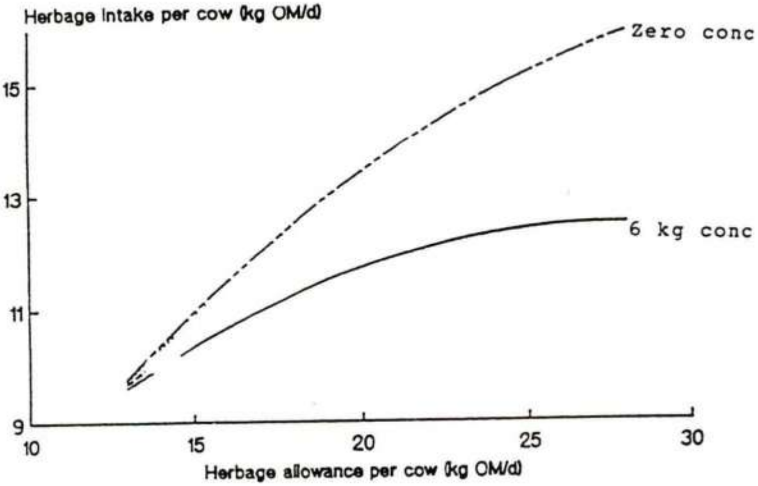

Fig 2 – Effect of herbage allowance on herbage intake at different levels of concentrate feeding (Meijs and Hoekstra, 1984)

example, Figure 2 from Meijs and Hoekstra (1984) presented earlier shows that if we are laxly grazing (which is what is often suggested for high yielding cows) then there are major depressions in grass intake when we give concentrates. In fact the only time when it is ever logical to give concentrates is when the allocation of grass is low and the sward is being tightly grazed. This is demonstrated in Table 6.

When 30 kg of grass OM/day is offered then the addition of 1 kg of concentrates results in the cow eating 0.69 kg less grass. Hardly a reasonable outcome and not one from which you can expect an economic response.

Table 6

Effect of supplementation with concentrates on DM intake when using different herbage allowances (Mayne 1991)

Herbage allowance	Substitution rate
(kg OM/day)	(kg herbage OM/kg conc OM)
15	0.11
20	0.30
25	0.50
30	0.69

It is therefore clear that supplementation, almost irrespective of yield, is unlikely to have a reasonable effect on total nutrient intake unless when pasture is being tightly grazed. This effect, when considered with that presented earlier in terms of the wastefulness of high herbage allowances, would tend to suggest that if high performance animals are to be grazed at pasture then a strategy of maintaining a sufficiently tight stocking rate, coupled with controlled supplementation, is likely to be the most effective. This would ensure efficient utilisation of pasture and retain sward quality. The alternative of using low stocking rates and lower levels of supplementation seems a very difficult route.

(d) Remember the replacement heifer

When we begin to compare differing systems of dairying, in terms of efficiency of converting feed into milk (or indeed total land resource into milk), we must not only consider the dairy herd itself but also its supporting replacement rearing unit. The efficiency of converting grass into milk within the rearing unit is zero, and hence differing policies of herd replacement, enforced or by choice, can have an effect on total efficiency of feed use, or potential milk output/acre. For example Table 7 considers two replacement policies for a herd of cows.

Table 7

Effect of replacement rearing policy on efficiency of feed energy use in the total dairying system

Yield (kg/cow)	5000		7000	
Annual replacements reared (%)	15	40	15	40
Efficiency of systems (%)	29	24	35	29

This shows that while we can struggle to become a few percent more efficient in our dairy cow keeping we can easily lose this if we have a higher replacement rate. For example, a 5000 kg yield per cow coupled with 15% replacements, is as efficient, in feed use terms, as achieving 7000 kg milk per cow and rearing 40% replacements. These calculations demonstrate that we cannot consider the dairy herd in isolation as the type of system we plan can influence many other issues which in themselves will have major impacts on efficiency of feed use.

Moving towards the future

The previous sections have set a potential production from an all grass/ silage based system and by implication have suggested that if this is the direction our industry should go then there are further opportunities for us to make progress. However, as soon as we leave our present simplistic approaches to managing the dairying systems which have served this industry well in the past, then we immediately think about how to fine-tuning the system. This I would contend is where all the management difficulties arise, and each of these difficulties is magnified many fold as the genetic merit (or potential feed use efficiency) of the herd improves. This increasingly puts pressure on management and the total decision making processes on the farm. There are many strategies which we can adopt as milk yield/cow increases, but we must take each of these steps carefully. We have previously discussed aspects such as:- allocating the correct amount of grass; under what situations will an economic response to meal at grass be obtained; and which type of supplement etc. to feed. All these are in reality high pressure decisions in which it is important to arrive at the correct answer. I would contend that while research in the past has been effective in helping the industry to move along a broad front to its present position it has not really addressed the issue of how we are to move forward over the next 10-15 years. We are now leaving behind the era of 'blueprints' for systems (although they must remain in the back of our mind as guidelines from which we start) and must now move towards approaches which will provide the manager with sound and reliable decision support systems. Systems which are solid, robust and are driven from an economic base. They must assess economic outcomes and not be driven by dogma. No longer can we provide simple answer to questions, such as the average response to concentrates at grass is 0.4 kg milk/ kg concentrate and therefore we should not feed these. If the farmer is to get it right all the time (which must be the objective) then he must have the management tools upon which to make decisions. It is certainly not good enough for researchers to say that it is either too complex, or we will provide the farmer with an understanding of what is going on and he can then make the proper decision on his farm. I will demonstrate what I mean by quoting to you the performance results from the last 11 dairy cow experiments at Hillsborough which have examined the response to wilting of grass prior to ensiling (Table 8). These results can either be quoted as an average response to wilting of 6% in animal performance, and therefore it is not worth striving to achieve this. Alternatively you can consider the individual experiments and see that in some experiments there was a depression in yield from wilting yet in some we had

Table 8

Effect of wilting of grass prior to ensiling on the response in intake and milk fat and protein output (Patterson *et al.*, 1996a & b)

Study	Increase in silage DM intake from wilting (%)	Increase in milk yield (fat + protein) from wilting (%)
1	2	8
2	1	0
3	24	18
4	10	-1
5	17	3
6	11	1
7	12	4
8	28	5
9	20	14
10	35	18
11	25	2
Mean of 11 studies	17	6

increases up to 18% in milk yield (There were 3 of the experiments with over 14% increase). All 11 experiments had the silages made by the same system, each using rapid wilting techniques and none had rain during the wilting process. If I make the assumption that high quality wilting systems (spreading and tedding grass) are expensive then surely the correct answer is that we must be able to help the manager to decide when he will get a major benefit from wilting and when he will not get any. Only when we have decision support mechanisms that will help make this type of decision will researchers have truly delivered.

Conclusions

Target production potentials from grassland based systems have been set and there is scope for becoming more efficient in systems which are based on relatively low inputs of supplementary feed. A target of 7000 kg milk/cow (1500 gal) from grass and silage alone and at a stocking rate of 1 cow/acre is a possibility, if this is the objective we wish to have in our systems. However in systems where grazed grass is a major component then we must be extremely careful in terms of how we move along the route of aiming for higher animal performance, and more complex systems. If this is to be achievable then researchers must provide the industry with good 'decision support systems' which will help the farmer through the much more complex decision making processes which will be involved. Otherwise we are likely to move our industry in entirely the wrong direction based on complex systems which cannot be implemented at farm level.

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Securing the Future for the Dairy Industry

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In addressing this topic, we all know the importance attached to efficient production, milk quotas, world production of milk and, of course, the global marketplace. However, these topics will all be adequately addressed at the conference by people more expert than I so in discussions with your Secretary a few months ago, I choose the much narrower topic "Diversify of Merge". I may be accused of ignoring the third alternative "stay as we are".

However, just like the producer having to change, so also must the industry to secure its future and that of its suppliers.

For centuries past, industries have had to restructure to meet competitive forces. It is no different today, other than the world is moving at a far faster pace and we have far shorter time frames in which to react. I need not mention BSE or CJD where action at industry or government level would not alone have been enough without action on a broader EU basis. Even so, the industry will never be the same.

During past years and into the next century, the dairy industry in Europe and throughout the world is coming face to face with new major external pressures which were not there even one decade ago.

CAP Reform
GATT Agreement, Eastern Europe and other emerging milk producing regions
Multiple buying power
Rapidly changing consumer taste and demand
Global food companies

There are many other forces which were not there in the '70s or '80s – environmental requirements, the corporate image, government or EU regulations, the working week and employee expectations and, of course, the right of the individual.

Different companies will react in different ways to these many challenges. Those who read the situation best will be the winners down the road - winners for their suppliers, winners for their shareholders, winners for all associated with the entity.

We can have a macro and a micro reading of the total situation, obviously very much influenced by the timeframe involved. On a macro level, raw materials for dairy or other food products will be produced in the lower cost producing areas, manufactured where it is most competitive, and consumer taste and buying power will dictate what is produced as distinct from a production led decision. If the consumer thinks butterfat is too expensive or less healthy, then the consumer will not buy it.

These are the long-term scenarios that co-ops or companies have to address.

There are many steps along the way which effect the lives and livelihoods of a great number of people.

The reform of the CAP and the freeing up of world trade in the new GATT agreement will, in time, change the price and, perhaps, the source for dairy and other food raw materials. Europe's prices may be too expensive. At the present time, farmers within the EU receive, for the most part, higher prices for their farming produce than those being obtained on the world markets. Under CAP reform, these prices will reduce by reducing the support mechanism and by reducing the export subsidies. Farmers will be compensated through direct income support.

Few of us could envisage that it would have taken so little time for certain farmers to start looking for B milk quota. The call comes particularly from farmers who are very efficient and who feel they can produce milk profitably at world market prices. Though the topic needs and will get a great deal of debate, as a processor of milk, I have to ask myself the question – Will milk be cheaper in Europe in the next decade by having no quotas or B quotas or should I look to other places in the world for cheaper sources of milk now? The debate so far has been producer led. The implications at processing and marketing level are just as significant. B quota is of little use to small producers. If such a quota comes will the processor and marketer of milk move elsewhere. Life was certainly much easier in the '60s, '70s and '80s.

The GATT agreement gives greater access to EU markets for certain agricultural produce which will come on to the EU market at lower prices. Side by side with GATT, we have NAFTA - a trade agreement for North America and the certainty of an enlarged EU. Eastern Europe is a producer of dairy and other food commodities produced at far lower prices, and though access to EU is now limited, the need for political stability will bring greater access as the years progress.

Most consumer foods in Europe are now sold through the shelves of very large retailers where fewer than six companies control 50% of the food retail space in each of the countries in northern Europe. Side by side with this development, retailers own brands are moving towards 50% of all products sold on those retail shelves. In past decades, retailers own label brands were often lower priced and of lesser quality but, today, all that is changed where, own label is as good if not better than any of the traditional brands to which we have become accustomed.

Perhaps, for the dairy industry and for most industries, this would be enough change to cope with but now we have the rapid emergence of the large or multinational food companies. The merger of dairy co-operatives within countries in Europe has obviously been phase 1. Phase 2, when it comes, will certainly break down country borders. Global food companies from America and Europe are following a strategy of producing their branded foods right throughout the world. We have Pepsi, Nestle, Grand Met, McDonalds and many others who are pushing out all the frontiers to become global players while trying to be cost competitive in everything they do. This is leading to, not just global marketing but global R & D and buying.

None of us can, any longer, under-estimate the importance of the consumer. The rapidly changing consumer taste and demand is bringing its challenges and its opportunities. Eating out, microwave cooking, ready meals and global tastes have all been pushing the outer limits of technology. How in the '70s could I have ever forecast that my own organisation would source, process and sell more water from the Dingle Peninsula than we would milk and that it would be selling at a higher price in the market-place?

I felt it important to sketch and review this background, the threats and challenges to this industry, before discussing the narrower topic "Diversify or Merge."

Ireland is a natural milk producing region so we will always have dairy farmers. However, none of us can predict in ten years from now as to how many or what will be the price of a gallon of milk. We can be certain that one will influence the other. Kerry Co-op had over 7,000 milk suppliers in 1974 where, today, 3,360 milk suppliers produce a greater amount of milk in those same regions. The introduction of a B quota would increase milk production in Europe, and would restore some of our world markets, now being picked up by other producing areas. The introduction of a B quota would also reduce the number of milk producers who could not compete.

Kerry, as everyone knows, chose the route to diversify. Back in the early '80s, it gave us the best chance of protecting the incomes and keeping on farms the greatest number of milk suppliers. Diversification brought other sources of income where farmers as shareholders also benefited. Dividends and share values as well as milk price all form an important component in our farmers income. The Kerry type of organisation succeeds because it has many different businesses depending on different raw materials and different consumers in various countries throughout the world. When one area turns down, there always is something else to compensate.

In Ireland, Dairygold went a different route and throughout Europe, for the most part, the dairy industry has opted more for merger than for diversification. Perhaps, if I were Chief Executive of a large dairy, with large dairy farmers and with similar co-operative neighbours, I would push strongly for merger to meet the global threat. The merger of co-operatives and milk processors will bring economies of scale. However, we need something more for the decades ahead. I see not just the merger of dairy co-operatives, needed for size and efficiency but the merger of dairy co-operatives with their marketing arm whether that be in Ireland, New Zealand or elsewhere. The alternative is for the merged entities to have their own strong sales and marketing arm. The world marketplace is calling for size and world marketeers. The forces around us, consumers, world buyers, world competition, will slowly, but with certainty, bring about the evolution. Merging co-operatives within countries or across geographic boundaries will bring the economies of scale but never the ultimate solution. The ultimate solution is to be a global marketeer. Time, and not the process I describe, is the only thing that is uncertain.

In Ireland, not so long ago, the competition was Golden Vale, Ballyclough, Mitchelstown, Kerry and others. Then as these organisations got closer together, the competition became the dairy industries of other countries, Denmark, Holland, France and New Zealand. We are now at a new frontier where competition in the dairy industry is coming from the new emerging dairy countries. However, outside of our dairy industry, there has been new sources of competition - vegetable fat replacing butter fat, cereal proteins replacing dairy proteins, other carbohydrates replacing whey solids. We concern ourselves so much about one another in the dairy industry that we can all stay blind to the threats and opportunities these changes offer. Securing the future for the dairy industry and its suppliers will best succeed when we open our eyes and minds to what is changing so rapidly around us.

Farmers and their co-operatives, be it in Ireland or elsewhere must first ask if they are contented to be suppliers of commodities to those who process or supply the supermarket shelf. If this is the goal, then those who produce and sell at the lowest price gain the upper hand. However, I would suggest there is little security for the EU dairy farmer in this type of scenario. Milk can be produced at a much lower price in other parts of the world. If a farmer or co-operative wishes to go a stage further - they themselves supplying the supermarket shelf, there must be a consciousness of the world market changing to global companies, global sellers and global tastes. Only global players will be noticed in a few decades from now.

Let me summarise. The pace of change has never been faster. Large corporations are living in a smaller world where travelling to any part of it can be done at very short notice. These large corporations in our dairy and food world will determine our and our farmers future. It is important that we become one or more of those corporations. Whether we should diversify or merge to become a global supplier is not the issue. The issue is to ensure that the dairy industry is not left behind and that it follows one or other or both routes. That will best secure the future for those who supply milk or work in the dairy industry.

Efficient Use of Grass for Mid-Season Lamb Production

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In mid-season lamb production the objective is to produce suitable lambs for sale mainly in the June to October period. Grassland management attempts to match grass supply with feed demand so as to achieve high lamb growth rate on grazed pasture with a minimum reliance on concentrate supplementation.

Lambing date

This should be chosen such that in a normal spring there is enough grass to meet ewes requirements at turn-out without the need for concentrate supplementation. The date is typically about mid-March at stocking rates of 10 to 12 ewes/ha. Some adjustment would be required at lower or higher stocking rates. Old pastures, low in ryegrasses, will be some 10 days later in spring growth than reseeded pastures and this should also be kept in mind. There are also regional and year to year variations in the date of spring grass growth. Lambing in February [2 to 4 weeks before enough early grass is available] increases the concentrate requirements for ewes post lambing and may only be justified in the expectation of selling lambs before the normal seasonal price drop.

Feed budgeting

Effective feed budgeting requires some knowledge of flock feed requirements at different times of the year, an estimate of available herbage, and of the expected grass growth rate.

Feed demand: The feed requirements of ewes is high post lambing in order to meet requirements for body maintenance and milk production. Measured herbage intake by ewes at pasture at Belclare increased from about 2 kg of organic matter in week 3 to about 3 kg in weeks 6 to 7 of lactation and declined gradually to about 2 kg in week 14. Intake by ewes rearing twins was 11% higher than for those rearing singles (Vulich *et al*, 1991). An intake of about 1 kg is sufficient for body maintenance post-weaning and this would increase to about 1.5 kg at flushing to allow for same weight gain. Intake by lambs increased to about 1 kg at weaning and remained in the range 1.0 to 1.2 kg post-weaning in the July/Sept period on grass swards. The herbage requirements for ewes and lambs can therefore be estimated. For example, at 12 ewes/ha the herbage requirement in week 3 of lactation [early April for mid-March lambing] would be about 27 kg DM/day, and this increases to about 48 kg in week 13 for ewes and lambs [at 1.5 lambs/ewe].

Feed supply: This can be estimated from sward height and the relationship between sward height and yield of DM. This relationship can vary somewhat from sward to sward and at different times during the season but can still give a useful estimate of the yield of DM available for grazing. On cattle pastures at Grange, for sward heights in the range 6 to 12 cm each 1 cm above a cutting height of 3.5 cm gave a yield of about 200 kg DM/ha (O'Riordan, E. G. 1995). On sheep pastures at Belclare in spring 1 cm height is equivalent to about 180 kg DM. When grazing down to 3 to 5 cm each 1 cm residue is equivalent to about 140 kg DM. A pre-grazing height of 7 cm gives a yield of about 1260 kg of DM, while a post grazing height of 4 cm gives a residue of 560 kg DM, giving a utilisation figure of 700 kg DM. At 12 ewes/ha in a 4 paddock grazing system the grazing pressure on a paddock is 48 ewes with a feed requirement in week 3 of lactation of 108 kg DM. Therefore the paddock will provide grazing for 6 to 7 days.

Sward height

This is a simple yet useful guide to the quantity of herbage available and its suitability for sheep grazing. The rising plate pasture meter or sward stick gives a reliable measurement when pasture is in the vegetative or leafy state. Caution is needed with height measurements taken in June when pastures may be getting stemmy if undergrazed at this time. Stemmy pasture will give high readings for sward height but this is a poor indicator of the suitability of the pasture for sheep.

Grazing system

High lamb growth rates can be achieved under set stocking or rotational grazing, provided the pasture is grazed at the desired height. However it is more difficult to maintain suitable sward heights with set stocking particularly when grass growth is changing rapidly. Paddock grazing gives greater management flexibility and makes it easier to take corrective action when required. Extra nitrogen can be applied to one or more paddocks if grass is too short, or a paddock can be closed for cutting if grass is too high. The latter can be very important in late May/early June in preventing the pasture becoming stemmy with consequent detrimental effects on lamb growth rate. With the widespread adoption of baled silage, surplus grass can now be more easily conserved at any time. A rotational grazing system can operate successfully with 6 to 9 paddocks

Grass at turn-out

The first critical requirement in the grazing season is to have enough grass at turn-out for ewes. A sward height of 4 to 6 cm will meet the immediate requirements of the flock without the need for supplementary feeding. This can usually be achieved in mid to late March where early grass is planned for by closing pastures by the end of November and applying 50 kg of N in February.

April-May: The objective at this time is to ensure that there is sufficient grass for grazing and that the sward is maintained in a leafy state and prevented

Table 1
Effect of sward height on lamb growth (g/day) to 10 weeks under set stocking

Sward height (cm)		
4	6	9
267	306	315

from becoming stemmy in late May/June. Results in Table 1 indicate that for set stocking a ward height of about 6 cm (range 5 to 7) is the optimum for April/May. Tight grazing at 4 cm will reduce lamb growth rate but lax grazing at up to 9 cm will give little further improvement in lamb growth rate. Lax grazing in late May results in selective grazing by sheep and the pasture becoming quite stemmy in June. This is more obvious on old permanent pastures where unpalatable grasses such as red fescue are rejected, resulting in the pasture developing a patch-work appearance of tightly-grazed areas and rejected high-grass areas. Lax grazing may provide a buffer against grass shortage due to drought, but does so at the expense of grass quality later in the season.

Table 2
Effect of post-grazing height (cm) on lamb weaning weight (rotational grazing).

Sward height (cm)		
3.0	4.5	6.0
26.3	27.0	29.2

With rotational grazing, the question arises as to how tightly paddocks should be grazed by sheep. Results in Table 2 with a ewe lamb flock illustrate the effect of post-grazing sward height on lamb weights. It is clear that grazing too tightly, to 3 cm, for 14 weeks depressed lamb weaning weight. However a post grazing height of 6 cm which gave the highest weaning weight may not be appropriate for April, May and June. Tight grazing in April had little effect on the 5 week weight of lambs. The effect is more pronounced when tight grazing was continued in May and June. This may be due to the fact that in April grass is very leafy and high quality so ewes can graze tightly without restricting lamb performance. Later in May/June the base of the sward becomes more stemmy as the flowering stems rise. Tight grazing at this time forces lambs in particular to eat herbage of lower digestibility, thereby reducing their performance. As a general guide, post-grazing heights of 3, 4, 5 and 6 cm may be more appropriate for March, April, May and June respectively. For the same reasons sward heights of 5 and 6 cm may be near optimum in April and May respectively for set stocking.

June: This is a difficult time to maintain pastures in a leafy state and prevent a decline in lamb growth rate. Records show that the growth rate of March-born lambs from 10 to 14 weeks is often lower than in the period of up to 10 weeks of age. This reduced growth rate occurs in late May and June when ewe milk supply is decreasing and lambs are becoming increasingly dependant on pasture. The pasture may be getting stemmy, if undergrazed in May, or it may be too short due to drought or too high stocking rate. Typically lamb growth rate may decrease from 280 to 220 g/day representing a loss in weaning weight of about 2 kg. This loss may largely go un-noticed on farms where lambs are not weighed regularly. It results in fewer lambs being ready for drafting at weaning in June (when prices are generally higher than later in the season) and delays the average sale date by about 2 weeks. Increasing the weaning weight by 2 kg, will increase the proportion of lambs drafted at weaning from 12 or 5% to 24 or 11% at litter sizes of 1.3 and 1.5 respectively. This delay may seem unimportant if lamb prices are stable but may cost about 70p/lamb, as weaned lambs will eat over 1 kg of DM/day costing some 5p/kg for grazed grass.

The decline in lamb growth at this time is largely due to the quantity and quality of the herbage available for grazing. With some adjustment in sward height it is possible to keep lamb growth at a high rate pre-weaning in June (Table 3). The objective is to offer lambs grass of high digestibility similar to that in April/May. With set stocking, tight grazing up to late May prevents seed-heads developing while an increase in sward height in June allows for the growth of new leafy material. The increased height in June may be achieved by applying nitrogen in late May, or by increasing the grazing area, by for example, including a paddock cut for silage in May. With rotational grazing, paddocks could be grazed less-tightly in June than earlier in the season. The provision of aftergrass for weaned lambs is desirable, but few sheep farmers would be in a position to have it available for ewes and lambs in June. In some situations with suitable farm layout it might be possible to allow lambs to forward creep graze on aftergrass while ewes are set-stocked.

Table 3

Effect of sward height and type on lamb growth rate (g/day) from 10 to 14 weeks of age

Grazed pasture		Aftergrass
5 - 6 cm	6 - 8 cm	7 - 9 cm
224	263	286

Creep feeding

This is an integral part of early lamb production and justified on the basis of the higher lamb prices in April to June, but is rarely justified with mid-season systems and prices. There is a response to creep feeding particularly with tight grazing that would otherwise reduce weaning weight (Table 4). At Belclare, over 4 seasons, feeding 250g creep to lambs between 5 and 14 weeks [total 15.75 kg/lamb] gave a 3.6 liveweight response at weaning with tight paddock

Table 4
Effect of creep feeding (CF) and creep grazing (CG) on lamb weaning weight (kg) with tight grazing to 4 cm

Control	CF	CG	CF + CG
27.8	31.4	31.2	33.0

grazing down to 4 cm at a F.C.R. of 4.4 for liveweight gain. The concentrate costs £2.56/lamb. The same liveweight gain in weaned lambs would be obtained in about 3 weeks on moderate quality pasture at less cost. Creep feeding could be economic with February born lambs if a high proportion of lambs was drafted at higher prices prevailing before the end of June.

Creep grazing

This is worth considering where a suitable paddock grazing system is used. Given the opportunity lambs will creep graze from about 7 weeks of age and do so to a large degree from 10 weeks to weaning. Allowing lambs access to the best grass ahead of ewes can help to maintain high lamb growth rates in June at a time when they normally decline. At Belclare over 4 years the response to creep grazing was similar to that for creep feeding at 250 g/day. The additional response to creep feed where lambs could also creep graze was small, with a F.C.R. of 8.5 for liveweight gain, indicating the benefit of high quality grass for lambs (Table 4).

Weaning age

This is normally at about 14 weeks of age and any variation from this date would depend on grass supply. If grass is scarce, with ewes competing with lambs for available herbage, weaning from about 12 weeks should be considered. Delaying weaning later than 14 weeks is sometimes practised in extensive systems where there is an abundance of grass, with a view to drafting more lambs off the ewes and avoiding a post-weaning check in lamb growth. It might also be delayed to facilitate putting weaned lambs directly on to aftergrass. If creep grazing is practised there would be less need to wean early even in a time of grass scarcity.

Post weaning

Lamb growth rate on pasture post-weaning can vary greatly and reports of poor growth rates on farms are frequent. Typical growth-rates can range from under 100 to over 200 g/day. Pasture height, clover content, previous grazing management, and "clean pasture" can all affect the rate of lamb growth. In addition mineral deficiencies such as cobalt [and occasionally selenium or iodine] or inadequate dosing practises can cause problems Assuming an average weaning weight of 31 kg, there will be a range of lamb weights from about 25 to 36 kg.

Table 5
Growth rate of weaned lambs (g/day) in relation to sward height (set stocking)

Sward height (cm)		
5	7	9
115	141	162

To add 12 kg to a lamb weighing 31 kg will take 120, 80 or 60 days at growth rates of 100, 150 and 200 g/day respectively. Sward height is a useful indicator of the growth rate to be expected on pasture. For set stocking a height of 7 to 9 cm is the target (Table 5). With rotational grazing, lambs should graze down to about 6 cm (Table 6). These results show a wide range of growth rates depending on the height and type of pasture being grazed. Grazing too tightly forces lambs to eat poorer quality herbage near the base of the sward, thereby restricting performance. The dry ewes can be used to graze off the grass left by lambs and can act as sward-improvers. The height to which paddocks are grazed in June will effect pasture quality for the post-weaning phase. For this reason the height of the layer of grass above "stubble height" may be a better indicator of the quality of the pasture for grazing than sward height only. Poor lamb growth rates on pasture post-weaning can be attributed to low intake of digestible organic matter. As indicated previously, intake by lambs was in the range of 900 to 1200 G.O.M. on grass swards. Intake will be best when lambs are offered leafy grass, of high digestibility and at a suitable sward height. Lamb growth rate on clover is higher than on grass due to higher intake of the more digestible clover. Supplementation with concentrates on pasture will give a further increase in total intake.

Table 6
Growth rate of weaned lambs (g/day) on different pastures in relation to post-grazing sward height (rotational grazing)

	Post grazing height (cm)		
Pasture Type	4	5	6
Old pasture	99	141	159
Ryegrass pasture	90	139	153
Ryegrass/clover	117	173	222

Concentrate supplementation at pasture

This is sometimes used, particularly when grass is scarce, to help finish lambs that would not finish on pasture only. There is a response to supplementation in the July to November period, the rate of response depending on the quantity offered and the supply of grass. The feed conversion rate

Table 7
Concentrate supplementation on pasture and feed conversion rate for extra carcass gain

Concentrates g/day	Dates offered	Sward heights Low	Medium	High
0 Vs 500	Aug - Oct	12.0	-	20.0
0 Vs 250	Sept - Nov	7.4	-	7.1
0 Vs 500	" "	8.0	-	10.0
250 Vs 500	" "	8.5	-	16.9
250 Vs 500	Jul - Sept	-	-	11.7
250 Vs 550	Oct - Nov	-	-	13.0
0 Vs 400	Sept - Nov	-	9.8	

(calculated as kg concentrate required per kg extra carcass gain) is in the range 7 to 10 when 250 to 500 g/lamb is offered on short grass. (Table 7). At this rate of response the extra carcass gain will leave a margin of profit over concentrate costs at normal autumn lamb prices. It gives an option to finish light lambs on the all-grass farm where alternative feeds are not available.

Coping with grass shortages

Grass growth rate varies from year to year and deficits may occur at different times. Lambing dates, stocking rates and nitrogen use are chosen, generally, to suit the "normal" year. Low temperatures in Feb/March as in 1996, will reduce early grass yield at turn-out and may necessitate supplementary feeding. If grass height is less than about 4 cm, supplementation of ewes should be considered at up to 1 kg/day until grass height reaches this target. Roughage such as hay or silage can also be offered on a bare paddock until growth improves.

Shortages in April - after the first grazing may be overcome by applying nitrogen after the first grazing and adjusting the area closed for first cut silage. Drought in May can result in a grass deficit pre-weaning. In this situation lambs could be early weaned at about 12 weeks and the ewes confined to bare pasture or housed and fed hay or silage. In extreme situations creep feed can be offered to lambs until grass supply recovers. The availability of hay or some baled silage gives some flexibility to the feeding of ewes in the post-weaning period up to flushing.

Grass surplus

This can also arise in a period of rapid grass growth in late May/June. Regular observations of grass height will indicate a developing surplus. This is difficult to control with set stocking unless part of the grazing area can be fenced off and even then the fenced-off area [with a grass height of perhaps 7 to 8 cm] may not easily fit into a silage-cutting situation. A surplus can be dealt with more easily with paddock grazing. If the sward height in the next paddock for grazing exceeds 10 to 12 cm it can be closed for silage, if the next paddock in the grazing sequence has 8 to 9 cm of grass. Controlling sward height at this time is critical for maintaining pasture quality in summer.

Extended grazing

The possibility of extending the grazing season and reducing the indoor feeding period and silage requirements is of interest to sheep farmers. At normal stocking rates pastures are generally grazed down to the desired height of about 3 cm by December 1 to 15. Ewe performance on extended grazing is satisfactory when ewes are given enough grass for an intake of 1 kg DM/day in early to mid-pregnancy. A daily allowance of 1.6 kg of grass at 65 percent utilization [estimated by cutting to ground level] allows for this intake. Grazing for 1 month therefore requires 48 kg DM/ewe. If stocking rate is 12.5 ewes/ha, extended grazing on 1/4 of the area at 50 ewes/ha for 1 month requires 2400 kg DM/ha. To achieve this yield, rest from about September 1 to 10 and apply 34 kg n/ha. The area grazed tightly by ewes in August would be suitable for closing. It can be grazed in the period early December to early January. Winter grazing even by sheep will cause some pasture damage especially in wet weather (and December is the wettest month of the year). This will reduce the yield of early grass by some 25 percent depending on grazing conditions.

Developing a complete outwintering system [as in New Zealand] for Irish conditions would only be possible at low stocking rates. Grass growth in Ireland in December to February is negligible in most years. Feeding 1 ewe for a 100 day winter requires about 160 kg/DM. At 10 ewes/ha it would require a cover of grass on the whole farm of 1600 kg of DM on December 1st. Any grass growth in winter would be more than off-set by die-back of this grass. A stocking rate of about 5 to 6 ewes/ha would be a more realistic target in a mixed grazing situation.

Grass-clover swards

The potential of grass clover swards for sheep is well recognised and demonstrated at Knockbeg and elsewhere. With moves towards REPS style farming and extensification the potential to exploit clover-based systems would appear to be greater now than in the recent past. Difficulties to be overcome

Table 8

A guide to sward heights (cm) for set stocking and post-grazing heights for rotational sheep grazing

	March	April	May	June	Post-weaning
Set stocking	4 - 5	5 - 6	6	6 - 8	7 - 9
Rotational grazing	3	4	5	6	6

include the low level of clover in many permanent pastures and the higher level of grassland management skill required to manage clover swards. Clover can be established reliably if reseeding, but better guidelines are required for introducing, maintaining and increasing clover in permanent pastures.

Extensification

This involves reducing stocking rates with corresponding reduction in the use of fertiliser, including nitrogen. At Belclare a system is being run on old pasture at a stocking rate of 111/4 ewes/ha and a N input of 90 kg/ha, levels appropriate for REPS. Extended grazing is provided for ewes for 1 month up to about January 10. Experience with this system would indicate that it is as difficult to operate at this level of intensity as it is at higher stocking rates with corresponding higher N input.

April lambing

A majority of lambs are born in March, leading to peak sales in July to September. Lambing in late April with a view to selling in October-December offers the possibility of reducing seasonality of supply. The system is used to a small extent in Britain and to a lesser extent in Ireland. Ewes could be at grass for a few weeks pre-lambing, thereby reducing concentrate requirements for ewes, but this would be offset by the extra concentrates required on an all-grass farm to finish lambs on pasture or silage. Target dates would be lambing April 25, weaning August 1 (at 14 weeks) at 30 kg, weighing 38 kg at the end of September and finishing at 44 kg in mid-November. Difficulties anticipated, include maintaining pasture quality for lambs in June/July pre-weaning and planning to have sufficient grass when mating ewes in late November. A small-scale trial is in its early stages at Belclare.

Mixed grazing

The benefits of mixed cattle/sheep grazing have been well demonstrated and different systems developed. Better growth rates and earlier sale dates are some of the benefits with lambs. There appears to be scope for the widespread adoption of this system on drystock farms.

Silage quality

If ewes are wintered on silage, quality is important with a view to reducing concentrate requirements for ewes. High yield with a long growth period must be offset against the extra concentrate requirements with a silage of lower digestibility. Attention to quality is also important now with baled silage. The cost of concentrate for ewes could vary from £2 to £5/ewe for high or moderate quality silage respectively.

Cleaner grazing systems

Lamb growth rate pre and post-weaning is generally better on clean pasture, that is, those with a low worm population. Some of the benefit of mixed grazing may be attributed to a lower worm population in lambs. Coccidiosis, Nematodirus and other worms can cause considerable problems on some farms. The area cut for silage on a sheep farm is smaller than for cattle systems and this limits the scope for alternating grazing and cutting areas. However a well planned approach to dosing of ewes and lambs, combined with alternating grazing and cutting areas where possible may merit more attention in the future, at a time of increasing concern for issues of animal welfare, use of chemicals and food quality.

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Prospects for Improving the Efficiency of Sheep Production from Grass

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Introduction

Grass, either grazed or conserved, accounts for 90-95% of the energy requirements of sheep compared to 65% and 80% for dairy cows and beef cattle respectively. Therefore the opportunity for increasing the reliance on grass is limited compared to other livestock enterprises. However, because of its high contribution, any improvement in the efficiency of production and utilisation of grass would significantly increase the profitability of sheep farming. Grazed grass is undoubtedly the cheapest feed for ruminants with the cost of silage and concentrate supplements three and seven times higher respectively. Unfortunately, grass does not grow all year round and conserved forage has to be provided during the winter period. Furthermore, there are times of the year when the nutritive value of forage is inadequate to supply the animal with its energy and protein demands or the intake of bulky food is restricted due to the ewe's condition e.g. late pregnancy and early lactation.

Greater reliance on legume-based pastures is regarded as the best way of improving the efficiency of sheep production (Hopkins *et al.*, 1994). Grass-clover swards can reduce production costs by saving money on N-fertilizer. Improved lamb growth rates are also likely due to the higher feeding value of the clover.

In this paper ways of improving the efficiency of sheep production from grass are discussed. These include grazing management, use of grass-clover pastures, choice of grass and clover varieties. Evidence from systems studies and farm survey data is also examined. Current research to improve our knowledge of diet selection and grazing behaviour is discussed in relation to the implications of the findings in the quest for more efficient sheep production from grassland.

Sward height

Development of grazing management systems based on sward surface height is regarded as the most significant technological advancement of recent times. Although sward height guidelines have been promoted for more than a decade, few farmers effect control by direct measurements on the sward. They resulted from detailed component research by scientists at the Animal and Grassland Research Institute at Hurley in Berkshire and at the Hill Farming Research Organisation in Edinburgh. Plant physiologists and animal nutritionists made detailed measurements of the growth and structure of grazed swards and of the

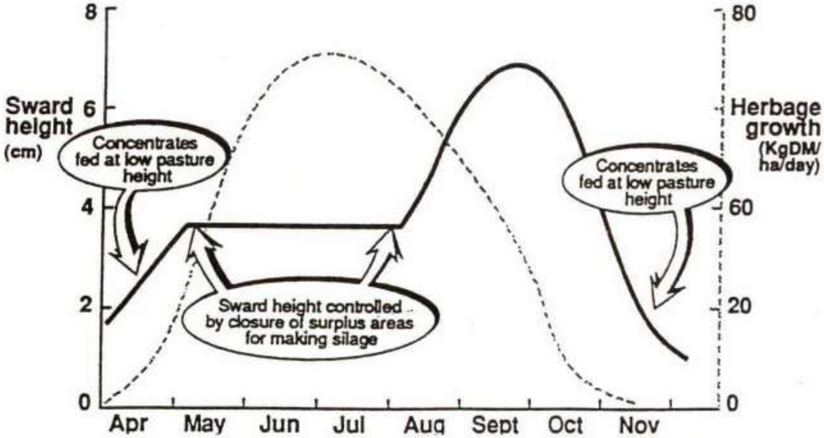


Fig 1 – Seasonal pattern of recommended sward heights

grazing behaviour and intake of herbage by the sheep grazing them. These studies led to a new understanding of the inter-relationships of swards and grazing animals. By managing continuously grazed pastures at specific sward heights, high levels of utilisation with optimum herbage growth and animal intake were achieved (Maxwell and Treacher, 1987). The annual profile of sward height recommended for upland systems is shown in Figure 1.

The influence of sward height on the intake and growth of weaned lambs was studied at Bronydd Mawr. Results (Table 1) show that higher intakes, and possibly greater scope for selecting higher quality feed, at the higher sward heights give better individual lamb daily liveweight gains. However, the higher sward heights carried less lambs per hectare. These data show that farmers could use sward height as a management tool to control weaned lamb growth rates and hence date of achieving finished target weights.

Table 1
Weaned lamb performance at different sward heights

	Sward height (cm)			
	10	7	4	7-4
Lambs/ha	29	35	62	56
Liveweight gain (g/day)	216	154	55	118
Output/ha (kg)	265	227	143	279

The use of white clover in pastures

The use of white clover in grazing systems has several advantages. It is a legume that fixes nitrogen from the atmosphere and thus reduces the requirement for mineral N fertiliser and pollution potential (Cowling, 1982; Parsons *et al.*, 1991). Under cutting, grass and clover swards have been shown to give DM yields equivalent to monocultures of grass receiving 200 kg N annum (Morrison, 1981). Clover is readily eaten by sheep and the performance of animals consuming clover is enhanced compared with those eating grass (Thomson, 1979; 1984). In indoor feeding studies, where grass and clover were cut daily and fed to ewes and lambs in set proportions (Gibb and Treacher, 1983; 1984), animals were found to perform better up to 100% clover in their diet. Gibb and Treacher (1983;1984) concluded that this increased performance was mainly brought about because sheep consuming clover had higher intakes, because of the higher rate of digestion and rate of passage of the legume, compared with grass (Moseley and Jones, 1984). There was also some increase in N supply to the animals eating clover and it has been suggested (Thomson, 1984) that the products of digestion from clover may be used more efficiently than those from grass.

We now have to ask the question 'How can these advantages for clover be incorporated into grazing systems? To answer this question it is first necessary to develop an understanding of plant to plant (i.e. clover vs grass) and animal/plant interactions.

First, we tested whether grazing sheep, as opposed to animals being offered feed indoors, also perform better on clover than on grass pastures (Penning *et al.*, 1995). Lactating Scottish Halfbred ewes with their twin Suffolk cross lambs were continuously stocked on monocultures of white clover (cv Huia) or ryegrass (cv Melle) maintained at sward surface heights (SSH) of 3 cm or 6 cm for each herbage species. On the tall (C6) and short (C3) clover swards the lambs grew

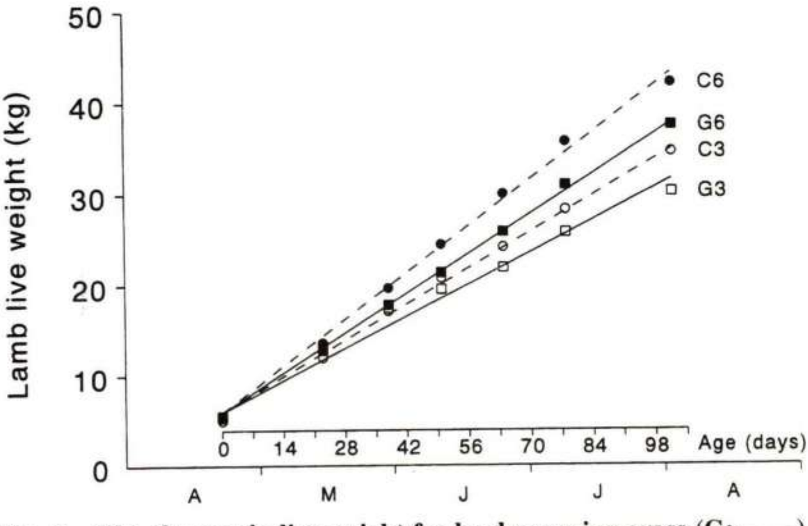


Fig. 2 – The changes in live weight for lambs grazing grass (G: ——) or clover (C: - - -) swards with target heights of 3 and 6 cm

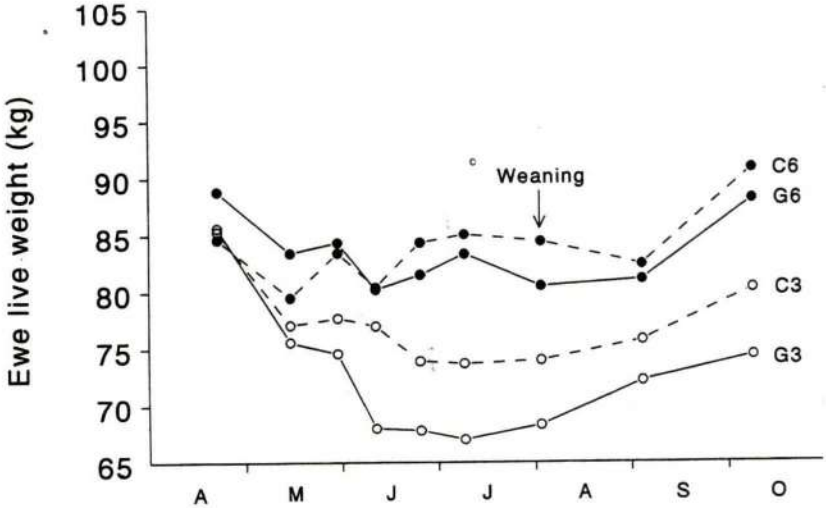


Fig. 3 – The changes in live weight of ewes grazing grass (G: ——) or clover (C: - - -) at 3 or 6 cm SSH

at 366 and 284 g/hd/d, whilst on the tall (G6) and short (G3) grass swards the lambs grew at 312 and 252 g/hd/d. A clear advantage for the clover can be seen (Figure 2). The changes in liveweight of the ewes are shown in Figure 3 and, again, the advantage for clover can be seen clearly.

Second we tested whether, given the opportunity, grazing sheep would select a diet of 100% clover. This has relevance, as in practical grazing systems animals usually have the opportunity to select between grass and clover. To measure their preference (i.e. selection with environmental constraints removed) we established monocultures of clover grown alongside monocultures of grass and allowed the sheep to select voluntarily between the two herbage species. They were offered clover and grass, maintained at 6 cm SSH, in proportions by area of clover to grass of: 20:80, 50:50 or 80:20. These areas of clover and grass offered were sufficiently large so that monospecific diets could have been obtained by the animals.

The sheep selected a diet containing 70 to 80% clover with lactating ewes tending to select a greater proportion of clover than the dry ewes (Table 2. Parsons *et al.,* 1994). It is interesting to note that animals selected a mixed diet, although we have shown that they would have performed better if they had eaten only clover. There was also a circadian pattern of selection with animals tending to consume more grass in the evening. The criteria by which animals asses optimum feeding strategy are obviously not the same as those of farmers e.g. to maximise growth rate and production .

A detailed knowledge of how sheep graze grass, compared with clover, would enable us to understand how the increased performance on clover compared with grass was achieved and give insights into creating possible manage-

Table 2
Mean percentage clover in the total intake

	Clover %			
Physiology	20	50	80	Mean
Dry	57.2	88.9	70.7	72.3
Lactating	67.5	81.0	90.7	79.7
Mean	59.7	87.0	75.7	74.1

management strategies for grazing systems. To investigate these aspects, the ingestive behaviour of lactating Scottish Halfbred ewes grazing monocultures of grass and clover at different SSHs was monitored.

Sheep were found to have greater bite masses in terms of fresh and dry material on clover than grass (Figure 4, Penning et al., 1995). Prehension biting rate (i.e. bites where material is harvested from the sward) was greater on clover than grass and mastication rate (jaw movements associated with chewing the material harvested with a prehension bite, but not rumination) were lower on clover than grass (Figure 5). As there is a fixed upper limit to total eating jaw movements, and prehension and mastication bites are mutually exclusive, this explains how differences in intake rate can occur. In fact intake rate was higher on clover than grass (5.3 vs 3.9 g DM/min grazing) at an SSH of 6 cm (Figure 6). The animals spent less time grazing on the clover than the grass but in spite

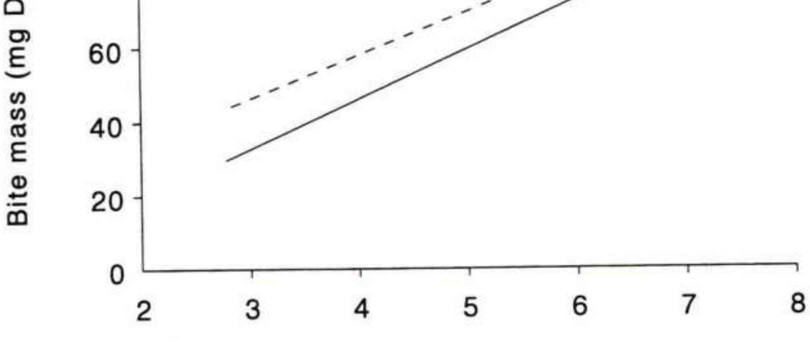


Fig. 4 – Effects of sward surface height on bite mass of lactating ewes grazing grass (——) or clover (C - - -)

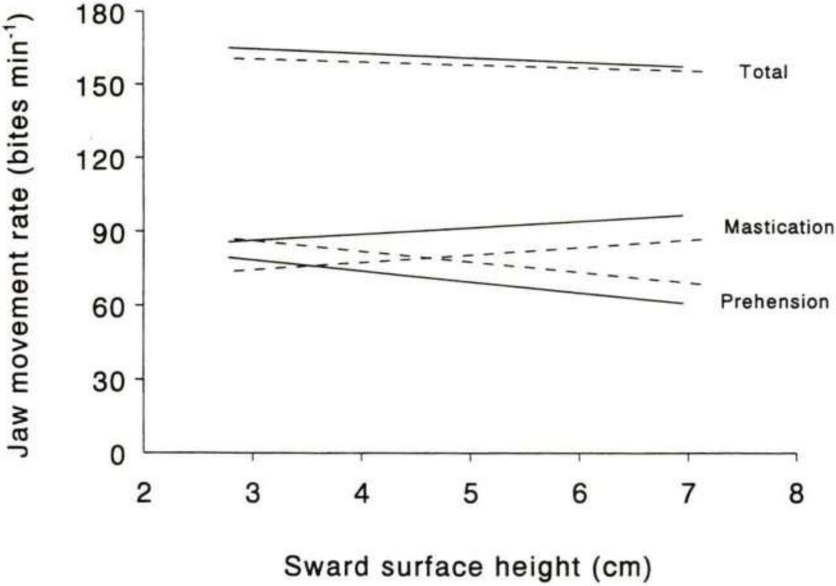


Fig. 5 – Prehension, mastication and total jaw movement rates for lactating ewes grazing grass (——) or clover (C - - -)

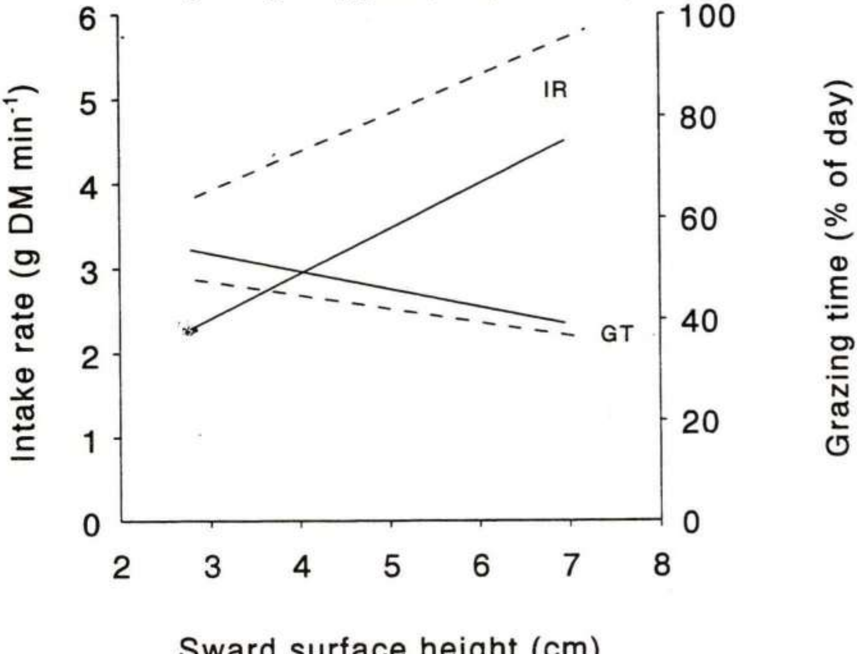


Fig. 6 – Intake rate and grazing time for lactating ewes grazing grass (——) or clover (C - - -)

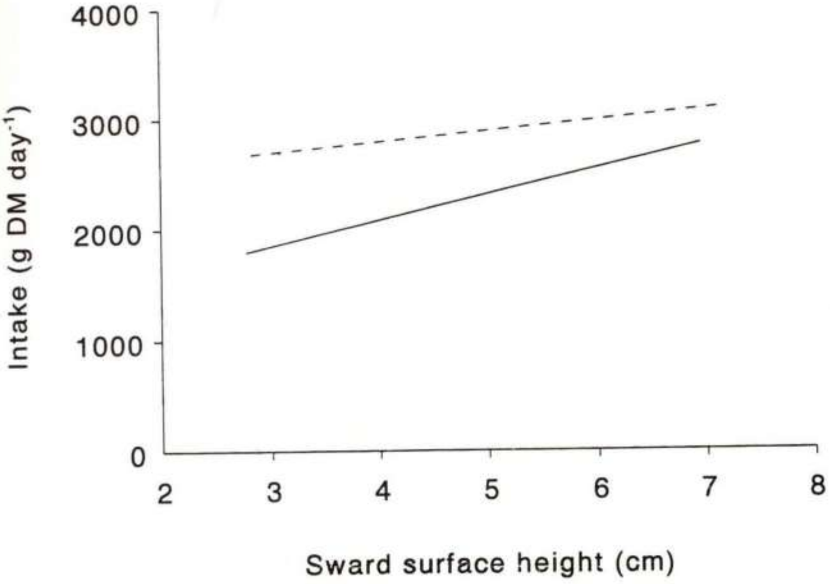


Fig. 7 – The effects of sward surface height on intake for ewes grazing grass (——) or clover (C - - -)

of this they still achieved greater daily intakes of DM of clover than grass (Figure 7). Another advantage associated with clover was, that per kg of herbage ingested, only 33 min ruminating was required for clover whilst 83 min was required to ruminate the grass. Thus overall, animals grazing clover had higher intakes but required to spend less time grazing and ruminating than those eating grass.

In addition to enabling animals to achieve higher intakes, clover has nutritional advantages over grass and these are shown in Figure 8. This Figure shows clearly that clover maintained a higher digestibility than grass and had a higher N content.

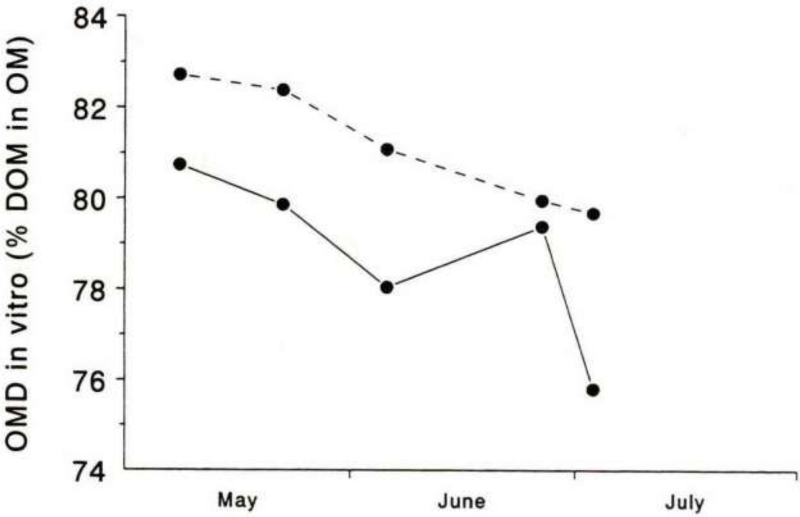
The above examples have illustrated the benefits in output per individual animal for clover compared with grass monocultures, but output per hectare from clover, grass and grass-clover mixtures must also be considered, as must N losses to the enviromnent.

Table 3

Stocking rates and total N excretion between 28 March and 23 October for dry ewes grazing swards maintained at 6 cm SSH

	Grass O N	Clover O N	Grass/Clover	Grass 420 kgN
Stocking rate (ewes/ha)	19.4	26.6	27.2	36.5
Total N excreted (kg N/ha)	161	358	249	484

These results (Table 3) show that clover swards and grass/clover swards



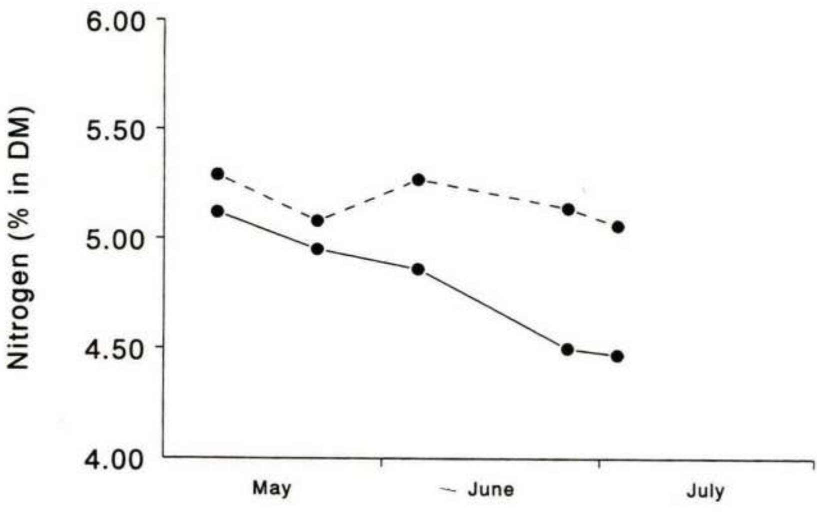


Fig. 8 – In vitro digestibility and N content of grass (——) or clover (C - - -) selected by grazing sheep

supported about 74% of the animal production of grass swards receiving 420 kg/N/annum (Orr *et al.*, 1995), whilst the grass sward receiving 0 N only supported 50% of the production. But the clover sward and the grass sward receiving 420 kg N gave higher nitrate concentrations in soil solution at 60 cm depth.

Mixtures of grass-clover offer a valuable, low cost and productive alternative to fertilised grass swards with output from grass-clover swards being about 80% of swards receiving 200 kg N.

Reliability of grass-clover swards

Systems based on grass-clover swards are often seen as carrying a high level of risk, in that year-to-year variation in herbage production and livestock output is greater than from N-fertilized grass, and this is often cited as the main reason for their non-adoption by farmers. Evidence from a number of published animal production comparisons show that, if anything, output between years is less variable from grass-clover than from N-fertilized grass swards. Over 6 years at Bronydd Mawr lamb production from grass-clover pasture had a range of 80-114% compared to a range of 75-125% for grass given 200 kg N/ha (Davies *et al.*, 1992).

Low productivity of grass-clover swards at critical times of the grazing season is also a constraint which may limit their adoption. Poor growth of grass-clover pastures in spring can be overcome in a number of ways. Strategic use of N fertilizer may be possible without a major detrimental affect on clover content. Alternatively, allocation of part of the farm to N-fertilized grass may provide additional herbage at this critical time. Another option is to change feed demand by altering lambing date. Progress has also been made in breeding clover varieties with improved winter hardiness and spring growth (Rhodes and Webb, 1993).

Grazing management for grass-clover

Successful grassland management involves making decisions to obtain a balanced compromise between the requirements for maintaining a desired level of pasture productivity on the one hand and meeting the nutritional demands for a given level of animal production on the other. In grass-clover pastures, allowance must also be made for the competitive interactions between the grass and clover components with their relative growth rates varying at different times of the year.

The sward height guidelines discussed above were devised on perennial ryegrass swards receiving high inputs of fertilizer N. In recent years, the suitability of these sward height recommendations for grass-clover swards has been investigated. In general, over most of the growing season there is no reason to deviate from the sward height profiles as illustrated in Figure 1.

Extensification policies of the EU might result in systems with sward height profiles which are higher than those regarded as the most efficient for animal production on a per hectare basis. The consequences of doing so is under investigation at Bronydd Mawr. Results over the first 3 years indicate that the higher sward heights (2 cm higher than recommended profiles) are creating pastures with a lower clover content and poorer feeding value.

Research in New Zealand (Hay and Baxter, 1989) has highlighted the effect of grazing management on white clover productivity and morphology. In a 5-year trial on a 20-year old sward, clover developed better with 12 weeks continuous stocking in spring rather than with rotational grazing. The resulting high clover density was best converted into animal-available herbage by rotational grazing during the subsequent summer, a time of year when conditions favour clover growth. Continuous stocking in spring, from lambing until weaning, followed by rotational grazing on a 4-week basis until autumn is now common practice on New Zealand sheep farms.

Manipulation of sward clover content is also possible by using different livestock species. At Bronydd Mawr in a study run jointly with the Macaulay Land Use Research Institute the beneficial effects of grazing by suckler cows and calves in spring rather than by ewes and lambs resulted in superior growth rates of weaned lambs that subsequently grazed the swards (Table 4). This was due to a higher clover content in the cattle grazed pastures (Wright *et al.*, 1992).

Table 4.

Clover content in early August and weaned lamb performance during August and September on swards grazed by either cattle or sheep from May to July

	Cattle		Sheep	
Sward height (cm)	4	8	4	8
Clover content (% DM)	13	9	6	2
Lamb liveweight gain (g/day)	92	140	52	119

Grass and clover varieties

A number of studies in recent years have compared lamb production from swards of contrasting perennial ryegrasses in the UK. Three of these experiments at IGER Bronydd Mawr and North Wyke and at the Scottish Agricultural College in Edinburgh included a comparison of tetraploid and diploid late-flowering varieties of perennial ryegrass. The results were consistent and showed significant better lamb performance from tetraploids. In the SAC experiment (Swift *et al,* 1996), lamb output averaged over 5 years was 12% higher from Condesa than from Contender (1112 v 995 kg/ha). At Bronydd Mawr over 6 years output from Meltra was 13% more than from Aberystwyth S23 (910 x 805 kg/ha). Based on current sale price for lamb the extra production from the tetraploids is worth over £100 per hectare.

The above results are from grass-only swards receiving around 200 N kg/ha. In both experiments, grass-clover pastures of the varieties were also compared. At Bronydd Mawr Meltra-S184 gave 16% more lamb output than S23-S184 swards (786 v 678 kg/ha). Detailed studies of the clover in these swards revealed that the tetraploid Meltra was much more compatible with clover than the diploid S23. Averaged over the 6 years mean clover stolon density on

Meltra-S184 was 61 m/m^2 compared to 37 m/m^2 on S23-S184 swards. Mean clover content of the herbage was 14 and 8% for the Meltra and S23 swards respectively. The better compatibility of the tetraploid Meltra was attributed to a lower total grass tiller density allowing greater development of clover (Fothergill and Davies, 1993).

There is little information on the effect of clover variety on animal productivity. However, one experiment was carried out by IGER which was duplicated at Bronydd Mawr in the uplands and at Plas Gogerddan, Aberystwyth in the lowlands. Lamb production was compared from ryegrass-clover pastures of three contrasting white clover varieties over 3 years and the results are presented in Table 5. (Davies *et al.,* 1995).

Table 5

Lamb production (kg/ha) from grass-clover swards of three clover varieties, mean of 3 years

	Upland	Lowland
S184	863	1179
AberEndura	726	913
Huia	755	1089
Mean	781	1060

Averaged for both sites, output of lamb was 11% more from small-leaved Aberystwyth S184 than from medium-leaved Grasslands Huia. Performance on the other small-leaved variety AberEndura was poorest. This suggests that it is not simply a question of leaf size. The differences were associated with growth habit (AberEndura being very prostrate) and its affect on the availability of the clover component of the sward to the animal. Again these differences between S184 and Huia in monetary terms are equivalent to around £100/ha. The high output achieved in this study is further confirmation of the potential of grass-clover swards without applied N in sheep production systems. However, as with perennial ryegrass choice of the appropriate clover variety is important.

Systems studies

A number of sheep systems studies have been carried out by IGER since the early 1980's. These have involved comparison of breeds, stocking rates, ewe:lamb ratios, nitrogen levels and sward height profiles. By using pre-determined sward height decision rules to adjust grazing area and the necessity to introduce supplementary concentrate or forage feeds with areas surplus to grazing requirement being conserved as silage, it is possible to determine whether a system of production is self-sufficient in terms of the provision of winter feed. With detailed monitoring of all inputs and outputs it is possible to carry out a financial comparison of the treatments.

Since 1988 attention has been focused on the development of low-input sheep systems based on white clover. Results of a 4-year study comparing grass-clover pastures receiving 200 or 50 kg N/ha are presented in Table 6. Three stocking rates (9, 12 and 15 ewes/ha) were compared at the lower fertilizer level and two rates (15 and 18 ewes/ha) at the higher level. By closing surplus areas for silage, the grazed swards were maintained at 3.5 cm until weaning on 17 July and at 5 cm for ewes and 6 cm for lambs until mid September. Lambs were finished at 34 kg liveweight.

Total lamb output closely followed stocking rate down from 801 to 449 kg/ha. Feed self-sufficiency in terms of silage made per ewe varied from less than 100% to nearly 300% of the annual requirement of 120 kg DM per ewe, increasing with reduced stocking rate.

Financial appraisal of the contrasting systems suggests that returns are highly dependent on relative sheep and feed prices and subsidy levels.

Table 6

Inputs and outputs from grass-clover swards at different stocking rates and fertilizer N levels, mean of 4 years

	200 N		50 N		
Ewes per hectare	18	15	15	12	9
Lamb output (kg/ha)	801	693	649	542	449
Silage made (kg DM/ewe)	98	147	103	179	322
Concentrate fed (kg/ewe)	17	10	24	17	5
Clover (% DM)	4	3	10	11	11
Gross margin (£/ha) at 1995 prices	1040	883	891	774	728
Gross Margin (£/ha) less subsidies	482	418	426	402	449

Farm survey data

The Meat and Livestock Commission (MLC) operates a recording scheme for commercial sheep producers and the physical and financial data collected is used as part of a farm advisory package known as Flockplan. Recently the rights of Flockplan has been assigned to Signet, a joint venture company between MLC and the Scottish Agricultural College. The data are published in Sheep Yearbook annually which gives information for different types of sheep enterprises in the lowlands, uplands and hills (MLC, 1995). Comparisons are made between the top and bottom third and average producers in terms of gross margins/ha. The principal components affecting profitability and their relative importance in upland and lowland spring lambing flocks in 1985 and 1994 are shown in Table 7.

Table 7
The contribution of flock performance factors to top third superiority in 1985 and 1994 in gross margin per hectare (%)

	Lowland		Upland	
	1985	1994	1985	1994
Lambs reared/ewe	25	6	42	0
Stocking rate	40	71	48	80
Lamb sale price/head	9	11	9	2
Feed and forage costs	8	0	-1	2
Replacement costs	11	9	1	13
Others	7	3	1	3

These values highlight the changes that have taken place in recent years with stocking rate now assuming over-riding influence on profitability. This reflects the contribution that Sheep Annual Premium payments now makes.

Concluding remarks

Evidence presented in this paper shows that opportunity exists for improving the efficiency of sheep production from grassland. Although current EU policy is geared towards putting a ceiling on total production, there is scope for individual producers to maintain and even improve the profitability of their enterprise. Reduction in production costs is possible by greater reliance on grazed grass. More use of white clover is unquestionably the key factor in this area. Plant breeding has a part to play in developing improved varieties of both grasses and clovers with better spring growth and higher feeding values. Better utilization of grazed grass is obviously another means of improving efficiency. Adoption by the industry of sward height guidelines would help in this respect.

Current MAFF funded research at IGER is examining the mechanisms governing the productivity and persistence of white clover in grazed pastures with the objective of devising more precise management guidelines. On-going studies on dietary preference and the grazing behaviour of ruminants should improve our knowledge of these aspects which again could lead to more precise management regimes.

In the long term, although consumption of sheep meat is on the decline at home, demand is predicted to increase with the growing world population and the improved purchasing power of the Pacific basin countries. However, to be competitive on the world market it is imperative that Northern Hemisphere producers improve the efficiency of their sheep production systems.

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Current Trends and Developments in New Zealand Sheep Farming

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Summary

Profitability on New Zealand sheep farms is at present very low. Individual farmers are managing up to 3000 sheep through having the appropriate farm facilities and stock and the judicious use of outside contractors. To increase profitability sheep farmers need to improve animal performance at stocking rates that give high utilisation of grass. One of the keys is high producing ryegrass/clover pastures that are maintained at high quality for better lamb growth during summer. Production research carried out in the past has provided this information but it needs to be more effectively extended to farmers. Future issues in sheep farming include increasing product returns through better marketing, improved animal performance, more effective extension of research results and use of high fecundity sheep breeds.

Short history

To understand the current position and future direction of the New Zealand sheep meat industry it is necessary to briefly recount events since the early 1970's. Up to 1973, most of the lamb and mutton produced was exported to Great Britain at a reasonably consistent high price and sheep farming was very profitable. In 1973, Britain joined the EEC and thereafter New Zealand was reliant on ever diminishing annual sheep meat quotas for entry into a previously unrestricted market. At about the same time the first of several increases in the price of oil occurred and the inflation rate increased from a historical low 1-2% to 15-20% through the 1970's. New Zealand developed other markets, notably the Middle-East for sheep meat but returns were lower than those received from Britain and fluctuated greatly from year to year.

In response to a situation in the late 1970's where many sheep farmers were not making a profit, the then conservative National Government introduced subsidies on sheep meat in the form of Supplementary Minimum Prices (SMP') paid out on individual carcasses. By 1984 SMF's made up to 50% of the income on sheep farms. As a results of SMP's, sheep numbers increased dramatically from 50 to 70 million, farm profitability improved and the price of intensive sheep farm land doubled from £600 to £1000 per hectare (£240 - £4000 per acre).

When the opposition Labour party came to government in 1984, one of their first acts as part of their market policies was to abolish SMF's. At the same time farm interest rates increased up to 25% and inflation, which had been government controlled in the early 1980's increased from 3 to 18%.

From 1984 to 1987, sheep farming went through a major crisis. Lamb prices were halved, the price of land fell dramatically and many sheep farmers, especially those that had borrowed large sums at previously low interest rates, were forced to sell.

By the early 1990s, the financial position of sheep farmers had improved due to lower inflation and interest rates. In addition, falling sheep numbers without a corresponding reduction in the slaughtering capacity of meat processing works meant that companies were having to pay premiums to achieve throughput, thus increasing lamb prices over and above the market return. As a result, company profitability was eroded and in 1994 two large companies went into receivership. The remaining companies could therefore procure animals without having to pay premiums to the farmer and prices dropped. Export prices for dairy and wood products increased in the mid 1990's and the huge demand for more land led to an increase in the price paid for sheep farms. These factors have all contributed to the current position where sheep farmers still have good equity in their land but at least half are failing to achieve a profit. Low wool and beef returns also contributed to this. Since 1984, national sheep numbers have declined from 70 to 47 million.

Since the financial trauma of the mid 1980's, the attitude of farmers towards farming has changed considerably. They are now more business like and searching for more profitable options and alternatives.

Financial status

In Table 1, the 1995/1996 budget for an intensive sheep farm in Southland (south of the South Island) is shown. This farm is regarded as average for this farm class and is monitored annually. Farm area is 200 ha wintering, 13 stock units per hectare (one stock unit is one ewe equivalent). Lambing percentage is 120%, lamb price £14 and wool weight 5.0 kg per ewe.

Although Southland has the coolest weather in New Zealand (average winter temperature 5°C, summer temperature 20°C) it is still at a more favourable latitude (by 5-10°) than Ireland. When the very low level of profit is combined with a high land price (£1000 per hectare), return on capital is very low (less than 1%).

Table 1
Budget (1995/96) for intensive Southland sheep farm

Gross revenue	£56,000
Variable costs	£30,000
Fixed costs	£24,000
Profit	£2,000

Management calendar

The timing of major management events follows a similar seasonal pattern to Ireland. In autumn (March to May), rams are put out for mating in early to mid April. From the end of mating in late May ewes are wintered outdoors on rationed autumn saved pasture or brassica crops with some hay and silage fed to make up a maintenance allowance. Lambing begins in early September with lambs weaned in December. Silage and hay is harvested in December and January and lambs are finished during January to March. Shearing is normally carried out every eight months (April, December, August).

Management of large flocks

In response to the large reduction in the inflation adjusted returns from sheep since the early 1970's, farm size and sheep numbers per intensive sheep farm have increased from 170 ha and 2000 stock units to 200 ha and 2600 stock units. As a cost saving measure, farm workers have also not been replaced with the results that the farmer/owner is now managing up to 2500 sheep. This has been achieved through working longer hours, having appropriate farm facilities and stock for a low labour input and the judicious use of outside and casual labour.

Farm layouts have been modified with more intensive subdivision (5-10 ha paddocks) and central races to ease movement of stock between paddocks and to the sheep yards. On larger farms there will be more than one set of yards to minimise the time taken to sort stock. Quick and easy to erect temporary electric fences are used to ration feed during winter. Four wheel vehicles (ATVs) are used to quickly move over even hilly areas of the farm. Sheep are grouped into large mobs to minimise the number of mobs to shift. Through selection and culling most sheep are now easy care being able to lamb without assistance and with minimal shepherding. Pregnancy scanning is used to identify multiple births so they can be managed separately. Ewes are set stocked at lambing and are rotated when lambs are large enough to shift easily. Contractors are generally used for operations such as shearing, crutching, dipping, fencing, making hay and silage and ground preparation for crops. This reduces the need for the farmer to own expensive machinery. For labour intensive operations such as tailing and weaning, three or four neighbouring farmers will combine to help each other.

Profitable pasture management

In an unfavourable outside economic environment, sheep farms have to be managed very effectively and efficiently to achieve a desirable level of profit and remain in sheep farming. Stocking rates need to be high enough (12-15 ewes/ha) so that the maximum proportion of grass grown (80-90%) is utilised by grazing animals. At these stocking rates, high animal performance is essential. Lambing percentage (lambs weaned in proportion to ewes mated) needs to be at least 150%, lamb carcass weight 15-17 kg (by end of March) and wool weight averaging at least 6 kg/ewe.

To achieve this performance, the important pasture management principles are:

1. Maintenance of high producing ryegrass/clover pastures (12-14 tonne DM/ha/yr) that persist for at least 20 years before renewal.

2. Appropriate grazing and conservation management to maximise pasture utilisation and transfer feed from high (late spring/summer) to low (winter/early spring) pasture growth periods.
3. Maximising pasture quality during late spring/summer to finish lambs at desirable carcass weights to maximise returns through the use of cattle to control pasture plus well timed pasture conservation.
4. On-farm monitoring of pasture cover, ewe and lamb liveweights and careful financial budgeting.

Role of research

As in Ireland, most of the research related to sheep farming was focussed on achieving more production up to the late 1980's. Since then there has been a change in emphasis towards the Government funding research on environmental effects, food quality and safety and genetic manipulation of plants and animals. At present there is a large body of production research information that requires assembling in an appropriate form (easy to read booklets, information sheets, decision support computer models) for use by advisors and farmers.

Important research that has shown how efficiencies in grass and flock management enhance profits include:

1. Identification of the correct level of pasture cover and quality to optimise sheep performance at critical times (Ewes during lactation and mating; lambs from weaning to slaughter). Farmers assess pasture cover in each paddock and use this to feed budget.
2. Understanding the grazing management necessary to achieve these appropriate levels. Rotational grazing is essential to ration and build-up pasture especially at high stocking rates. Set-stocking or continuous grazing can be used when pasture growth exceeds animal demand to achieve maximum live weight gain or wool growth. Pasture conservation is an important tool in maintaining pasture quality.
3. Identifying the soil pH and nutrient levels (P, K, S) required for optimum economic returns for an individual farm. This allows profit to be maximised and any adverse environmental effects to be minimised. Modelling of results has been carried out and a decision support computer model developed. There are also economic benefits to be gained from the use of nitrogen fertiliser (up to 50 kg N ha applied from late autumn to early spring).
4. Solutions and remedies for animal health problems have been developed. Anthelmintic drench resistance in lambs has been countered by on-farm monitoring of faecal egg numbers and judicial use of different drench families, identification of pasture species that have lower worm egg burdens and breeding of sheep for tolerance to internal parasites. Extender drench capsules are used in ewes for prolonged protection against internal parasites. Trace element deficiencies have been identified and the appropriate animal or fertiliser treatment (e.g. application of selenium prills in fertiliser) developed. The role of fungal endophyte in ryegrass causing ryegrass

staggers but also preventing plant death from Argentine stem weevil has been recognised and low or high endophyte ryegrass bred. Biological control measures for grass grub and Argentine stem weevil have been developed.

5. Now specialist pasture cultivars for summer growth in low rainfall areas (cocksfoots, fescues) and finishing lambs (chicory) have been released.

Improving lamb carcass quality

These technologies include newly introduced use of breeds such as Texels to improve carcass conformation, reducing overfats by early selection of high lean growth potential lambs, slaughtering lambs at appropriate carcass weights (15-17 kg) to maximise the proportion of lean meat and provide the correct sized cut and minimisation of pre-slaughter stress in handling animals.

Future issues

1. To regain the viability of sheep farming, returns per lamb must increase from the current £14 (cost of production) to at least £20 through better marketing of New Zealand's 'clean green' image to the more affluent end of the market. All year round supply of lambs will become important.
2. In addition to better marketing, sheep farmers need to take up existing management technologies to increase animal performance.
3. Sheep farmers have to adopt management strategies that through minimising nutrient loss and erosion are at least possible risk to the environment. This is important both for internal local government and marketing requirements.
4. There is a need for high fecundity sheep breeds (e.g. East Friesian) to increase the number of lambs finished per ewe wintered and take maximum advantage of the pasture growth pattern. Better milk production from these ewes will also lead to higher carcass weights.
5. Systems for extension of research results have to be developed to replace the old Government extension services. Monitor farms where groups of farmers pool information and research is adopted to meet farm goals is one method that is proving successful in New Zealand. Up to 25% more profit annually has been achieved on these farms.

Producing Lambs from Grass

D. BOURNS
Eyrecourt, Co. Galway.

Our main objective is to maximise lamb output per ewe making the best use of the grass available on the farm, while keeping costs to a minimum.

All grass farm

The farm is an all-grass farm with deep soil, good land for producing grass especially in a dry summer. The pastures are mainly permanent, while some, especially those used for cutting silage, have been re-seeded in the past 8-10 years. Pastures are based mainly on perennial ryegrasses.

We run a mixed stock enterprise of beef cattle and sheep, densely stocked on good grass. The farm is somewhat exposed, especially to the north. We are making strident efforts to plant shelter belts and hedges, but the process is very slow.

Ewe breeds

Flock size is 1030 ewes consisting of 800 matures and 230 hoggets. The ewes are mainly Greyfaces (Border Leicester x Scottish Blackface) and Mules (Bluefaced Leicester x Scottish Blackface) bought as ewe lambs in Co. Antrim.

We buy light ewe lambs (30-40 kg liveweight) in late August; they are not put to the ram until the following year. In our experience the quality of the Co. Antrim ewe is very good. The ewes are double vaccinated with Hep-P on arrival at the farm and are dosed for fluke and worms. They spend the winter grazing off the residual grass after the ewes. They are housed in the lambing shed in late March for 3-4 weeks where we hope that they will pick up toxoplasmosis and gain immunity before they are tupped in the following autumn. They also become accustomed to feeding on silage and to being housed.

We now favour the Greyface over the Mule because they have a longer productive life and are more capable of carrying multiples. We find that both breed types are great milkers and very capable of finishing twins quickly.

Sire breeds

The rams are Suffolk and Charolais. The Charolais have been introduced as sires over the past two to three years and we are pleased with them. However, the Suffolk is hard to beat as a sire breed; the lambs are vigorous when born and they finish quickly off a good milking ewe.

We buy our rams at pedigree Suffolk sales with strong bone, good conformation, a good neck and shoulder being essential to compensate for the rather poor shoulder in some of our ewes. Side by side with these traits, we also aim for rams with high LEAN GROWTH INDEX, knowing that ability to produce lean meat quickly will be passed on to their progeny.

Management calendar: Ewes pre-tupping

People often complain that there is a lot of work associated with sheep. With a big flock we try to keep to a fairly rigid management calendar. In late August the ewes are dagged and body scored. All their feet are examined and trimmed as required. We use a turning crate and we can get through just over 1000 ewes in 3½ days. Thin ewes are flushed immediately and all are dosed with cobalt. The rest of the ewes are flushed for three weeks pre-tupping. Ewes and rams are winter dipped pre-tupping.

Ram care

The rams are foot pared and given booster Hep-P in late August. They are fed a whole barley/soya mix for six weeks pre-tupping.

Mating management

The ewes are managed in flocks of 200 with 6 rams per flock. Care is taken to have a good mix of rams, e.g. 2 ram lambs, 2 hoggets and 2 matures. They are harnessed and crayons are changed as per ewe mark up. We find about 10 days for the first change and the next change following within 7 days, giving us a peak of lambing around St. Patrick's Day. Last autumn we split the ram turn-out; rams were turned out with 600 ewes and 7 days later the other 430 ewes were joined. This resulted in a lambing peak spread over seven days and not five days as in previous years. It meant that facilities and staff were not always stressed to the limit.

When the rams are with the ewes they are disturbed as little as possible.

Post-mating

Rams are removed after 6-7 weeks, checked for condition, feet etc., treated as necessary and put on good pasture to recuperate. The ewes are permitted to hoover around the farm mopping up any spare grass.

Housing and winter shearing

Ewes are housed in the first week in January, this year on January 8th. They are shorn shortly afterwards, this year on January 10th.

Winter shearing is a great asset to us: (1) We can carry more ewes in the sheds; (2) lamb birthweight is increased significantly; (3) it facilitates ease of suck and management greatly. One disadvantage is large milky elders in some ewes can become chapped and sore as there is no fleece to protect them in cold sleaty weather. Good field shepherding is essential to identify these ewes before mastitis and hungry lambs occur. In general, the advantages of winter shearing outweigh the disadvantages.

Our sheds are not purpose built and are all converted cattle sheds. The ewes are penned in groups of 45-60 per pen. They are body scored after shearing and thin ewes are penned together where they will not be bullied.

Feeding pre-lambing

After housing, the ewes are offered silage only, fed with a Keenan diet feeder. In mid February meal feeding is commenced according to mark up, at the rate of 450g (1 lb) meal per head per day for six weeks pre-lambing.

Meals consist of a home mix of oats, beet pulp and soya with minerals added. Current price is about £142.00 per tonne and we find that it is good value. The meals are fed mixed through silage. It is an excellent system; it cuts down on labour and it is easier on sheep and shepherds alike. The ewes do tend to sort out the meals but in general all ewes appear to get their quota. The thin ewes that are segregated are given extra meals in troughs.

One disadvantage is that when ewe numbers are decreasing in sheds, it is difficult to regulate the meal/silage ratio. When ewe numbers are down to 200 to lamb, we use trough feeding.

The whole flock is given mid pregnancy copper and Fasinex 14 days after housing. This is the only fluke treatment given to the ewes.

At four weeks pre-lambing according to their mark the ewes are given scour vaccine – this year we used immocolibov. At three weeks pre-lambing Hep-P and a worm dose of Nilverm are administered. This is the only worm dose given to the ewes for the year. At every vaccination the ewes are footbathed and lame ewes are foot-pared.

At all times ewe body condition is assessed and any ewes showing signs of stress or loss in condition are group penned separately for extra feeding.

Lambing season

Lambing is our harvest. It is all hands on deck. We work a 24 hour watch with one shepherd on at night and three people on during the day.

This year I had no outside labour and we managed. I find that a person who knows what he/she is doing is better than two people who are not familiar with the flock or with the set up.

We use a work rota where every one knows their job. I mainly work with deliveries, penning and lamb health. Another shepherd works with nurseries and turn-out to grass. We have a field shepherd for inspecting the fields after turn-out of young lambs. Our policy is 'don't send problems to the fields, keep them in until they are strong enough'.

This year we bought extra hurdles for individual pens. We now have about two pens per 10 ewes; this was a great help. There is nothing worse than having six ewes lambing together in a pen and nowhere to put them. We use straw and disinfectant liberally.

Management post-lambing

Our system is simple. After lambing, the ewe is penned and lambs' navels are dipped. Lambs are given a suck and if there are milk problems, other ewes are robbed or cows colostrum is used. Stomach tubing is frequently carried out especially where lambs are slow to suck. They remain penned for 24 hours; they are marked and ringed and four hours later are moved to a nursery, where 10-12 ewes are penned with their lambs. On the following day they are moved to the fields.

Lamb adoptions and cross fostering

We carry out a lot of adoptions, mainly triplets onto single lambs. Inevitably some adoptions do break down. Adoptions are usually conducted at birth when the lambs are wet; there are usually no problems. We go to great lengths to fool the ewes and spend time wetting a lamb and getting him bonded. We find that it is time well spent. We use fostering crates for adoptions in the case of ewes that have lambed for a quite a while. After two days the ewes are usually quite happy to accept their new lambs.

Turn-out is conducted with ATV transport and trailer or let out crate which carries 16 ewes and their lambs. After turn-out, particular watch is maintained for mis-mothering.

Results

Ewes and lambs are not fed at grass unless the weather is very bad. This year we used the ATV with a snacker which delivers neat piles of nuts on the ground; the ewes were very good at hoovering up the nuts. But feeding was confined to a few very wet days. High Mag buckets are liberally dispersed in the fields to prevent tetany and appear quite effective. The silage fields are all grazed intensively until they are closed in the first week of April. The lambs are dosed at 6 weeks and given a copper bolus.

Ewe lambing results for 1996 are summarised in Table 1.

Table 1
Ewe lambing results 1996

No. ewes joined:	Hoggets 230	
	Mature <u>800</u>	1030
No. ewes lambing		985
Litter size		1.85
No. lambs reared		1751
No. lambs reared/ewe joined		1.70

Drafting lambs

The first sales commence at about 11 weeks and at weaning we hope to have 45% of the lambs sold. The pattern of lamb weights at weaning in 1995 is summarised in Table 2.

Table 2
Lamb weaning weights 6/7/95

No. lambs	Liveweight
355	Sold
292	For sale 42 kg +
620	Over 35 kg
439	Under 35 kg

Lambs are drafted every 10 days approximately or if the factory is anxious for a few! We use the scales and body scoring. In general, we sell at around 42 kg but fat lambs would be let off at lighter weights. At weaning, we draft all lambs which are fit because kill-out drops afterwards.

The weaned lambs are weight graded, worm dosed and given cobalt. Any piners are also given multivitamins.

Management post-weaning

Flock health is monitored after weaning and lambs are dosed only when we think it is needed; we do not dash out at the first sign of a dirty tail. This year we are using Oramec, next year Levamizole. We do not use the white drenches.

The ewes are culled after weaning when elders are still in milk and any problems can be identified. Old and broken mouthed sheep are culled severely. This means that our replacement rate is high but we feel we are rewarded by having healthier, more productive sheep in the flock.

The ewes are tightened up and live mainly on fresh air and exercise until September!

Dipping is carried out as needed; usually two dippings during the fly season and then the winter dip.

Results on financial performance in 1995 are shown in Tables 3 and 4.

Table 3
Gross margin per ewe 1995 (£)

1.7 lambs @ £39	66.30	
Wool	2.40	
Premium	26.00	94.70
Direct costs per ewe:		
Grazing	10.00	
Silage	6.75	
Meals (31 kg)	4.40	
Vet/medicine (ewe+lambs)	3.00	
Depreciation	8.80	
Labour	6.00	
Straw	2.00	
Shearing	0.90	41.85
Gross margin per ewe		52.85

Table 4.
Net margin 1995 (£)

1.7 lambs @ 19.3 kg carcase/lamb	66.30
Wool	2.40
Premium	26.00
	94.70
Direct costs	41.85
Fixed costs	20.00
Net margin/ewe	32.85
Lamb carcase output/ewe	32.8kg
Income/kg carcase	289p
Net cost/kg carcase	189p
Net margin/kg carcass	100p

Summary

To summarise, we believe that costs are an important issue in flock profitability. We aim to keep costs, especially labour, to an absolute minimum without affecting ewe productivity.

Of late, developments and "buz" in the sheep industry have been lacking. There have been substantial advances in understanding nutrition in the ewe, in particular for ewes carrying multiples, and scanning has proved a great help to many farmers.

For my own flock I would like to see an effective vaccine against the plague of scour and watery mouth. I am becoming a bit fed up with chemical companies blaming failures on sloppy management. Farmers are no fools; we are prepared to progress, we now diligently vaccinate, feed and care for our flocks. We need innovation from chemical companies and research institutes to motivate us.

Carcass Classification: Results and Prospects

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Introduction

The need for a defined system for describing sheep carcasses has been promoted for a long time. The principal argument for the introduction of a standardised classification system for carcasses is that it would provide the language to enable all interested parties - farmers, exporters, wholesalers, consumers and support agencies - to communicate about the product, without ambiguity. This is an essential facility if producers are to be enabled to match their product to the requirements of the market. The absence of a classification system for the output of the sheep industry has allowed confusion to reign in discussions about market requirements, production objectives, breed choices etc.

It should be noted that a carcass classification system has been in operation in Britain for the past 20 years and for an even longer period in France. It is remarkable that our industry has been able to expand and continue to find markets without having a system for describing its product. This is probably fortuitous and due in the main to expanding demand in France allied with shrinking domestic production. Clearly, to continue on such a laissez faire course would be a very high risk strategy, given the ever increasing consumer reactivity to issues related to quality, health and value for money and the increasing competitiveness of our export markets. The imminent introduction of an agreed, standardised national classification system for lamb carcasses is very welcome and long overdue - the regret is that it has taken such a long time to arrive at this threshold.

What is classification?

It is appropriate to remind ourselves what "classification is" and what "it is not".

Classification is a system which describes the attributes of individual carcasses. The objective is to give information on those attributes which are of economic importance, in terms which are easily understood by producers, wholesalers and retailers. The list of attributes needs to be short, otherwise the purpose will be defeated. It is widely agreed that carcass weight together with an assessment of fat content and conformation provide an adequate and practical system for describing lamb carcasses for the purposes of the market.

Classification is <u>not</u> a system for describing the <u>value</u> of individual carcasses. Thus it is not correct to expect or demand that specified price differentials be attached to the various classes which a system of classification yields. It is up to market forces to determine the value of carcasses with any particular combination of attributes at any particular time. Classification provides the language which allows the requirements of the market to be transmitted, via price, to the producer.

Carcass weight - presents no difficulties as it is an objective attribute.

Carcass fatness - this is based on the visual assessment of the amount of fat on the external surface of the carcass in conjunction with the amount of kidney plus channel fat. This assessment is subjective but standardised against objectively-determined ranges of subcutaneous fat in carcasses.

Conformation - this is also subjective being a visual assessment of the thickness of the flesh (i.e. muscle + fat) in relation to the size of the skeleton. The various conformation classes are based on the blockiness and convexity of the carcass and the fullness of the legs. No attempt is made to allow for the influence of degree of fat cover on overall shape.

The EU Sheep Management Committee regulation on sheep carcass classification provides for a grid defined by five conformation classes and five fat classes - the EUROP grid. However precise standards were not specified to define this grid. The terms used to define the different classes are to a large extent indicative and require the development of specific standards - such as those developed by the Meat and Livestock Commission - to enable consistent application in practice. The precise standard specifications which have been developed in countries - such as France, Britain and Spain - with established classification systems are not directly comparable although all use the EUROP grid to describe the results. This means that it is not possible to directly compare the classification results across countries. Such comparisons would require the use of exactly the same classification standards in both countries and regular inter-country checks to ensure consistent interpretation of such standards.

These issues are raised so that it is clearly understood that one cannot compare classification results in the same way that one can compare carcass weights. Careful and cautious interpretation is essential. The same reservations apply to classification systems which have been operated by individual abattoirs. The value of a nationally standardised system is that, provided there is on-going supervision and refresher training, classification results can be compared among abattoirs. It should be understood by all concerned that, heretofore, quotations based on R3 carcasses could not be compared among abattoirs to any useful degree.

<table>
<tr><th rowspan="2">Conformation</th><th colspan="5">FAT CLASS</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>E
U</td><td rowspan="3"></td><td colspan="2">A</td><td colspan="2" rowspan="4">Overfat
(X)</td></tr>
<tr><td>R</td><td colspan="2">B</td></tr>
<tr><td>O</td><td colspan="2">C</td></tr>
<tr><td>P</td><td colspan="3">Unfinished (Y)</td></tr>
</table>

Fig. 1 – The EUROP classification grid with proposed combined grid for lamb carcasses at export abattoirs

The classification system which, according to media reports, has been agreed among the interested parties is based on a simplification of the EUROP grid and apparently uses the standards developed by the MLC in Britain as the basis. The proposed system is overlaid on the EUROP grid in Figure 1. The following are the definitions of the Irish system in terms of the EUROP (MLC) grid:

Class	EUROP (MLC) grid elements
A	E2 + E3 + U2 + U3
B	R2 + R3
C	O2 + O3
X	E4+E5+U4+U5+R4+R5+O4+O5+P4+P5
Y	E1 + U1 + R1 + O1 + P1 + P2 + P3

The labels A, B, C, X and Y are used here for convenience of reference only. In practice many of the cells on the 5 x 5 EUROP grid will not contain any carcasses or so few that they can be safely ignored. Thus, our experience using the MLC system in Irish export abattoirs shows that the majority of fat-class 1 carcasses are conformation P; a conformation score of less than U is hardly ever seen for fat class 5; less than R is very rare for fat class 4 while fat classes 2 upwards almost never get a conformation score of less than O. Hence, in practical terms we have the following equivalence between the proposed Irish grid and the EUROP (MLC) grid:

Class	EUROP (MLC) grid elements	Comment
A	A E2 + E3 + U2 + U3	—
B	R2 + R3	—
C	O2 + O3	Poor conformation
X	E4 + E5 + U4 + U5 + R4	Overfat
Y	P1 + P2	Unfinished

At Belclare we have been using the full MLC grid to classify lambs from research flocks and from commercial flocks since 1988. The same team of technical staff have done the classification throughout and they received refresher training each year at MLC training centres in Britain.

In the following sections of this paper results from our studies will be used to highlight various aspects of carcass classification. In all cases the classification results will be presented in terms of the proposed combined grid as outlined above.

Classification results

General. We have routinely classified carcasses at various export abattoirs during the main marketing season from May to November in each year since 1989. The pattern of visits to abattoirs was usually dictated by deliveries of lambs from the various flocks attached to the sheep research programme in Teagasc. In addition specific visits were made as part of an assessment of the carcass profile for lambs delivered by various producer groups. On all such visits our technicians routinely classified carcasses from other sources which were being processed at the time. These carcasses will henceforth be referred to as "commercial", to distinguish them from those from Teagasc flocks and from producer groups. In all cases the information recorded included a code which identified the carcasses belonging to an individual supplier (farmer or dealer) and carcass weight was also recorded. When the carcasses were from hill lambs this was also noted.

An indication of the general pattern of the classification results is given in Table 1, which is based on all carcasses from commercial sources which were classified during the years 1993 to 1995 inclusive. During these years there were occasions when of lambs destined for the "light-lamb" trade were being processed. Such carcasses and those from hill lambs were not included in Table 1. The classification standards which were used (defined by MLC in Britain) included subdivision of fat classes 3 and 4 into L and H subclasses. Inspection of Table 1 shows a concentration of carcasses in the following classes:

U3L, U3H, U4L, R3L, R3H, O2 and O3L.

It is also obvious from the table that there is an association between fatness and conformation - as carcass fat score increases so conformation improves (O to R, R to U). A final point to be noted is that most of the "overfat" carcasses (i.e. 4 and 5) are in the U4L class. It can be argued, on the basis of the patterns in the table, that by avoiding the production of overfat carcasses most of these will be converted into U3H or R3H and thus will increase the proportion in the A/B group of the combined grid.

Table 1

Classification results (%) for carcasses, from commercial sources, classified at export abattoirs for 1993 to 1995 inclusive (4022 carcasses; mean weight 18.9 kg; weight range 14.1 to 35 kg)

Classification	Fat class						
class	1	2	3L	3H	4L	4H	5
E	0.0	0.0	0.0	0.3	0.2	0.3	0.4
U	0.0	0.3	4.8	12.2	13.1	5.9	4.3
R	0.0	2.7	18.3	16.8	2.8	0.5	0.3
O	0.0	6.4	9.6	0.9	0.1	0.0	0.0
P	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Above results on the combined classification system:

A 17.6%
B 37.7%
C 16.9%
X 27.7%
Y 0.0%

The same results expressed in terms of the combined classification system are also given in Table 1. These show that 28% of carcasses were over fat and almost 17% had poor conformation.

A third feature of the results is that while mean carcass weight for these years was 18.9 kg the range was very great - 14 to 35 kg. Indeed any examination of carcasses at export abattoirs reveals an extreme variability in carcass weight. This is an undesirable aspect of the "quality" profile, but one which is easily remedied.

Pattern over years: An indication of the profile of carcasses for the years 1990 to 1995 is given in Figure 2 which displays the proportion of A/B and of over-fat (X) carcasses for each year. There has been no consistent pattern of

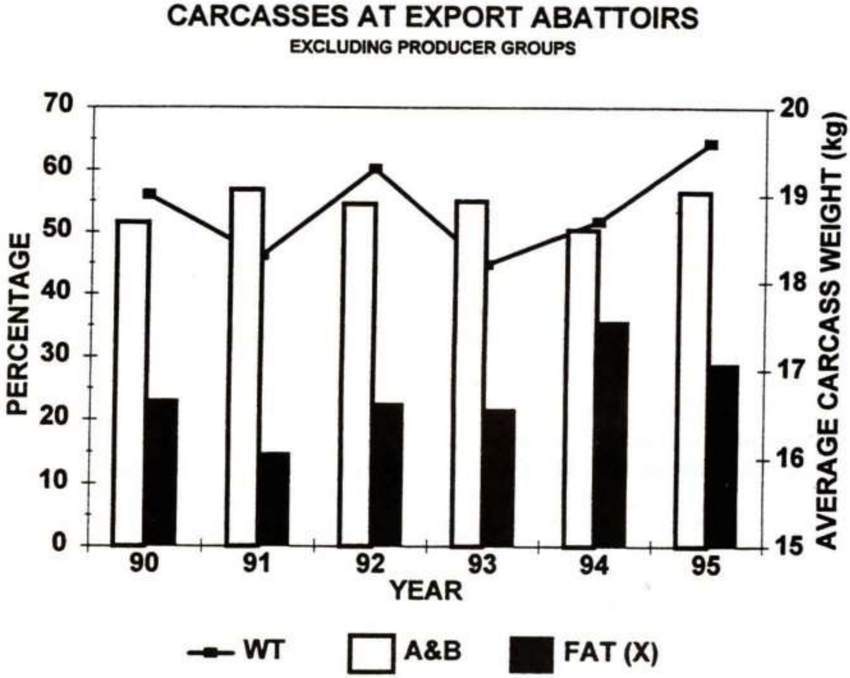

Fig. 2 – Trends in classification results and carcass weight for carcasses at export abattoirs

improvement over time although the proportion of class-C carcasses was lower in 1994 and 1995 than in any previous year. This change was, however, accompanied by an increase in overfat carcasses such that the proportion of class A/B in 1994/95 was 52% compared with about 53% for the 1990/91 period.

Table 2

Comparison of the classification profile of carcasses from lambs supplied by producer groups and those supplied by other farmers (1989 to 1992)

Combined class	Producer groups	Non-producer groups
A	14.1	14.5
B	44.4	34.2
C	28.4	18.8
X	12.8	31.5
Y	0.2	1.0
Average weight (kg)	18.4	19.0
No. of carcasses	2529	5624

Table 3

Comparison of the classification profile of carcasses from lambs supplied by producer groups and those supplied by other farmers (1993 to 1995)

Combined class	Producer group	Non-producer group
A	30.2	17.3
B	39.3	39.0
C	9.1	16.3
X	21.4	27.4
Y	0.0	0.0
Average wt (kg)	18.8	18.8
No. of carcasses	15613	4221

Producer groups: The results for the classification of carcasses from lambs supplied by producer groups are summarised in Tables 2 and 3 alongside carcasses for corresponding periods for sources other than producer groups (commercial). Clear differences are evident for both periods which, it can be argued, are attributable to the well defined marketing objectives which motivate the members of such groups. Producer groups delivered a greater proportion of A/B carcasses and a smaller proportion of overfat carcasses in both periods covered by the data in these tables. These differential results also support the argument, advanced later in this paper, that producers can transform the classification profile of lamb by the implementation of specified strategies when selecting lambs for slaughter. These results strongly support the idea that farmers can substantially alter the profile of the carcasses produced by adhering to well defined objectives in relation to the drafting of lambs for slaughter. This argument is further supported by the results on the classification of lambs from two research flocks over the period 1988 to 1994. The flocks in question consisted of a variety of crossbred- and Belclare-type ewes and each year these ewes were joined with 16 to 20 individual rams representing as many as 8 different breeds. The classification profile yielded by over 4000 carcasses involved was as follows:

A 20.8%
B 41.4%
C 10.3%
X 27.2%
Y 0.3%

The average carcass weight was 18.1 kg. The proportion of A/B was as high as that achieved by producer groups in most years, the proportion of class C was generally lower than for producer groups while the proportion of overfat carcasses was generally higher than for the producer groups. Sixty percent of the carcasses in the overfat class were in fact U4L and by the imposition of more rigorous fatness standards at drafting these would be converted to either U3H or R3H classes and thus one could project that the proportion of A/B would be increased to over 75% with only a marginal increase in the percentage of class-C carcasses.

Weight characteristics of carcasses from different sources: A striking aspect of carcasses from commercial sources is the variability in carcass weight. The difference between such carcasses and those from producer-group lambs is summarised in Table 4. This table displays the weight range which encompasses 90% of all carcasses from each source for the years 1990, 1993 and 1994. There was at least a 2 kg difference between the two sources in the weight range required to include 90% of all carcasses. More detailed analyses have shown that this is not a reflection of greater differences among individual suppliers of lambs. The difference in variability was just as great when the variation among lambs from an individual owner on a given day was examined. Carcasses from individual members of a producer group displayed less than 50% of the variability evident among carcasses from individual suppliers who were not producer group members.

This difference in weight variation can account for a large proportion of the difference between these sources in the proportion of carcasses in the A/B category.

Table 4
Weight variation characteristics of carcasses from two sources

Year	Producer group	Non-producer group
	90% weight range	90% weight range
1990	16.3 to 21.5 = 5.2 kg	14.5 to 22.4 = 7.9 kg
1993	16.0 to 21.3 = 5.3 kg	15.3 to 22.3 = 7.0 kg
1994	16.1 to 20.9 = 4.8 kg	15.9 to 22.7 = 6.8 kg
1995	—	12.6 to 23.8 = 7.8 kg

Seasonal variation: The association between the classification profile and time of the year was examined using classification results for one producer group whose lambs were monitored weekly from May to November in each of

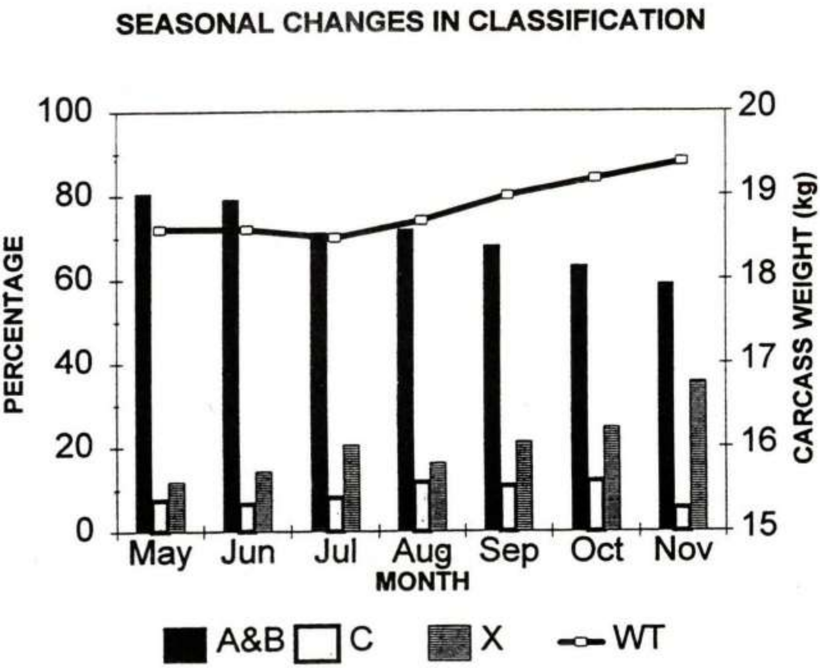

Fig. 3 – Seasonal trends in classification results and carcass weight – one producer group

two seasons. The results for one year are shown in Figure 3. These show some seasonal decline in the proportion of A/B carcasses - from near 80% in May-June to about 70% through July to September with a further decline to around 60% in October/November. There was little change in the proportion in class C but a noticeable shift upwards in the proportion of overfat carcasses. This trend was accompanied by an upward shift in average carcass weight from about 18.9 kg in May/June to 19.3 in October/November.

This pattern of change suggests that a substantial part of the seasonal change could be attributed to associated changes in the weight at which lambs were marketed rather than any major inherent seasonal shift in the intrinsic quality profile attainable.

Carcass weight: The weight of a carcass has a very strong influence on the likely classification. This is illustrated in Table 5 for both EUROP grid and for the proposed combined classification system. These results illustrate that poor conformation carcasses are generally quite light (average about 16.5 kg) while overfat carcasses are at the other end of the weight range. There will, of course, be considerable overlaps such that not all 16.5 kg carcasses will be in the 'O' conformation category and carcasses weighing ≥21 kg are not automatically

Table 5
Carcass weight (kg) in relation to the classification grid (commercial lambs '93 to '95)

EUROP grid		Combined grid	
Class	Weight	Class	Weight
O3	16.6	A	19.3
R3	18.1	B	18.3
R4	19.4	C	16.5
U3	19.1	X	21.0
U4	20.5	Y	
U5	23.1		

overfat. The results also indicate that for the A/B sector of the classification grid the carcass weight should be around 18.5 kg (Fig. 4).

The likely response of producers to price differentials among the different carcass classes will be, at least in part, determined by how any such differential affects overall value per carcass. For example, the average overfat carcass (Table 5) weighs about 12% (2 kg) more than the average carcass in the A/B group. Since the nominal direct costs of the extra liveweight to produce this additional carcass weight are quite small relative to the carcass value (and the opportunity cost is probably close to zero) the producer is unlikely to respond dramatically to price differentials of less than 10 percent. This is because an A/B carcass weighing 18.8 kg, and attracting a premium of 10% per kg relative to a carcass in class X, is in fact worth marginally less:

$$1.1 \times 18.8 = 20.68 < 21.0$$

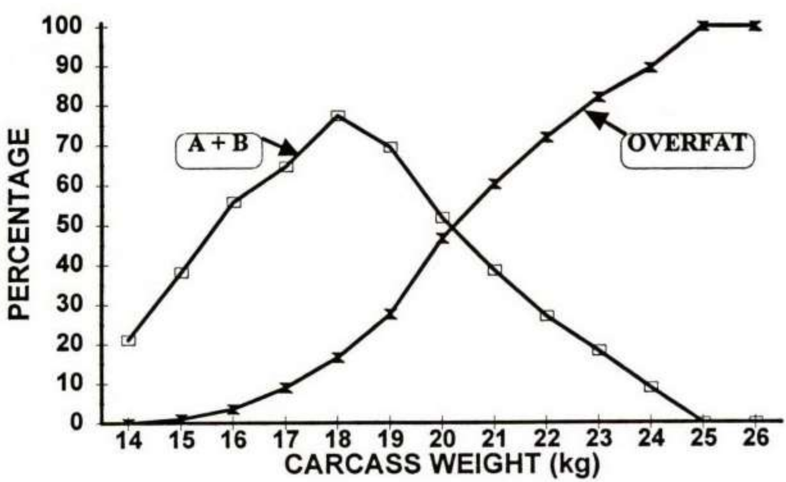

Fig. 4 – Relationship between carcass weight and classification.

Table 6
Classification results (%) for carcasses from lambs by breed of sire

Breed of sire	No. of carcasses	Classification A + B	C	X	Carcass wt (kg)
Suffolk	694	70.2	7.5	22.0	17.9
Charollais	664	59.2	8.3	32.4	18.4
Texel	953	66.4	7.1	26.2	18.0
Dorset	115	40.9	4.3	54.8	18.9
Ile de France	272	58.8	9.2	31.3	18.0
Vendeen	257	53.3	19.5	27.2	17.6
Belclare	243	54.3	17.7	28.0	18.4
Blue du Maine	259	64.1	26.6	8.9	17.6
Rouge de l'Ouest	234	75.2	8.4	21.4	18.3

The magnitude of the response by producers to any price differentials forthcoming from the market will certainly be determined by the magnitude of such differentials in conjunction with overall impact on returns per carcass.

Animal factors and Classification

The main issues which arise in relation to intrinsic animal factors influencing classification results are probably breed, sex and rearing type, i.e. single or multiple.

Breed effects: The impact of breeds on classification results is an issue which is generally to the fore in discussions about carcass "quality" and is also an issue on which there is no shortage of conviction. This is all rather surprising given the absence of any consistent system for carcass classification - a point upon which the "convicted" should carefully reflect. The broad evidence from our studies of breed effects on carcass classification shows that while breed differences do exist they are not overwhelming. The most straightforward comparisons which we have arise from an evaluation of breeds as terminal sires, where all breeds of sire are used across a range of ewe breeds. These results are illustrated in Table 6 and indicate that, for example, all of the more recently introduced French breeds as a group, are somewhat poorer (in terms of percentages of A/B and C) than the long established terminal sires (Suffolk and Texel). Thus the average percentage A/B for the set "Charollais, Vendeen, Bleu, Rouge" was 62 compared with 68 for Suffolk and Texel combined while the corresponding percentages for class C were averaged 12 and 7, respectively. Given these results one must wonder about the basis for the factory quotations which offer a premium for continental-cross lambs.

The other general point with regard to breed is that our results show that lambs from Scottish Blackface or Scottish-Blackface-cross ewes will yield fewer carcasses in the A/B classes and somewhat more in class C. However any such

Table 7

Carcass classiffcation results (%) for lambs reared as singles and those reared as twins (Teagasc flocks)

Combined class	Singles	Twins
A	28.5	27.4
B	29.7	38.6
C	3.2	2.7
X	38.5	30.6
Y	0.0	0.0
Average carcass wt (kg)	18.6	17.9
No. of carcasses	727	1945

shifts in carcass classification must not be judged in isolation but rather must be considered in the overall complex of factors influencing profitability of the sheep enterprise.

Sex effects: The principal way in which sex influences classification results is through fatness at a given carcass weight. Female lambs achieve the same degree of fatness (and conformation) at a carcass weight which is about 0.5 to 0.6 kg less than male castrates reared under exactly the same conditions. Thus, in selecting female lambs for slaughter, it should be remembered that they will be finished at a liveweight of 1 to 1.5 kg less than their male counterparts. The differences between entire males and wethers is of much smaller magnitude and can usually be ignored although the kill-out percentage will be lower for the entire males (by about 1 percentage point).

Rearing type effects: Lambs reared as singles grow much more rapidly than those reared as twins and are usually ready for slaughter 3 to 4 weeks earlier. The differences between single and twin lambs with respect to carcass classification are shown in Table 7, based on lambs from Teagasc flocks. The most obvious fact in this table is that singles are more likely to be overfat - probably a reflection of delaying drafting until after weaning in our research flocks so that all lambs have complete liveweight records to weaning at 14 weeks of age. However there is also a difference in average carcass weight in favour of singles and this is not explained by the higher proportion of overfat lambs. In fact more detailed analyses of these data show that singles are still about 0.7 kg heavier than twins when both are in the A/B class. Thus twin-reared lambs are "finished" at a lighter weight. This is probably explicable in terms of the differences in dietary composition between single and twins - grass constitutes a significant proportion of the diet of a twin from a much earlier age than for a single and as a result the diet of twins is probably less optimal for synthesis of body protein, with the result that a greater proportion of energy intake is deposited as fat. There is no evidence in the results to suggest that twins yield carcasses with poorer conformation than singles.

Consistency of Classification

While it is not possible to go into this question in any detail here the reliability of any classification system is undoubtedly of interest to producers. Consider the situation in which the classifier makes one error in every 50 carcasses. This, it can be argued, is a very low error rate for a subjective system. Such an error rate would mean that where a producer has 20 carcasses classified then all 20 will be classified correctly with a probability of 0.67. On the other hand, if the error rate is 1 in 10 carcasses then the probability that 20 carcasses will be all classified correctly is 0.1. My analysis of such error patterns indicates that given a supervisory system which involves the checking of a set of 20 carcasses then there will be little difficulty in detecting error rates of 1 in 10. Error rates of 1 in 20 will be more difficult to detect and would require the checking of at least three sets of 20 carcasses. It would seem reasonable to argue that an error rate of less than 1 in 10 should be tolerable since the errors can be either for or against the producer with equal likelihood.

On a number of occasions during the past few seasons we have compared our classification results with those produced by abattoirs. The results of one such exercise are given in Table 8 for illustrative purposes. **It must be emphasised that these exercises were undertaken prior to any agreed standard classification system.** The results do, however, emphasise the subjective basis of all classification systems and that the labels put on individual classes have no absolute, objective meaning. The results also underline the vital importance of an industry-wide system with continuous monitoring of standards to ensure consistency. The numbers illustrated in Table 8 show that the factory classifier used a much narrower range of classes and consistently under scored fatness relative to the Teagasc classifiers and also assigned lower conformation scores. This was a consistent feature of all such exercises which we have undertaken. It must be pointed out that I am not saying that our results are "more correct". From a producers viewpoint these experiences suggest that factory classifiers are lenient towards what we would call "over fatness".

Table 8

Comparison of Factory classification and Teagasc classification for the same carcasses

Teagasc	Factory classification			
	O2	R2	R3	R5
O2	<u>37</u>	7	9	0
O3	19	11	53	0
R2	23	<u>16</u>	16	1
R3	40	63	<u>480</u>	19
R4	0	0	16	23
U3	5	27	537	13
U4	4	3	365	131
U5	0	0	5	102

Future prospects – Producing to a specification

Individual producers can readily increase the proportion of carcasses which fall within specified cells of the classification grid. Comparisons given above between producers groups and other suppliers illustrate the shift in classification profile which can be effected by setting defined production goals and implementing drafting procedures designed to attain the goals specified. The two main elements which are of relevance are carcass weight and fatness. Thus, under present marketing conditions for the majority of our main season lamb there is a specified carcass weight range with some penalties for overfat carcasses. To attain this specification the first requirement is to draft lambs so that they yield carcasses within the specified weight range. Based on analyses of information on liveweight and carcass weight the following rule holds.

To get 90% of carcasses within a specific weight range the lambs must be drafted within a liveweight range which is not more than one third greater than the specified carcass-weight range, i.e. liveweight range should equal 1.33 *(carcass weight range).

Thus, if the specified weight range for carcasses is 3.5 kg then lambs must be drafted within a 4.5 kg liveweight range. The required precision of drafting can only be achieved by weighing lambs at the point of drafting.

While the foregoing rule specifies the liveweight range it does not give the minimum and maximum values needed in practice. This can only be done with some knowledge of the kill-out percentage. This varies with the production system, e.g. early lamb will usually have higher kill-out rates, due to the fact that they will be on dams milk plus concentrates, than main-season lamb), time of year, diet, sex, breed, etc. However as a general rule one can adopt the following conventions:

Unweaned lambs	48%
Weaned lambs on grass (early summer)	45%
Weaned lambs on grass (late summer/autumn)	43%

Now for a target carcass weight range with an upper limit of 20 kg and a lower limit of 16.5 the target liveweight is 18.25/0.44 = 40.5 kg. The range in liveweight should not exceed 4.5 kg. The upper limit should be 43kg and the lower limit 38.5 kg. Similar calculation can be made for other combinations of carcass weight and kill-out proportion.

Note that the liveweight range should not be calculated by dividing the upper and lower limits of carcass weight by the kill-out proportion. This will yield a range which is far too wide (8 kg for the present example) resulting in a correspondingly wide carcass weight range (6kg).

That the simple exercise of restricting carcass weight within specified limits will significantly alter the classification profile as illustrated in Table 9. The proportion of A/B is increased from 55% to 66% with corresponding reduction in the overfat and poor-conformation classes.

Table 9
Effect of restricted carcass weight range (16.5 to 20 kg) on the classification profile (carcasses at export abattoirs '93 to '95)

Combined class	Full set of carcasses (%)	Weight restricted set of carcasses (%)
A	17.6	21.1
B	37.7	45.1
C	16.9	11.4
X	27.7	22.4
Y	0.0	0.0

In practice, drafting should be done using the specified liveweight rules together with an assessment of fatness. Degree of fatness can be assessed through palpation over the rib cage, at the tail root and over the loin. It is not possible to "write down" how to assess fatness - this must be learned through hands-on experience. With regular practice related to results from the abattoir, producers should be able to avoid producing lambs which are over-fat or under-finished.

Based on results from producer groups and flocks and with a clear objective of avoiding the production of carcasses in the 4L fat category it should be quite feasible to achieve a target of between 75 and 80% of carcasses in the A/B sector of the combined classification grid.

This target can be achieved without any recourse to breed changes. In fact I would argue that focusing on the issues such as "which breed?" is an avoidance of the question of how to effect an immediate and dramatic improvement in the quality profile. However, such improvement requires that individual producers take responsibility for the type of lambs they draft for slaughter. Abattoirs can assist in this process by implementing the proposed classification system and by reflecting market preferences in their quotations of price with reference to the classification grid. It is, I would suggest, counter productive to offer premiums for any breed type. Rather carcasses should be paid for on their merits relative to market demand. Past experiences can readily be adduced to support the notion that producers will quickly respond to unambiguous and consistent signals from the market - a process which can only operate through the medium of carcass classification.

Competitiveness of Irish Sheep Production

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Introduction

The main purpose of this study is to examine and compare sheep production in France, the UK and Ireland. Ireland and the UK were selected as being the main EU exporting countries, whilst France is the main EU importing country and is also a major sheep producer.

Sheep production was investigated under the following main headings:

1. A review of sheep production within the EU.
2. Size and structure of sheep production in France, the UK and Ireland were examined at in terms of sheep numbers, flock size, and meat production.
3. Lamb prices, seasonality of production and carcase weights were investigated.
4. Technical performance of sheep farming in France, the UK and Ireland, was examined. Stocking rate, weaning percentage, mortality rate, carcase weight produced per hectare are all reported here. Performance comparisons are confined to lowland flocks, as it was difficult to compare mountain sheep production in the three countries.
5. Financial performance of the sheep enterprise in the three countries are compared. Again the data relate to lowland flocks to make the comparisons meaningful. Output, cost, gross margin and net margin data are presented for the three countries.

Sheep production in the E.U.

Sheep meat accounts for only 4% or 1.2 m tonnes of total meat production within the EU. Pigmeat production, at 15 m tonnes is the highest, followed by beef (7.2 m tonnes) and poultry meat (7m tonnes) in 1994. Sheep meat production has also declined over the last 5 years - from 1.2 million tonnes in 1991 to an estimated 1.1 million tonnes in 1995. Table 1 shows production by EU member state from 1980 to 1995.

The UK is by far the largest producer accounting for 0.4 m tonnes or one third of total EU production in 1994. Spain contributed 20%, France 13%, Greece 11% and Ireland 8% in the same year. These five countries accounted for 86% of total EU production in 1995. Since 1980 production increased dramatically in both Ireland and the UK but remained virtually static in all other EU countries, except France where it declined by over 30,000 tonnes. Table 2 shows the change in ewe numbers throughout the EU from 1980 to 1995.

Table 1

Gross production of sheep meat in EU countries 1980 - 1995 (000 tonnes c.w.e.)

Country	1980	1990	1991	1992	1993	1994	1995*
Belgium-Lux	4	5	5	3	3	3	3
Denmark	1	2	2	4	4	2	2
France	180	177	170	156	156	147	146
Greece	120	128	120	129	126	129	129
Ireland	39	87	95	99	103	96	96
Italy	55	56	58	59	59	53	54
Netherlands	25	30	31 ·	28	28	26	25
W. Germany	22	29					
UK	283	392	417	390	399	392	392
EU 9	**729**	**906**					
Spain		224	232	240	239	237	236
Portugal		28	30	27	30	30	30
E & W Germany		60*	62	45	40	40	41
EU 12		**1,189**	**1,222**	**1,180**	**1,187**	**1,155**	**1,154**

Source: EUROSTAT *Estimate

Table 2

Ewe numbers in EU countries 1980-1995 (000 head)

Country	1980	1989	1990	1991	1992	1993	1994	1995*
Belgium-Lux	54	110	115	114	115	114	110	106
Denmark	25	78	87	101	95	92	74	74
France	9,185	8,432	8,476	8,071	7,734	7,920	7,755	7,755
Greece	6,487	6,954	6,860	6,770	6,723	6,735	6,750	6,750
Ireland	1,607	4,193	4,578	4,625	4,806	4,676	4,545	4,500
Italy	6,789	8,836	8,134	7,698	7,681	7,835	7,900	8,050
Netherlands	604	1,295	1,400	1,350	1,220	1,370	900	855
W. Germany	759	1,079	1,251	1,227	1,219	—	—	—
UK	13,766	20,469	20,566	20,323	20,647	20,104	20,169	20,000
EU 9	**39,276**	**51,446**	**51,467**	**50,279**	**50,240**			
Spain		17,600*	17,612	17,994	18,307	18,432	17,497	17,450
Portugal		2,220	2,227	2,260	2,253	2,222	2,222	2,220
E&W Germany		2,119	2,050	1,760	1,691	1,687	1,696	1,720
EU 12		**72,306**	**72,105**	**71,066**	**71,72**	**71,187**	**69,618**	**69,480**

Source: EUROSTAT *Estimate

The UK has the largest ewe flock, 20 million ewes, in 1995, an increase of almost 7 million since 1980. Spain had 17.4 and Greece 6.7m in 1995. The balance between production and consumption of sheepmeat in each member state is shown in Table 3 for 1995.

Table 3
Production and consumption of sheepmeat in EU countries-1995 (000 tonnes)

Country	Production	Consumption	Deficit /Surplus
Germany	40	84	- 44
France	146	310	- 164
Italy	54	98	- 48
Netherlands	25	22	+ 3
Belgium/Lux	3	21	- 18
UK	392	322	+ 70
Ireland	96	30	+ 66
Denmark	2	7	- 5
Greece	129	153	- 24
Spain	236	253	- 17
Portugal	30	43	- 13

Source: EUROSTAT

Belgium, France, Germany and Italy consume much more sheep meat than they produce, but the amounts involved are much greater in France i.e. 164,000 tonnes in 1995 versus 44,000 tonnes for Germany, 48,000 for Italy and 18,000 tonnes for Belgium. The UK is the largest consumer and, on the basis of the data in Table 3, appears to be in equilibrium in relation to production and consumption. However, the UK exported approximately 140,000 tonnes in 1995 to other EU countries, and imported 132,000 tonnes in the same year. Ireland produced three times more lamb than it consumed in 1995. Consumption is mainly confined to Greece, Ireland, France, the UK, Spain and Portugal, as per capita consumption is only 1 to 2 kgs in the other countries. Consumption in the UK has declined rapidly since 1990 by 74,000 tonnes (almost 17%) in 5 years. Table 4 shows the overall level of self sufficiency within the EU in sheep meat for selected years from 1981 to 1995.

Table 4
Percentage self sufficiency within the EU in sheepmeat production

1981	1985	1990	1991	1992	1993	1994	1995
79.5	81.1	83.0	84.3	82.6	83.2	82.5	83.4

Source: EUROSTAT

Self sufficiency has increased slowly over the 14 years - from 79.5% in 1981 to 83.4 in 1995. Sheep meat therefore is unusual in relation to other meats within the EU in that it is in deficit. However, the shortfall is supplied by third countries, most notably New Zealand. The deficit of 16.6% in 1995 represented almost 200,000 tonnes of sheep meat.

Structure of sheep sector

The output from sheep in France in 1995 was £IR 430 m, which represents 1.25% of gross agricultural output. This amount does not include direct grants and premia paid to the sheep sector, which if included would increase the sheep contribution to gross agricultural output to 1.6%. Sheep contributed 7.6 and 5.0 per cent to gross agricultural output in the UK and Ireland respectively in 1995, excluding direct grants and premia.

Table 5
Agricultural output in France, UK and Ireland - 1994

	France	UK	Ireland
Total agric. output (IR£M)	34,395	16,281	3,418
Sheep output (excl. subsidies IR£M)	430	1,240	169
Sheep output % total output	1.3	7.6	5.0
Number of sheep producers	63,963	92,398	49,451
Agriculture as % of GDP	2.5	1.4	8.9

Sheep production is therefore not a main contributor to agriculture in any of the 3 countries. Nevertheless there were 61,400 farms with at least 10 ewes in France in 1994, 92,398 in the UK and 49,451 in Ireland in the same year.

Total sheep numbers and ewe numbers are shown for the three countries in Table 6 in 1995 based on ewe premium applicants.

Table 6
Sheep and ewe numbers (premium applicants) in France, UK and Ireland – 1995

	France	UK	Ireland
Total sheep numbers (000)	10,450	42,771	8,378
Ewe numbers (000)	7,106	20,066	4,714
Flock numbers	63,225	90,030	47,243
Average number of ewes per flock	112	223	100

The UK is by far the largest sheep producer with average flock size of 223 ewes in 1995, which was double that of Ireland or France. In the UK, 24% of ewes were in flocks of over 1000 compared to 1.6% in France and 1% in Ireland.

Sheep production has become concentrated within the disadvantaged areas in all three countries, as is shown in Table 7, and even more so in France where 85% of the breeding flock is within the disadvantaged areas and this trend is continuing.

Table 7

Percentage distribution of ewe flocks between disadvantaged and non-disadvantaged areas - 1995

	France	UK	Ireland
		% of ewes	
Disadvantaged areas	85	74	75
Non-disadvantaged areas	15	26	25

Lamb prices, weights and marketing

Table 8 shows average lamb prices in France, the UK and Ireland. The French and UK prices have been converted to Irish punts using annual market exchange rates.

Table 8

Lamb prices in France, UK and Ireland 1985 - 1995 (IR £)

	1985	1990	1991	1992	1993	1994	1995
				IR £/kg carcase weight			
France	2.79	2.44	2.55	2.49	2.63	2.75	2.72
UK	2.13	1.90	1.62	1.81	2.15	2.32	2.27
Ireland	2.28	1.90	2.00	1.81	1.99	2.23	2.12

The prices shown are as reported to the EU for calculating the ewe premium. Sheep prices in all three countries have remained virtually static in current terms, implying a considerable decline in real terms over the period shown. Average French prices were consistently higher than Irish prices over the period, 1985-1994, with differences ranging from 22% in 1985 to 38% in 1992. French producers received from 51 pence to 68 pence more per kg for their lamb than their Irish counterparts. The UK price was lower than the Irish price up to 1991 but moved ahead of the Irish price from 1992 onwards following the rémoval of the variable premium. The Irish lamb price therefore, is deteriorating viz a viz France and the UK in recent years. Table 9 shows the relative difference in price between the 3 countries over the 1985-1995 period.

Table 9

Relative lamb prices in France, UK and Ireland 1985-1995 (Ireland = 100)

	1985	1990	1991	1992	1993	1994	1995
				(Ireland = 100)			
France	122	128	128	138	132	123	119
U K	93	100	81	100	108	104	107

Quarterly lamb slaughterings are shown in Table 10 for the three countries.

Table 10
Seasonality of lamb slaughtering in France, UK and Ireland - 1995

	Jan-Mar	Apr-June	July-Sept	Oct-Dec
	% of disposals			
France	24	30	24	22
U.K.	22	21	29	28
Ireland	13	29	33	25

The data shows that both French and UK lamb disposals are more evenly distributed throughout the year than Irish disposals. The French have a slight tendency to produce more in the earlier part of the year to avail of higher prices and a higher percentage of French lambs are finished indoors on all year round basis. Ireland on the other hand produces almost 60% in the mid-season i.e. April to October, with only 13%in the first quarter. On a monthly basis, Ireland and indeed the UK's main disposals occur from May to November and this has major repercussions for the price of lamb.

Average carcase weights for lamb in France the UK and Ireland are shown in Table 11.

Table 11
Lamb carcase weights in France, U.K. and Ireland 1990 - 1994

	1990	1991	1992	1993	1994	5 Year Ave
	Carcase weight (kg)					
France	17.7	17.4	17.5	17.1	17.2	17.5
UK	17.1	17.5	17.5	17.3	17.4	17.4
Ireland	18.8	18.2	18.9	18.3	18.6	18.6

French and UK carcase weights have remained virtually constant over the period and are almost identical. Irish carcases on the other hand have been on average 1.1 kg heavier than the French and UK carcases. Irish carcase weights shown are based on results of a Teagasc survey of lamb carcases at various export abattoirs on a range of dates during the main slaughtering period.

Sheep marketing co-operatives are extremely important in France with 50% of carcase sales going through producer groups and 32% of the live lamb trade marketed through groups. This is in marked contrast to the Irish and UK situation, where only a fraction of lambs are sold through groups. Theoretically all lamb carcases are graded in France on the EUROP classification grid. However, in practice only approximately 50% of carcases are actually classified and paid for on that basis. All sales through French producer groups are on the basis of classification.

In the UK, 5.3 million lamb carcases were classified in 1994 on the EUROP grid. This represented 31% of all slaughterings. The MLC monitor, on an annual basis, the percentage of UK lambs in the "target" classification sector (EUR and 123L), and 49.1% of all lambs were in this sector in 1994. The percentage in the "target" sector has increased from 42% in 1990 to almost 49% in 1994. Ireland, unlike the other two countries, does not have a national carcase classification scheme, despite much discussion and many attempts to put one in place. An agreed carcase classification scheme would be crucial in providing information to produce a quality product, as is demonstrated by the schemes in France and the UK.

Financial performance

In this section financial returns of sheep production are presented for the 3 countries. In inter-country comparisons, it is important to use data which represents the average commercial situation in each country. Individual farm data or results from sheep research units, whilst useful in demonstrating levels of performance and efficiency that can be achieved, do not represent the average national situation, and consequently should not be used for this purpose. The performance of the Irish sheep sector is based on the results of a random sample of sheep producers from the 1994 National Farm Survey. Individual flock results are weighted by flock size to provide national data on performance. The UK data are based on a national survey of sheep producers carried out by Exeter University in 1994. The UK data are also weighted by flock size to provide national results for the sheep sector. Unfortunately, there are no similar national data available for French sheep production. Following discussions with INRA (National Agricultural Research Agency), and with the French Agricultural Advisory Service, two regions were selected to represent lowland French sheep production, viz - the Limousin and Poitou - Charentes Regions. These are the 2 largest lowland sheep producing regions in France and account for 20 per cent of all ewes in France. An annual survey on financial and technical performance of commercial sheep production is carried out by the regional advisory service. These data were taken to represent the French sheep situation and 1994 results were used.

Table 12 shows the financial performance of sheep production in the UK, Ireland and both French regions. To facilitate direct comparison French and UK currencies have been converted to Irish punts using average annual exchange rates.

On a per ewe basis, the French obtained the highest output and gross margin followed by the Irish with the UK flocks having the lowest returns. Ireland had the lowest direct costs of production on a per ewe and per hectare basis in 1994, and survey data for each country from 1988 to 1994 show that Ireland had consistently lower direct costs over this period. On a per hectare basis the UK achieved highest output and gross margin, due as will be shown later to their higher stocking rate.

Table 12
Financial performance of sheep production in France, UK and Ireland - 1994 (IR £)

	Limousin Region	Pouitou-Charentes Region	UK*	Ireland
		IR £/ewe		
Output	95	88	68	71
Direct costs				
- concentrate	21	17	10	9
- forage	6	6	6	6
- other	8	7	9	5
Total direct costs	35	30	25	20
Gross margin	60	58	43	51
Overhead costs	43	41	31	23
Net margin	17	17	12	28
		IR £/ha		
Gross output	694	735	905	641
Direct costs	255	261	332	182
Gross margin	439	474	573	459
Overhead costs	314	340	406	206
Net margin	124	134	167	253

*Exeter Survey provisional

Direct costs, whilst they are an important component in calculating relative profitability, do not illustrate the complete picture. Overhead costs are also critical, as when deducted from gross margin they show the real net profit arising from sheep production and available to meet farmer's living expenses.

Overhead costs vary in each country, as is shown in Table 12, so their effect on comparative efficiency of lamb production must therefore be examined. The overhead costs shown in Table 12 are actual costs attributable to the sheep enterprise, which must be allowed for by the farmer and include hired labour, interest on borrowings, insurance, farm and building maintenance, building and machinery depreciation and others. These costs were collected in all three countries and are shown in Table 12. Overhead costs per ewe were highest in France due to higher building and machinery depreciation as well as higher interest and labour costs. Overhead costs per hectare were highest in the UK due mainly to paid labour, land rent and depreciation. The impact of overhead costs is shown in Table 12, where Ireland is seen to have the highest net margin per ewe and per hectare.

Data in Table 13 summarize output, costs and margins per kg carcase produced in the 3 countries. The data show that whilst France had the highest

Table 13
Output, costs and margins per kg carcase in France, UK* and Ireland - 1994

	Limousin Region	Poitou-Charentes Region	UK*	Ireland
		IR £/kg carcase		
Gross output	4.39	4.62	2.68	3.14
Direct cost	1.61	1.58	0.98	0.89
Gross margin	2.78	3.04	1.70	2.25
Overhead costs	1.99	2.15	1.20	1.00
Total costs	**3.60**	**3.73**	**2.18**	**1.89**
Net margin	0.79	0.89	0.50	1.25

* Exeter provisional

direct and overhead costs per kg carcase, Ireland on the other hand had the lowest direct and overhead costs per kg carcase at IR £0.89 and IR £1 respectively compared to IR £0.98 and IR £2.18 for the UK. Direct costs of producing a kg of lamb in Ireland were therefore, 9 pence less than in the UK and 70 pence less than in France. Ireland had an additional 20 pence per kg carcase advantage on the UK in relation to overhead costs. Net profit per kg is highest in Ireland, with UK producers receiving the lowest net returns. Total cost of producing a kg of lamb is therefore, highest in France at IR £3.66, followed by the UK at £2.18 with Ireland lowest at IR £1.89.

The Meat and Livestock Commission (MLC) in the UK also collect data on a select group of sheep farms, who pay for this service. These farms have above average performance, but it is interesting to note that even on those farms direct costs per kg lamb carcase produced are higher than on Irish farms with average level of performance.

Table 14
Direct cost of producing 1 kg lamb in UK and Ireland 1991 - 1994**

	1991	1992	1994
		Direct production costs IR £/kg carcase	
UK (MLC)	0.86	0.76	0.91
Ireland (NFS)	0.85	0.75	0.89

** MLC Flock plan

Data in Table 14 show that even average sheep producers in Ireland had slightly less direct costs of production than the top achievers in the UK.

Technical performance

Data showing technical performance of sheep production in the 3 countries are shown in Table 15.

Table 15

Technical performance of sheep production in France, UK and Ireland - 1994

	Limousin Region	Poitou-Charentes Region	UK	Ireland
Number of flocks	53	277	410	278
Average number of ewes	359	400	247	88
Weaning (%)	124	125	138	122
Stocking rate ewes/ha	7.3	8.3	13.2	9.0
Lamb carcase weight (kg)	17.4	17.3	18.5	18.6

The UK had the highest weaning percentage and stocking rate, with performance in Ireland and France being similar. It is interesting to note that weaning percentage at 138 lambs per 100 ewes in the UK in 1994 is identical to that found in the last Exeter national sheep study in 1988, while stocking rate has increased from 11 to 13.2 ewes per hectare. The average UK weaning rate of 138 lambs per 100 ewes mated, in 1994, whilst higher than that in Ireland, is 14 points lower than the oft quoted MLC figure of 152.

Summary and conclusions

Sheep numbers and meat production peaked in EU in 1992, and have declined since then. The UK is the largest producer in the EU accounting for 33% of sheep meat in 1994, with France and Ireland accounting for 13% and 8% respectively. Average flock size in the UK was 223 in 1995, which was double that of Ireland or France. Over 75% of all ewes in the 3 countries are located within the disadvantaged areas.

French producers obtained the highest prices, with little difference between the UK and Irish prices since 1992. Prices in current terms have remained static in the 3 countries since 1985. French lamb disposals were more evenly distributed through out the year than disposals in Ireland and to a lesser extent in the UK. Carcase weights were virtually identical in France and the UK with Irish carcases 1.1 kg heavier.

Gross margin per ewe was highest in France, followed by Ireland while the UK had the lowest margin. Gross margin per hectare was highest in the UK due to high stocking rate. Per ewe and per hectare direct costs were lowest in Ireland, with the French having the highest direct costs per ewe and the UK the highest costs per hectare. Ireland had the lowest overhead costs and the highest net margin per ewe and per hectare. Total costs of producing a kg lamb carcase was IR £ 1.89 in Ireland, IR £2.18 in the UK and IR £3.66 in France.

Weaning percentage was similar at 124 and 122 for France and Ireland respectively, while the figure for the UK was 138 per 100 ewes joined. Stocking rate in the UK at 13.2 ewes per hectare was higher than France at 7.8 and Ireland at 9 ewes per hectare.

In 1994, Irish sheep farmers produced a kg of lamb at 86 per cent of the UK cost and at 52 per cent of the French cost and this competitive advantage can be increased with improvement in technical efficiency of Irish flocks.

Marketing Irish Lamb

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The sheepmeat industry in Ireland, and across the EU, has undergone major structural changes over the past decade. Significant shifts in markets, a move from red meats to white meats, the new EU sheepmeat policy, and GATT reforms have all contributed to these changes.

In Ireland, the industry, which expanded almost threefold since 1980, has recently begun to decline and is facing a tough battle on a number of overseas markets, especially in France.

Meanwhile exports from the UK, Ireland's main competitor on overseas markets, are growing and the sterling/punt gap adds to their competitiveness. Imports of fresh chilled products from New Zealand add further to the competition facing Irish exports and act to moderate prices, especially in the early season.

Market requirements are moving to lighter and leaner lambs, reflecting a trend to smaller households and to more health conscious consumers. In Northern Europe carcases of around 18 kg $\pm$ 1 kg are preferred, while in southern locations the preference is for lighter carcases in the range 9-16 kg. All markets are looking for lean product.

For the Irish industry, the combined effect of these trends is that changes are needed to improve competitiveness, enhance product quality and to re-position our product in export markets. Future development must be guided by market requirements, and must operate within a competitive cost framework. Most of the changes proposed in the Bord Bia Sheepmeat Study are within the control of the industry.

These sets of changes are recommended:

1. Changes to maximise production efficiency of the Irish flock through actions:
    - to reduce production costs
    - to increase lambing rates
    - to improve breeding practices and
    - to improve lamb selection,
2. Changes to improve carcase quality and to increase value added sales through:
    - the introduction of grading / classification scheme that offers appropriate price differentials.
    - further moves into the preparation and sale of meat cuts rather than carcases

3. Changes to increase market returns through:
    - Target spring lamb sales before the seasonal price fall commences in May
    - Extend production season for top quality lamb
    - Build market for value added products

Lamb Quality / Classification

A national lamb carcase classification scheme has been launched by the Department of Agriculture, Food and Forestry. This is based on the EUROP system and results in five grades representing the full grid being implemented.

A number of plants have now organised to have computer print outs showing grades and carcase numbers on all lambs. Prices are being quoted to most producer groups on the basis of the classification scale.

Market prospects for lamb

Export sheep throughput to late April increased by 27 per cent over last year. This arose from increased hogget sales with no hold up like Spring '95 and early lamb producers responding to the high prices for Spring lamb by moving at lighter weights.

Prices for both hogget and Spring lamb have been the highest on record, in part as a result of the BSE media crisis in beef. This created an extra demand for lamb, especially in the UK, and thus less British lamb was exported to France.

The outlook for the remainder of the year looks encouraging. EU sheep supplies will be lower this year following a four per cent fall in EU ewe numbers in the December '95 census.

An Bord Bia activities in support of Irish lamb

An Bord Bia has a comprehensive range of supports to the Irish lamb sector. The principal elements of this are as follows:

- Support to Export Processing sector under the Structural funds
- Lamb promotions on Home and overseas markets
- Market information provided through the weekly 'Market Monitor' and through briefing with Farm Organisations, Press and participation at producer meetings
- Participation at major Food Fairs and Trade Shows
- Inward buyer missions and outward seller missions to forge new business and consolidate existing links

The specific approach in each market is as follows:

France

Promotions of Irish lamb in France for 1996 will concentrate on selected top quality lamb. The following promotional programme will be carried out:

- Irish lamb will be promoted from late May through August with the main retail groups.

- In the South of France promotions will extend into September. Promotions of Irish lamb to the catering sector will also be intensified.
- The major Food Fair 'SIAL' takes place in Paris in October 1996 and Irish lamb will be given a central role in that exhibition of Irish Food.

Home Market

The Easter Lamb Promotion consisted of:

- Colour advertisements in the National Press and RTE Guide
- Distribution of promotional material to all retail outlets

The Summer Campaign will include:

- Media advertising of lamb, with lamb joints for roasts, minced lamb for economical and quick mid-week meals and lamb chops for best barbecues
- Consumer education programme promoting lamb as a convenient good to eat, healthy and affordable meal option
- Point of sale material to all retailers
- Special Food Fairs / Agricultural Shows

Other EU Markets

Germany

- Support sales of lamb cuts to retailers
- In-store promotion of lamb

Spain/Portugal

- Lamb launch in June to bring together suppliers and buyers
- Support meal-fed lamb sales
- In-store promotions

Scandinavia

- Support retail sales of lamb cuts
- Maintain media contact to ensure positive coverage on Irish lamb

Italy

- CIBUS Food Fair, Parma 9-13 May
- In-store promotions

Summary

The Irish sheepmeat industry after a decade of growth in output and incomes is now at a turning point. Ewe numbers and the numbers of producers in the industry have both fallen. Unless action is taken to stabilise returns, further declines may be inevitable.

European markets are, and are likely to remain, tight and highly competitive. Exports from the UK are likely to expand further. Imports of New Zealand fresh product are also likely to grow in the coming years.

By improving its cost competitiveness, and achieving more uniform product quality, the Irish industry can enhance its position on export markets and thereby make for a better future all round.

Current and Future Perspectives

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1. Introduction

Within the meat sector, sheepmeat is a relatively small player. Of almost 33 million tonnes of meat production in 1995 in the community, sheepmeat and goatmeat accounted for just 3.6%. In consumption terms, its share was just 4.4%. There are about 700,000 producers.

But lamb is no longer simply competing with other meats. At the dinner table fish, cheese, yoghurts and an increasing array of processed products, vegetables and fruits are all fighting for a place on the table.

Family size, eating habits and tastes are changing and convenience, if not yet king, is certainly heir apparent in the meals industry. The implications for producer prices in all these changes are highly important. Consumers have many choices before them. They can decide to eat or not to eat lamb or other meats and also the price they are prepared to pay. In meat terms, if lamb is more than 3.5 times the price of poultry or more than twice the price of pigmeat, consumers tend to shy away from it.

The trends in other meat and other food prices have a direct long-term effect on producer prices for lamb and this factor has to be a major element in the prospects for the sheep industry.

Regardless of policy and despite changes in the fortunes of other meats, this is the long-term market reality facing the sheep sector.

2. Policy

The Community sheep sector policy has been built up over many years and is well-known. The key elements are:

- A Community premium
- An individual quota system
- A GATT/WTO based import regime

3. Operation of Policy

a. Premia

The Common Community premium has been in place since 1992 although Ireland did obtain a derogation that year. The logic behind a common premium is that, within a single market, the opportunities to sell are open to all. The market inevitably takes account of supply and demand, quality differences and consumer preference. Ireland with 300% self sufficiency is unlikely ever to have the same price as France which is only 50% self sufficient. But, it is a matter for the entire Irish industry to reduce the gap.

In recent years, much less has been made of the issue of the convergence of market prices in so far as the premium is concerned. Price convergence was not set as a target in the 1989 reform just as the convergence of production costs was not set. In fact since the introduction of price reporting based on standard quality, Irish prices have tended to converge towards the Community average. In 1992, the Irish price was 74% of the Community average whereas by 1994 it had reached 82% of the average. In 1995, despite the acknowledged difficulties, the Irish price was again 82% of the Community average.

b. Individual quota system

The individual quota system was put into place in the 1992 reform as part of the more general reform of agriculture.

Its introduction brought to an end the remarkable increase in sheep numbers seen across Northern Europe but particularly in Ireland and the United Kingdom since 1980. Ewe numbers declined by 12% in Spain, 9% in Ireland, 6% in UK and rose by just 1% in France in the three years to the end of 1995 as producers adjusted to quota. Clearly, production without quota is not proving interesting.

The introduction of quotas has brought another advantage by way of the community budget. Community expenditure on the sheepmeat sector, which was rising rapidly in the late 80's and early 90's as production increased and prices decreased, has been brought more firmly under control. The cost of the ewe and rural world premia together with the relatively small amount for private storage which has grown from 1800 MECU in 1990 to surpass 2000 MECU in respect of both the 1991 and '92 marketing years has been stabilized.

c. Import regime

The changes introduced in the import regime via GATT/WTO do not, in the short term, alter the import situation to any major extent. Under the voluntary restraint agreements' adaptations of 1989 and '90 the overall import possibilities in the sheep sector were approximately 802,000 tonnes at zero duty. This was in fact somewhat less than the possibilities available in the period prior to then which acted as the basis for the GATT agreement.

Total Access in 1996 at zero duty is approximately 315,000 tonnes. The reasons for the increased access are:

- The GATT basis for the calculation of access (1986-88). At that time New Zealand, in particular, had access for 40,000 tonnes more than from 1990.
- The development of Association Agreements with Eastern countries which in the longer term are to be Members of the Community.
- The enlargement of the community to take in Sweden, Finland and Austria.

In reality, imports of sheep and sheepmeat have not grown in recent years with total imports reaching about 250,000 tonnes annually. The most significant change has been that New Zealand has, over about 12 years, redirected its exports to the Community so that the UK now receives only 50% of them as opposed to 90% in the past. On chilled meat, the growth in imports from New Zealand continues to be in line with the 1500 tonne annual growth formerly agreed in the adapted VRA. Imports of NZ chilled meat are forecast to reach 16-17,000 tonnes in 1996.

4. Prospects

The overall trends in the market place suggest great stability in the Community sheep scene in the next five years. The Commission's forecast group expects sheep and ewe December census numbers to remain static at 97 million and 70 million head respectively to the end of the century. At Member State level a similar pattern is forecast.

Production may go down slightly but is expected to be about 1.15 million tonnes annually. It is possible, of course, that some increase in production could take place as producers react to higher prices this year due to problems in the beef sector.

The prospects for imports are of considerable interest. Breeding ewe numbers in New Zealand have fallen by 17 million head in recent years and now stand at 33 million. Dairying and forestry are now more attractive enterprises. New Zealand's overall export sheepmeat production has fallen to about 350,000 tonnes product weight. The Community market remains the key but New Zealand will want to maintain its other markets around the world. In these circumstances, apart perhaps from this year, New Zealand may not quite fulfil its 226,700 tonne quota.

In Eastern Europe, the decline over the past five years has been remarkable. Sheep numbers have fallen by about 50%, 12 million head, and as yet there is little sign of any recovery. Countries which fulfilled their VRA quantities with ease in the past are now experiencing serious difficulties in so doing.

It appears therefore that the overall level of imports of 250,000 tonnes in recent years is unlikely to change in the next few years.

As exports are very small, Community consumption will be a function, as always, of production and imports. The declining trend in British consumption, so evident in recent years, may be reversed this year as British consumers turn to domestic and New Zealand lamb. This, in turn, may leave rather more room on the French market.

Prices in the past two months have risen substantially in the UK, France, Ireland and to a lesser extent in Spain. Elsewhere the price rise has not been as dramatic.

Longer term, as I indicated earlier, sheep prices are subject to other forces.

The difficulty of forecasting prices can be appreciated when one looks at the situation each spring over the past five years. In '92 spring lamb prices were low due to the effects of the ending of the variable slaughter premium in Great Britain; in '93 they were high due to foot and mouth disease in Eastern Europe; in '94 they were high due to the late spring in Northern Europe; in '95 they were low due to over supply and lower prices for other meats while this year they have been high.

5. Policy for the future

Few people in this audience will be unaware that the Council has asked the Commission to report to it before 1st July this year on the operation of the quota system.

The preparatory work for this report is underway. The Commission in due time will present it to the Council. I am not in a position, nor am I foolish enough, to try to indicate what the conclusions of the report will be. This is a matter for the Commission itself and not for one of its officials.

However, the remarks I have made already indicate that the quota has succeeded in bringing production and budgetary expenditure under greater control and thus it is one of the more successful measures ever taken within the sheep regime.

Several commentators appear to believe that the report will be the time for putting all the problems they perceive onto the Council table for resolution. Thus, top up premia, the stabilizer mechanism, extensification premia and the definition of the eligible ewe all risk being aired in one form or another in coming months.

The Commission is due to prepare a second report on the sheep sector before the end of the year, this time on the implementation of carcase classification. Subject to the conclusions of that report, the Council shall set itself the goal of making the use of the Community grid compulsory in slaughterhouses during the 1999 marketing year or by 1 January 2000 at the latest.

6. Conclusions

Against the background I have outlined above the most likely prospect is that the next years will be relatively calm within the sheep sector. But the sheep sector does not, of course, live in isolation from the remainder of agriculture or from the more general development of the Community.

A series of future developments inevitably will impinge on the sector. The most obvious of these are the next round of the World Trade talks due to start in a few years, the next enlargement of the Community and the pressures on and the requirements of the Community both politically and in budget terms.

The outcome of discussion and negotiation on all these items could, of course, bring changes to the sheep regime over the longer term. So indeed could other changes in funding measures for agriculture. But, these are not at or indeed very close to the table now. In the meantime, the sector faces a period of stability in production and consumption terms. In those circumstances, the development of the industry continues to depend on consistent improvement of production, processing and marketing.

Potential of Beef Production Systems Based on Grass

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1. INTRODUCTION

Grassland is Ireland's greatest renewable feed resource and it provides the main feed for ruminant livestock. Over 90% of agricultural land is under grassland (including rough grazing). Grassland (excluding rough grazing) accounts for 4.3 x 10^6 hectares, of which 30% is used for silage and hay production and the remaining 70% for grazing. Grazed grass, followed by conserved grass, are the cheapest renewable feeds available (Table 1). As the majority of cattle are Spring-born, grazed and conserved grass are logically the basis for efficient beef production systems. As a producer of livestock, over 80% of which is exported, Ireland has few competitive advantages, but its ability to grow grass does offer the chance to provide cattle (and sheep) with a relatively cheap feed source. A national balance sheet by McLoughlin (1991) for the 6 year period 1983/84 to 1988/89, shows grazed grass, conserved grass and concentrates contributing 57%, 29% and 14% of dry matter intake for beef cattle, respectively, accounting for 30%, 35% and 34% of the feed costs (Table 2). The feed cost for some more intensive beef systems (Table 3) shows the proportional cost for grazed grass at 28%, conserved feeds at 42% and concentrates at 30%.

Table 1.
Unit cost of various feed sources
Cost £/GJ ME* consumed

Crop	Mean	Range
Grazed grass	3.2	2.4 to 4.9
Silage		
- 1st cut	7.0	5.6 to 9.6
- 2nd cut	7.7	6.4 to 11.8
Maize silage	7.7	6.3 to 12.2
Fodder beet roots	10.9	8.8 to 14.2
Barley		
- Spring	11.8	
- Spring (+ Area aid)	8.4	

*ME from different sources used with different efficiencies

Source: O'Kiely 1994

The key to efficient beef production from grass, now and in the future, is to operate a flexible, adjustable grassland management programme, using factual information for prompt and appropriate decision-making purposes. The system operated must clearly match feed supply to animal requirements, putting the major emphasis on increasing the proportion of cattle diets that comes from grazed grass. The aim of this paper is thus to describe the technologies by which beef can best be produced from grazed and conserved grassland, to relate these to current practices and to identify and quantify the opportunities for future improvements.

Table 2.
Quantities, proportions and costs of various feeds in beef and dairy systems (6 year average -1983/84-88/89)

	t DM/LU/year		% DM intake		Cost/t DM fed	£ Feed cost/LU		% Feed cost/LU	
	Dairy	Beef	Dairy	Beef	£	Dairy	Beef	Dairy	Beef
Concentrates	0.47	0.41	10	14	175	82	72	28	34
Conserved grass	1.32	0.87	29	29	85	112	74	38	35
Pasture grass	2.73	1.67	60	57	38	104	63	35	30
TOTAL	4.52	2.95	99	100		298	209	101	99

Source: McLoughlin 1991

Table 3.
Feed types and their proportion of the overall feed bill

		DM intake		Cost	
		t/year LU	% of total	£	% of total
Dairy*	Grazed grass	3.3	62	125	36
	Silage	1.4	26	119	34
	Concentrates	.6	11	105	30
	Total	5.3		349	
Beef**	Grazed grass	2.9	53	110	28
	Silage	1.9	35	162	42
	Concentrates	0.65	12	114	30
	Total	5 .45		386	
Sheep***	Grazed grass	3.0	85	114	66
	Silage	0.40	11	34	20
	Concentrates	0.15	4	26	15·
	Total	3.55		174	

* Spring calving dairy herd (Curtins, Moorepark)
** Dairy Calf to Beef (24 months) (Grange)
*** Mid season lamb producing ewes with 1.5 lambs sold per ewe (Belclare)

Table 4.
Farm profile on cattle producing farms

Farm size	22.4 ha
Family farm income	£4851
% of gross margin from cattle	60
Cattle livestock units	20.9
Average stocking rate - units/ha	1.36
% with off farm incomes	34

Source: Hickey (1996)

Table 5.
Estimated prices, output and costs per kg liveweight

	1994
Price per kg liveweight (p):	
purchases	145.3
sales	124.0
Per kg liveweight produced (p):	
market output	106.7
direct payments	49.0
Total output	155.7
Direct Costs	50.3
Overhead costs	50.2
Total producer costs	100.5
Net margin	55.2

Source: Hickey 1996

Table 6.
Estimated liveweight productivity by cattle system (1994)

	Single Suckling	Mixed Rearing	Weanlings/ Stores to Stores/Finish	Stores to Finish	All Systems
Estimated liveweight produced (kg):					
per animal unit	226	285	275	245	256
per feed ha	300	373	358	387	348

Source: Hickey 1996

2. CURRENT PRACTICES ON FARMS

a) Soil nutrient status

Recent soil analysis results (Gately, 1996) show that the average lime requirement for soils is 6.2 tonnes/ha. Farmers who had soils analysed as part of the Rural Environment Protection Scheme (REPS) had an average soil lime requirement of 7 t/ha, compared with 5.2 t/ha for other farms. Soil P readings were 7 and 8.7 mg/l and K readings were 108 and 110 mg/l for REPS and non-REPS sources, respectively.

b) Sward type

Most of the grassland in Ireland is old pasture. Based on the quantities of grass-seeds sold, about 3% of the agricultural land is reseeded in any year. Much of the reseeding is carried out on land primarily used for winter feed production. Cattle thus tend to graze old pasture for most of the season.

c) Management standards

Using the 1994 Teagasc National Farm Survey (NFS) data, Hickey (1996; Tables 4 to 8) described the characteristics of cattle-producing farms, and showed that beef farmers in general use low inputs of nitrogen (<65 kg N/ha/year) and other nutrients and operate a relatively low stocking rate (1.36 livestock unit/ha). He showed considerable scope to improve animal productivity and utilisation of grassland. Farm profile data for more intensive, specialised suckler farms have been compiled by Barlow and Smyth (1996) using the 1994 Beefmis survey results (Tables 9 and 10). These farms, operating at an above average technical efficiency, had a stocking rate of 2 livestock units/hectare, while performance at grass for weanlings and older progeny was 1.1 and 0.9 kg liveweight gain per day, respectively. Barlow and Smyth (1996) reported an animal output of 500 to 700 kg liveweight/ha, which is much higher than the national average figure of 350 kg (Hickey, 1996). Both sources of data show that currently average costs of production are distributed equally between fixed and variable costs.

d) Cost of grass production

Grass growth is affected by a range of factors, some of which are outside the control of the farmer. For example, factors such as weather, geographical location and soil type have a major influence on grass growth and consequently on the cost of feeding livestock. Geographical location significantly affects the date of the start and end of the grazing season and Figure 1 shows that the beginning of the grazing season in the south and south-west is at least 3 weeks earlier than the north and north-east. A time difference also exists at the end of the grass-growing season, where the south and south-west again have up to a 3-week advantage. The effects of the above factors on the costs of producing grass are shown in Table 11. For the same soil type and level of inputs, the effect of geographical location means that grass yields can range from almost 16 t DM/ha to less than 10 t DM/ha (Figure 2). Translated into feed cost terms, the effect of location results in costs ranging from £37 to £52/t DMD (digestible dry matter). Weather, which can cause considerable variation in year to year annual grass production (i.e. + or - 20% difference from the long term average), can alter production costs from £42 to £63/t DMD. Excess soil wetness can result in production costs that range from £47 (dry) to £56 (wet)/t DMD.

The main factors controlling grass growth which are directly influenced by farming practices are soil fertility, nitrogen usage and grazing management. Now more than ever, farmers have to be cost conscious and each input has to be justified. For grazed grassland, fertilisers account for 80% of the input costs associated with grass production. It is an essential requirement that each farmer knows the soil nutrient status of their land. The decision to apply fertilisers to grazing grassland, especially phosphorus (P) and potassium (K), has to be made against the background of a knowledge of soil nutrient status.

Nitrogen is the one major input at the farmers disposal which can be used to influence grass growth. The effect of nitrogen application on grass

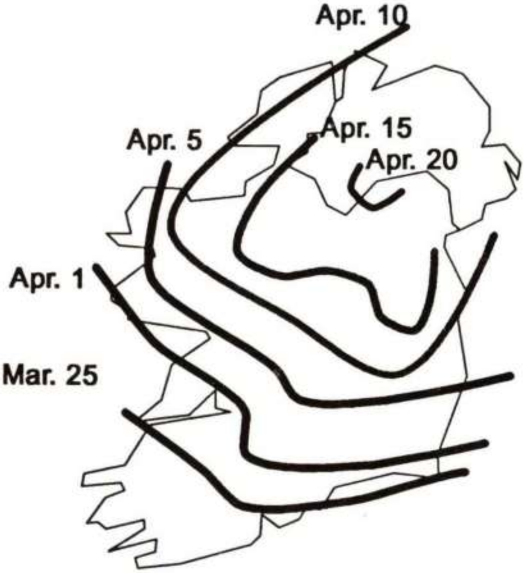


Fig 1. The estimated starting dates of the grazing season in Ireland

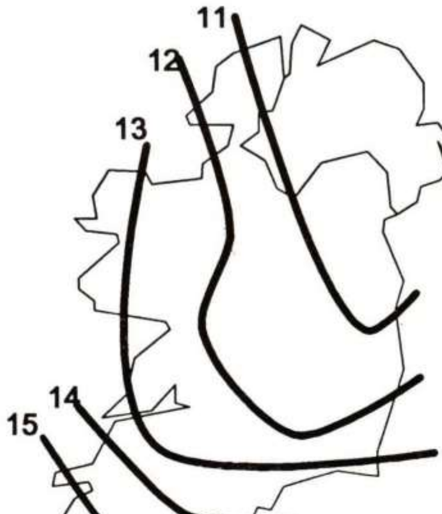


Fig 2. Model estimates of annual dry matter grass production (t ha^{-1})

Table 7.
Estimated purchase and sale prices, financial performance per kg of liveweight produced and per hectare by cattle system (1994)

	Single Suckling	Mixed Rearing	Weanlings/Stores to Stores/Finish	Store to Finish	All Systems
Liveweight purchased per kg produced (kg)	0.14	0.27	1.86	2.27	0.82
Estimated prices (p/kg):					
-purchases	156.0	182.5	136.0	130.5	145.0
-sales	124.5	125.5	126.0	122.5	124.0
Per kg liveweight produced (pence):					
Market output	120.4	110.5	107.5	104.5	106.7
Direct payments	65.2	40.6	31.9	40.9	49.0
Total output	185.6	151.1	139.4	145.4	155.7
Costs - direct	54.4	49.7	52.8	52.9	50.3
-overhead	54.1	46.2	51.9	54.2	50.2
-total	108.5	95.9	104.8	107.1	100.5
Net margin	77.1	55.2	34.6	38.3	55.2
Per ha:					
Net margin (£)	231	214	132	146	185

Source: Hickey 1996

Table 8.
Output, costs and margins by cattle system (£)

	Single Suckling	Mixed Rearing	Weanlings/Stores Stores/Finish	Stores to Finish
Per animal unit:				
Market output	272	315	295	256
Direct payment	147	116	88	100
Total output	419	431	383	356
Producer costs	245	274	288	262
Net margin	174	157	95	94
Per hectare*:				
Animal units	1.44	1.45	1.43	1.68
Net margin*	231	214	132	146
Per £100 output:				
Producer costs	58	63	75	74

*Hill and mountain farms excluded
Source: Hickey 1996

Table 9.
Proportions (%) of suckler farms receiving various premia payments

Premium					
Suckler cow	10 month	22 month	Slaughter	Extensification	Headage
100	88	52	21	79	85

Source: Barlow and Smyth 1996

Table 10.
Financial (£) and physical outputs for suckler farms

	Gross margin/ha		
	Top 1/3	Middle	Bottom 1/3
Output less premia (£)	924	734	600
Premia + headage (£)	329	296	254
Output + premia/headage (£)	1252	1030	855
Variable costs	388	306	284
Gross margin (£)	914	724	571
Fixed costs (£)	358	287	237
Profit (£)	556	437	334
Stocking rate (LU/ha)	2.40	1.99	1.73
Output (kg liveweight)	697	578	506
Premia + headage as % of profit	61	72	79

Source: Barlow and Smyth 1996

Table 11.
Effect of location, weather and soil type on grass production costs

	£/Tonne digestible dry matter (DMD)
Location	37 in South West to 53 in North East
Weather	42 in best grass growing season to 63 in worst grass growing season
Soil Type	47 on dry well drained to 56 on wet poorly drained

Source: O'Kiely 1994 and Brereton 1995

growth is shown in Table 12. These data are based on a country-wide study (Ryan, 1974) where all of the major soil types were included each year over the four years of the study. Dry matter yields continued to increase up to an application rate of 400 kg N/ha (360 units/ac). However, the grass yield response (%) in terms of extra grass grown for each 50 kg N applied/ha (45 units/ac) declined from 13% to 12%, 11%, 9%, 8%, 7%, 5%, 3% and 0% as the rate of nitrogen increased to 450 kg N/ha. Table 12 also shows the cost of producing the extra grass, in terms of £/tonne DMD, for each extra 50 kg N applied/ha. An attractive response is achieved with the lower levels of nitrogen applied but grass production costs increased with each increment of nitrogen used

Table 12.
Effect of Nitrogen application on grass growth

Nitrogen application rate (kg N/ha)	Relative yield (100 = 6.9 T. DM/ha)	Cost of grass produced (£/t DMD) for each 50 kg N used
0	100	
50	113	41
100	125	54
150	136	56
200	145	68
250	153	76
300	160	92
350	165	121
400	168	177
450	168	346

Source: From Ryan 1974 and O'Kiely 1994

Increasing nitrogen usage from 300 to 350 kg N/ha (270 to 310 units/ac) resulted in a yield increase of 5% and the cost of the extra grass was £121/t DMD. Grass costs of this magnitude are very expensive and alternative purchased feeds could be economically more attractive.

3. CURRENT RESEARCH STANDARDS

a) Chronology of recent advances

In reflecting the national importance of the contribution of the suckler herd and the progeny from the dairy herd to the Irish beef industry, Grange Research Centre has for a considerable number of years being researching systems of producing beef from these sources. Both systems take calves from birth through to slaughter, in most cases at 20 months (heifers) or 23 to 26 months (steers) of age. Table 13 shows the progression of advancements in these systems over the past 15 years, and suggests likely output for the near future through further improved technologies (including grassland management). It is clear that through technological improvements both systems have been steadily increasing output and efficiency. Present outputs are 730 and 500 kg carcass/hectare for the Dairy Calf-to-Beef and Suckler Calf to Beef systems, respectively. These outputs contrast sharply with those reported on commercial farms (Teagasc NFS, Hickey 1996; Barlow and Smyth, 1996).

b) Current Grange systems

(i) Suckler Calf to Beef System

The present system (Drennan, 1993), based on early-March calving, finishes animals at 20 (heifers) and 24 (steers) month of age. The system is stocked at 0.84 ha per cow unit (cow + calf + year old + replacements), has a carcass output of 500 kg per hectare per year. This target is achieved by producing a steer carcass weight of 400 kg, heifer carcase weight of 300 kg and cull cow carcase weight of 400 kg. The target output (carcass/ha) is achieved from 10

Table 13.
Grange Systems Research: Target stocking rates (ha/animal), carcass output (kg/ha) and carcass weight (kg) during the 1980's to 2000 (projected)

	1980	1985	1990	1995	2000
Dairy Calf to Beef System					
Stocking rate	.47	.47	.50	.48	.40
Carcass output	600	680	700	730	900
Carcass weight	280[1]	320[1]	350[2]	350[2]	360[3]
Suckler Calf to Beef					
Stocking rate	.90			.85	.80
Carcass output	410			500	530
Carcass weight	340[4]/240[5]			395[4]/308[5]	395/308

[1] Friesian steers
[2] Charolais X (Friesian) plus Friesian steers
[3] Charolais x Friesian steers
[4] Steers
[5] Heifers 27

tonnes of herbage dry matter (DM) plus a concentrate input of 820 kg/ha. Herbage production is based on 230 kg N/ha, and silage being harvested from 55% of the farm in late-May, and 35% of the farm area in late July. Silage harvested in May is fed to the progeny, while the July-conserved swards are offered to the cows. Cows and calves graze separately from the older cattle. Rotational grazing, with 10-12 paddocks per animal group, is practised. The grazing season starts in mid-April, and silage areas are not currently grazed early in the season. Calves are weaned in mid-October and housed shortly afterwards, while cows typically remain outdoors at pasture until late-November. Steers are housed in mid-October while heifers are housed in September and finished by mid-December. Variable costs for the system are 92-94 p, while fixed costs are 170-180 p/kg carcass.

For the Suckler Calf-to-Beef sytem, Table 14 shows the liveweights achieved and the proportions derived from grazed grass, forage and concentrates. Two-thirds of the lifetime gain for the progeny from the suckler system is produced during the grazing season. The liveweight gain during the first grazing season amounts to 220 kg (females) and 250 kg (males) or almost 60% of the animals lifetime gain. The indoor winter period accounts for one-third of the lifetime weight gains. The proportion of gain achieved by heifers is small in the second winter as animals are slaughtered early (at 20 months of age). However, almost half of the indoor liveweight gains are achieved through concentrate feeding. All of the liveweight gain achieved on the cows is derived from grazed grass.

(ii) Dairy Calf to Beef System

The present system at Grange (Keane and Drennan, 1989) involves purchasing March born calves (7 to 14 days old) from dairy herds and finishing them

Table 14.
Weights achieved by the progeny from the Grange suckler herd and proportions of weight gained at pasture and indoors (24 month old system)

Period	Males		Females* *	
	Weight (kg)			
Birth weight	45		43	
To grass 1st season	75		72	
To 1st winter	325		290	
To grass 2nd season	390		365	
To 2nd winter	575		(500)	
To slaughter	710		565	
Lifetime weight gain	665		522	
- From grazed grass	435 (65%)		353 (68%)	
- 1st season		250 (58%)		218 (62%)
- 2nd season		185 (42%)		135 (38%)
- From indoors	230 (35%)		169 (32%)	
- calf stage		30 (13%)		29 (17%)
- 1st winter		65 (28%)		75 (44%)
- forage		36 (55%)		41 (55%)
- concentrate		29 (45%)		34 (45%)
- 2nd winter		135 (59%)		65 (39%)
- forage		67 (50%)		43 (66%)
- concentrate		68 (50%)		22 (34%)
Total indoors:				
- forage	45%		50%	
- concentrate	55%		50%	

* 100% of seasonal liveweight gain for suckler cows comes from grazed grass
**Heifers finished at 20 months of age.

24 months later. Both Friesian and Friesian/Charolais crosses are used. Calves are reared indoors for the first 10 to 12 weeks and go to grass in early May. Prior to 1995, yearlings were turned out to grass in mid-April and did not graze the areas designated for silage. However, this has now changed, with silage-ground being grazed in early Spring. Sixty percent of the farm area is cut for silage in late May, with a further 40% cut in late July. Animals are stocked at 0.45 ha/animal unit (yearling plus calf). Herbage production is about 10 tonnes DM/ha and together with a concentrate input of 2.2 tonnes/ha, produces 750 kg carcass per hectare. The concentrate input at 1 tonne per animal is made up by feeding 100 kg at the calf stage (including some at grass in the autumn), 150 kg during the first winter and the remainder during the second winter. A rotational grazing system involving 6 paddocks up to June and 8 paddocks at the end of the year has been practised. Cost of production are estimated to be £2.04/kg carcass. The main components of this cost are, 84p for the calf purchase, 91p for variable costs and 29 p for fixed costs.

In the Dairy Calf to Beef System (Table 15), lifetime weight increases of 565 and 630 kg per head are achieved for Charolais x Friesian and Friesian steers, respectively. Fifty to 55% of the gain is achieved at pasture and a further 25% is achieved from forage indoors. A greater proportion (55%) of the weight gain is achieved during the second year at pasture when compared with the Suckler Calf to Beef System. Weight gains during the final winter are almost double those achieved during the first winter.

One of the main features of both Calf to Beef Systems is the high stocking rate achieved in the early part of the season (Table 16). Both systems reach a peak in early June of 3000 kg liveweight/ha and this nevertheless results in high animal gains and provides sufficient areas to be conserved for winter feed. The long-term future of beef production systems in Ireland will depend on integrated Calf-to-Beef systems with a major proportion of the lifetime liveweight gain being derived from grazed grass.

c) Grazing management strategies

(i) General principle

The objectives of grazing management are to produce high yields of quality grass over a long grazing season and to manage both the cattle and grass so as to utilise the sward as efficiently as possible while getting high levels of animal intake and thus achieve high levels of animal output.

(ii) Producing grass

As stated earlier, grass production is affected by many factors, some outside the farmers control (location altitude, aspect etc.) and others which are directly affected by farm management decisions.

Soil nutrition Getting the basic soil nutrition such as lime, phosphorus and potassium correct are key factors in grass production. The minimum that needs to be known are:

a) soil pH, which gives a measure of soil acidity and the soil lime requirement, and

b) phosphorus (P) and potassium (K) status

A knowledge of potential trace element problems is highly desirable. In terms of lime application, its relationship with overall soil fertility, grass growth and animal production are of the greatest importance. With very few exceptions, liming of grassland to raise the soil pH to at least 6.0 is nearly always justified. The effects of lime on improved nutrient availability, increased proportions of more desirable grasses in the sward, a better response to applied fertilisers, especially nitrogen, and thus to an overall improvement in animal output is well documented and accepted. An example of the beneficial effect of lime application over the subsequent four years is shown in Table 17. More grass was produced (+28%) and more animals (+47%) were carried as a result of lime application. The net effect of applying lime was to get an extra grass production response each year equivalent to 75 kg N/ha (60 units/ac).

Table 15.
Weights achieved and proportions of weight gained at pasture and indoors (24 month old system) on the Grange Dairy Calf to Beef System

Period	Charolais X	Friesian
	Weight (kg)	
Start	50	45
To grass 1st season	85	80
To lst winter	225	220
To grass 2nd season	320	300
To 2nd winter	500	470
To slaughter	680	610
Lifetime weight gain (kg)	630	565
-From grazed grass	320(51%)	310(55%)
-1st season	140(44%)	139(45%)
-2nd season	180(56%)	171(55%)
-From indoors	310(49%)	255(45%)
-calf stage	35(11%)	35(14%)
-1st winter	96(31%)	80(31%)
-forage	53(55%)	40(50%)
-concentrate	43(45%)	40(50%)
-2nd winter	180(58%)	140(55%)
-forage	80(45%)	63(45%)
-concentrate	100(55%)	77(55%)
Total indoors:		
-forage	50%	47%
-concentrate	50%	53%

Table 16.
Grazing pressure (kg liveweight/ha) on Grange Suckler Calf to Beef and Dairy Calf to Beef Systems

	Month							
	April	May	June	July[1]	August	Sept.[1,2]	Oct.	Nov.
Suckler Calf to Beef System								
% area grazed	45	45	45	65	65	100	100	100
Liveweight (kg/ha)	2600	2800	3000	2300	2500	1400	1500	1600
Dairy Calf to Beef System								
% area grazed	40	40	40	60[1]	60	100[2]	100	100
Liveweight (kg/ha)	1700	2400	3000	2200	2300	1550	1650	1700

[1] Silage aftermath available
[2] Heifers housed on suckler system

Table 17.
Effect of lime on output from pastures

	Lime input Tonnes/ha		
	0	7.5(3t/ac)	Difference
Animals No./ha	4.7	6.9	+ 47%
Grass yield (t/ha)	8.0	10.2	+ 28%
% clover	5	14	+ 180%
DMD (g/kg)	665	692	+ 27 g/kg

Source: Gately and Blagden 1983

Annual dressings of phosphorus and potassium to grazed grasslands are sometimes neglected. Application rates must be related to stocking rates and soil test results. Little loss in production on grazing land will be seen by omitting one year's application of phosphorus or potassium. However, long-term studies at Johnstown Castle and Grange have shown that annual applications of 15 or 30 kg P/ha (12 to 24 units/ac) compared with no phosphorus were associated with 15 to 25% extra liveweight gain per year. Thus, an annual application of 15 kg P/ha (13 units/ac) is recommended to maintain soil P levels on grazed grassland. Animal production responses to applications of potassium (K) are

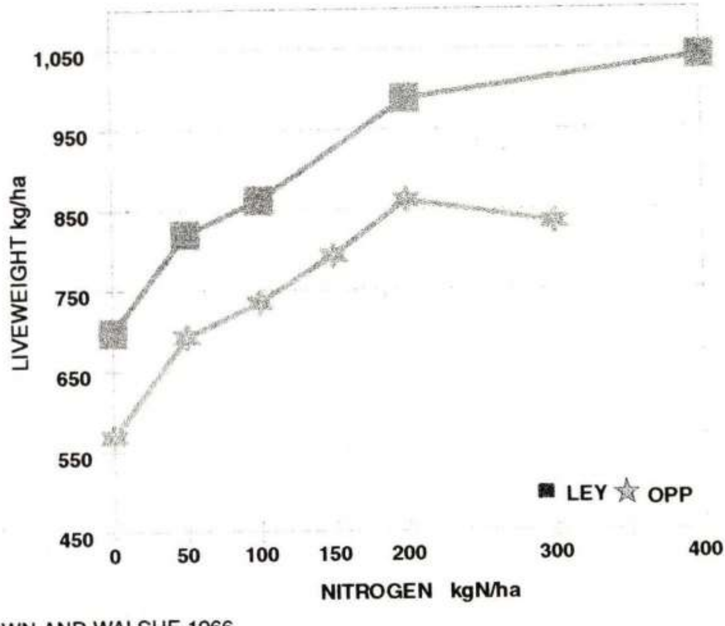


Fig 3. Beef production : Effect of nitrogen

small under grazing, but its role in conservation is of great importance. For grazing an annual application of 30 kg K/ha (27 units/ac) will supply sufficient potassium for grass growth.

Numerous studies have been conducted to look at the relationships between nitrogen usage and animal output. Figure 3 summarises the results of a 4 year experiment outlining the outputs, measured as liveweight gain/hectare, in response to increasing levels of nitrogen (Brown and Walsh, 1966). Both old pasture and reseeds were compared. With old pasture, an increase in liveweight was obtained through the use of 200 kg N/ha/year (180 units/acre). However, with new swards, output continued to increase in response to well over 300 kg N/ha (270 units/acre), although at a slower rate. Data from the National Farm Survey (1994) shows the average nitrogen input on drystock farms to be less than 65 kg N/ha (55 units/acre). The output potential of these farms could readily be increased by 33% in response to additional nitrogen (if livestock were available). While national quotas have placed restrictions on the number of cattle for which premia payments are attainable, in the longer term Ireland's ability to cash-in on a natural competitive advantage depends on our ability to produce high yields of grass and efficiently convert them to beef. While most farms have the capacity to expand livestock numbers, any expansion must be done with careful management of costs.

Sward type Sward type has a major influence on output of herbage and animal output, and for the foreseeable future swards based on perennial ryegrass seem to be the obvious preferred choice of sward. With current plant breeding approaches, the present rate of advancement in dry matter yield increase is likely to remain at 0.5 to 1% per year, unless new biotechnological advances take place.

Management Management, involving timeliness of operations and a knowledge of plant response to varying fertiliser application rates and dates, will remain critical to producing high yields of grass.

(iii) Utilising grass

Grass utilisation is discussed below. The main emphasis is on:

- knowing (measuring) grass supply
- knowing animal feed requirements (kg DM/head/day)
- matching supply and requirements. This will be achieved through
  - rotational paddock grazing system
  - moving cattle when swards have been tightly grazed (target height, herbage mass)
  - knowing, identifying and storing surplus grass
  - re-introducing the stored surplus at times of deficit or, if necessary, supplementing with other feeds

Successful beef production from grazed grassland depends on having a **PLANNED MANAGEMENT SYSTEM** which allows for **FLEXIBILITY** as conditions change. As grazed grass is the main feed component, a knowledge of its growth pattern and stock-carrying capacity is important. Grass growth is seasonal and can change widely over short periods of time. The rate of grass

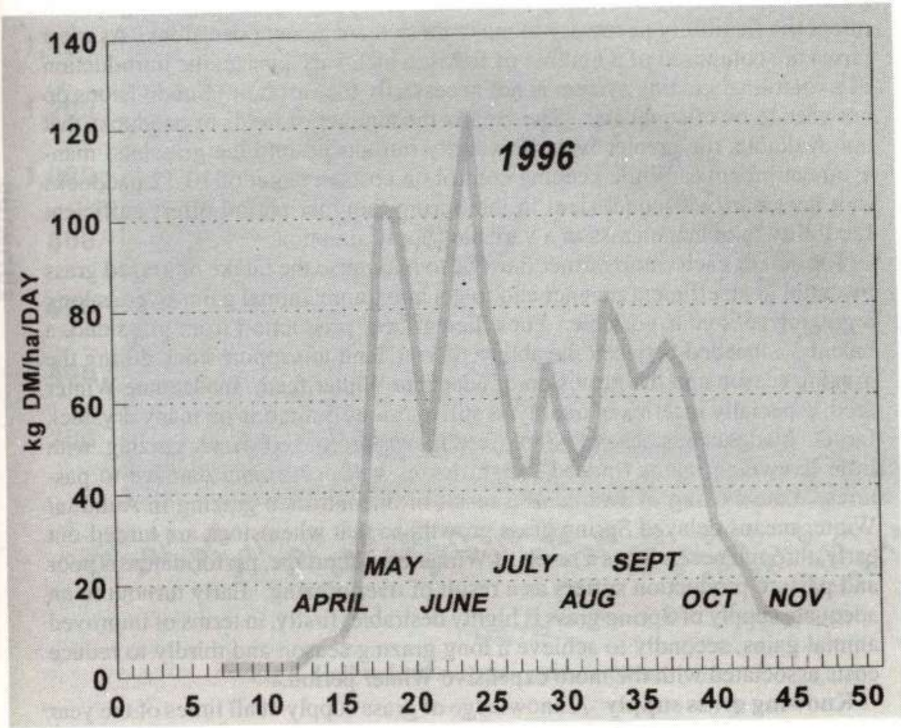


Fig 4. Grass Growth at Grange Research Centre 1993/94/95/96

growth for Grange Research Centre, expressed in kg DM/ha/day is shown in Figure 4. One general trend is evident and that is that once mid-April is reached, grass growth increases rapidly, and during May values of 100 kg DM/ha/day are common. At that level of growth each hectare is capable of supporting up to 5 livestock units (2 LU/ac) assuming that each LU is offered 20 kg DM/day. Once mid-June has passed there is an inevitable decrease in grass growth, so that by mid-August pastures will only support half of the May stocking rate. There is nevertheless big variation between years. Thus, for example, grass growth during early April 1994 and 1996 was 10 kg DM/ha/day or less compared with 20 to 30 kg DM/ha/day in 1993 and 1995. During 1994, over a 3-week period in late-April to mid-May, grass growth increased 10-fold from 12 to 120 kg DM/ha/day, but then proceeded to 40 kg DM/ha/day during the following four weeks. It then increased to 80 kg DM/ha/day within the next 3-weeks and finally decreased steadily over the remainder of the season. Similar fluctuations are evident most years. To fully exploit this changing grass supply, a flexible management system is required. A system that allows the farmer to see up-coming shortages as well as short-term surpluses needs to be practised if grass is to be utilised efficiently and economically. A rotational grazing system offers the flexibility necessary to make these management decisions. As most farms are composed of a number of fields, which vary in size, the introduction of a rotational grazing system is not necessarily too difficult. Subdivisions do not need to be of equal size. The greater the number of fields or paddocks that are available, the greater is the flexibility introduced into the grassland management process. While keeping control on costs, a target of 10-12 paddocks (not necessarily of equal size) in the Spring-Summer period offers sufficient flexibility to manage grass in a variable supply situation.

The aim of each cattle farmer must be to maximise the intake of grazed grass by cattle in an efficient manner and to get maximum animal gains over as long a grazing season as possible. For efficient beef production from grassland, a balance is needed between the ability of grassland to support stock during the grazing season and the provision of adequate Winter feed. Inadequate Winter feed, especially in terms of quality, is still a serious limitation on many drystock farms. Inadequate stocks of winter feed means prolonged winter grazing, with little liveweight gains (indeed weight losses will occur) and damage to pastures. Late closing of swards as a result of uncontrolled grazing in Autumn/ Winter means delayed Spring grass growth, so that when stock are turned-out early, through necessity as a result of Winter feed shortage, performance is poor and pasture production suffers as a result of over grazing. Early turnout to an adequate supply of Spring grass is highly desirable, firstly, in terms of improved animal gains, secondly to achieve a long grazing season and thirdly to reduce costs associated with the more expensive Winter period.

Knowing grass supply A knowledge of grass supply at all times of the year is essential if informed management decisions are to be made. While issues such as rotation length and rest interval are of great importance to planned grassland management, a knowledge of pasture supply or pasture cover on a weekly basis (if not daily) is essential if the best use is to be made of grass.

All grassland farmers should have the skills to quantify pasture sward height and pasture yields (sometimes referred to as pasture cover). Tables which relate sward height (compressed heights) to yield have been produced at Grange. As a simple guide, each centimeter of compressed grass above 4 cm of stubble contains approximately 150 kg DM/ha. The use of sward height for grassland measurements are more fully discussed in the attached Appendix. An assessment of pasture cover may be obtained by frequently (once per week) walking the entire grazing area and measuring sward height. The measurement can be made with a sward stick, ruler or place meter. Eye assessment can also be used to estimate pasture availability. Once the technique of pasture cover measurement is mastered, it is surprising how quickly small changes in pasture supply will be detected. An example of pasture cover (Figure 5 & 6) on the Grange Dairy Calf to Beef System for 1996 is shown. At turnout, a pasture cover of 500 kg DM/ha was present over the grazing area (40% of farm). This increased to a peak of 1500 kg DM/ha in early June when surplus grass (20% of area) was removed and a cover of 800 to 1000 kg was maintained until early August when silage aftermath became available.

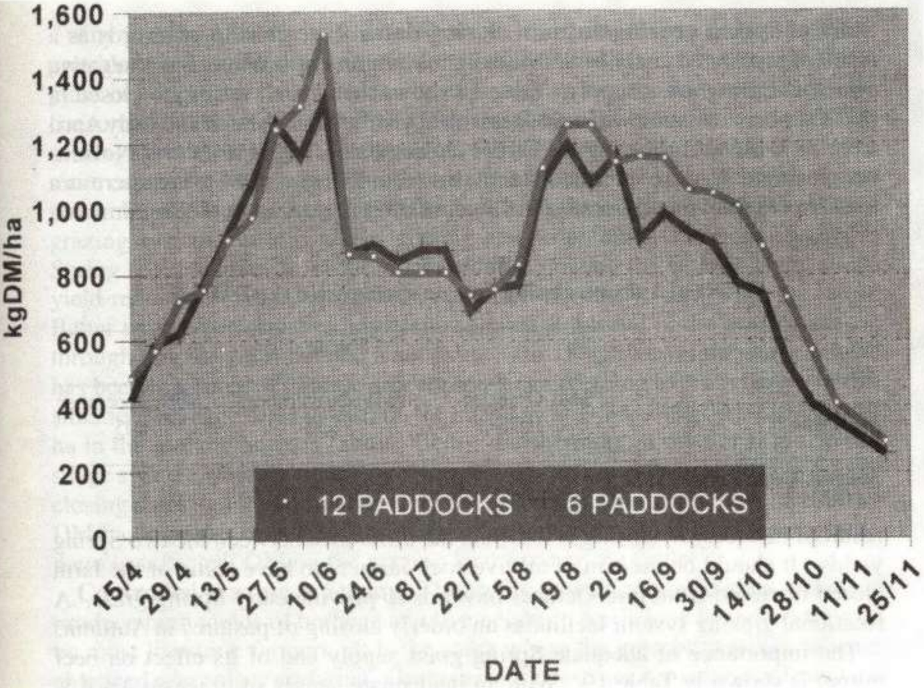
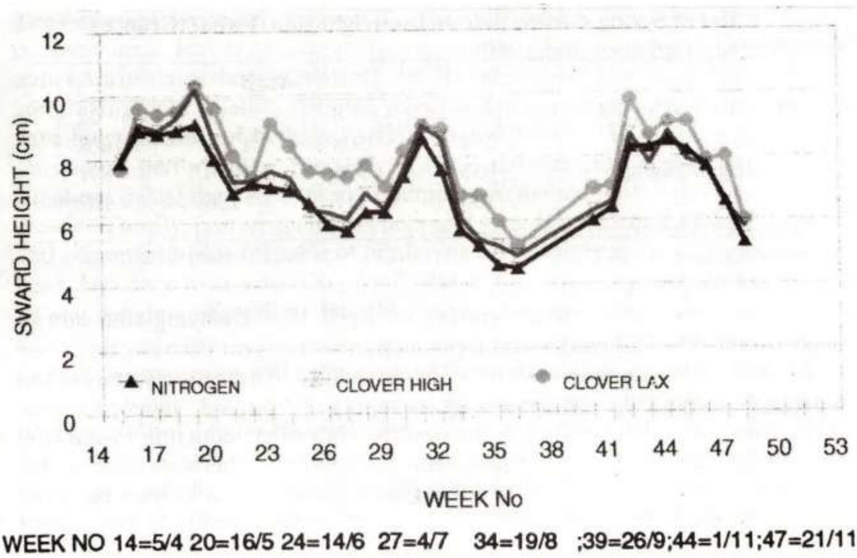


Fig 5. Calf to beef system - pasture cover



WEEK NO 14=5/4 20=16/5 24=14/6 27=4/7 34=19/8 ;39=26/9;44=1/11;47=21/11;

Fig 6. Pasture height (pasture cover) on grass/clover and N grazing systems

Start of spring grazing/autumn closing dates Late closing of swards as a result of prolonged uncontrolled grazing in Autumn/early Winter has a negative effect on Spring grass supply. Table 18 shows that when swards are closed in mid-October compared with mid-December, yields in mid-March and early April were 78% higher following the earlier closing date. Yields from mid-November closing date were intermediate. Apart from less grass in Spring, there is a total loss to the system because the amount of grass grazed in the Autumn as a

Table 18.
Effect of Autumn closing date on spring yield (kg DM/ha)

	Closing date		
	Mid-October	Mid-November	Mid-December
Mid-March	1078	830	605

Source: Carton et al., 1988

result of the delay in closing is less than the difference between the two Spring yields. It should be the aim of all livestock farmers to have some of the farm closed or rested from mid-October onwards to provide early Spring grass. A rotational grazing system facilitates an orderly closing of pastures in Autumn.

The importance of adequate Spring grass supply and of its effect on beef output is shown in Table 19. With an inadequate supply of grass on April 1, animal output was 17% poorer than when grazing started one week later, which

Table 19.
Effect of Spring starting date on liveweight gain (kg/ha) (Grange)

	April			
	1	8	15	22
Grass yield (kg DM/ha)	254	508	1261	1608
Liveweight gain (kg/ha)	833	976	1046	891
Relative	100	117	126	107

Source: Collins et al., 1977

in turn was inferior to starting grazing on April 15. Delaying the start of grazing until April 22 reduced total production for the year because the excess supply resulted in stemmy pastures of lower quality. Alternatively, the earliest grazing date resulted in inadequate grass supply and not only reduced animal performance but also resulted in the need for an earlier reduction in stocking rate in mid-summer. Consequently, when pastures have a herbage mass (yield) of approximately 1000 kg DM/ha (in the grazing horizon) or a sward height of approximately 8 cm (compressed sward height), pasture supply should, in most years, be sufficient to support the full livestock grazing requirements on the grazing areas.

Any grazing of silage swards in Spring will reduce silage yields. However, provided that the final grazing is done before April 10, a reduction in silage yield of not greater than 15% can be expected. When the amounts of herbage consumed by the animals is allowed for, the net quality effect of Spring grazing of silage swards is likely to be less than 5%. Thus, grazed grass has replaced a more expensive winter feed (but the remaining winter feed may be more expensive). Recent Grange results (O'Riordan, 1996) have shown that in a planned grazing system, up to 3 weeks grazing can be obtained on silage swards in Spring. The earlier the sward is closed after grazing the smaller is the silage yield reduction. All silage swards should be closed by April 10 at the latest. Better animal performance has been achieved at the end of the grazing season through this early turnout and a net extra 10 to 15 kg liveweight gain per head has been measured at Grange as a consequence of going to grass early. In this situation, herbage mass (yield) on the silage swards was only 500-750 kg DM/ha in the grazing horizon (above 4 cm). Furthermore, a rotational grazing of silage swards, where paddocks are grazed only once, results in a series of Spring closing dates and thus a smaller yield reduction. At a pasture supply of 1000 kg DM/ha or greater in early April, silage swards do not need to be grazed because there is sufficient DM on the grazing land to carry the cattle.

Controlled grazing in Spring The ability of well-managed grass swards to produce high yields of herbage and liveweight in April/June is underestimated by most livestock farmers. It is the stage where the greatest wastage of valuable feed takes place on farms. Grass growth rates vary considerably from year to year and location to location, but over half of the annual grass yield is produced in the April/June period. In most cases, this high yield of high quality herbage is not managed correctly and its true feeding value is not well used. The failure to adequately convert this valuable feed resource has a number of consequences. Firstly, while satisfactory animal gains are achieved in the short term (April/May), the performance for the subsequent months suffers as stock are grazing poor quality, stemmy, rejected herbage. Animals do not need to have huge masses of herbage (greater than 3000 kg DM/ha) in order to give satisfactory performance. Secondly, because of under-utilisation, which in some situations is less than 50%, pasture output is depressed for the remainder of the season. Thirdly, pasture quality is poor and swards which had a DMD value of 750 g/kg in mid-May (capable of producing a liveweight gain of 1 kg or greater/head/day) drop to around 650 g/kg DMD in June and July with the result that animal weight gains suffer. Fourthly, as pasture growth rates fall off, animals will be forced to eat into a stubble of very low quality with the result that gains in mid to late season will be poor, a phenomenon seen on many farms. This cycle of surplus grass growth early in the season and the inability to subsequently capture it in an efficient manner is repeated yearly on many farms.

Recent Grange research has shown that high stocking rates in Spring can be associated with high levels of animal performance both in the short and long term. Data in Table 20 show that over a 3 year period high performance was achieved over an extended period of time. On swards receiving 200 kg N/ha, a daily liveweight gain of over 1.1 kg was achieved from early April until mid-

Table 20.
Effect of Spring stocking rate on steer gains (kg/head/day)

	Stocking rate (kg/ha in early April)		
	2000	2500	3000
Up to mid August	1.25	1.16	1.12

Source: O'Riordan, 1996

Table 21.
Seasonability of grass growth

	April/June	July/August	April/August
% of total season's grass growth	60	25	85

Source: O'Riordan, 1996 (unpublished)

August on swards stocked at 3000 kg liveweight/hectare at turnout. The grazing pressure had increased to 4000 kg liveweight/hectare in mid August before a stocking rate reduction took place. Similarly, clover-based swards receiving only 50 kg N/ha in February, and stocked at 2500 kg liveweight/ha at turnout, were able to achieve weight gains of over 1.1 kg/day during the period from early April until mid August. These latter swards were supporting a stocking rate of 3000 kg/ha in mid August. These animal performances at grass were achieved with animals weighing 550 kg in April, and that had gained 0.9 kg/day during the previous winter. As well as achieving these levels of animal gain at high stocking rates, the use of flexible grassland management allowed up to 25% of the grazing area be removed as surplus grass for ensiling. These high daily gains and stocking rates are achieved on the basis that most of the seasons growth (60%) takes place in April/June (Table 21) and that the feeding quality is high (750 g/kg DMD) if well managed. In Table 20, increasing stocking rate from 2000 to 3000 kg liveweight/ha, thereby releasing 50% of the land area, only depressed daily gain by 10%. In terms of response to applied fertiliser nitrogen, the best response is achieved during the months of April/June. It is then clear that most of the winter feed requirements should be obtained early in the season (May/June). Trying to achieve a large proportion of the winter feed requirement after mid summer is most likely to be unsuccessful.

Guidelines for grazing swards in Spring should centre on a rest interval of not greater than 24 to 26 days. Rest intervals greater than these, while growing more grass, will lead to poor pasture utilisation and thus lead to swards of lower quality later in the season. Data from Grange show that grazing to a stubble height of 5 to 5.5 cm (compressed sward height) or a residual mass of 500 to 600 kg DM/ha during April to July, resulted in gains of over 1.1 kg liveweight/head/day.

With proper grassland management, animals can achieve a steady rate of gain over a long grazing season. Recent Grange data (Figures 7 and 8) show

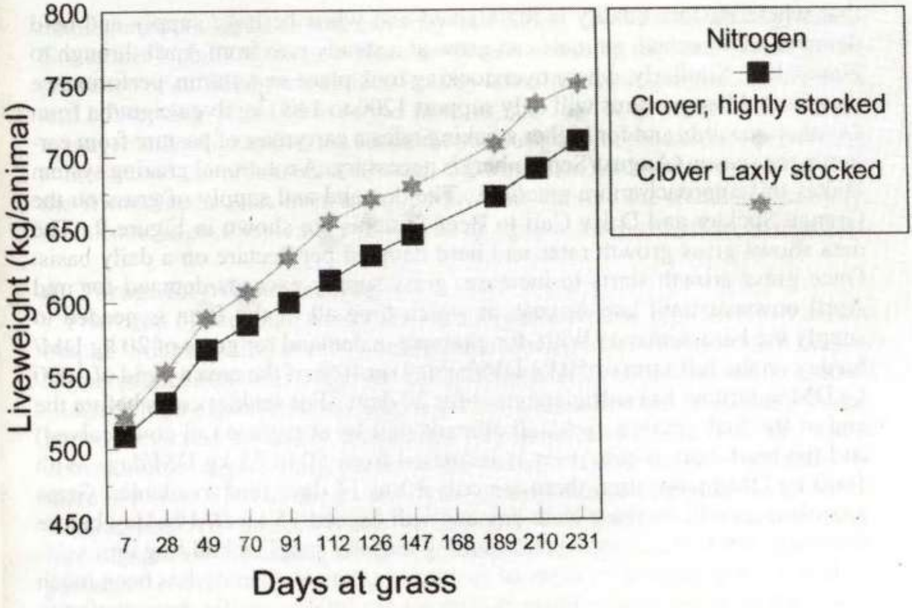


Fig 7. Animal performance at pasture (grass and grass clover swards, 1995)

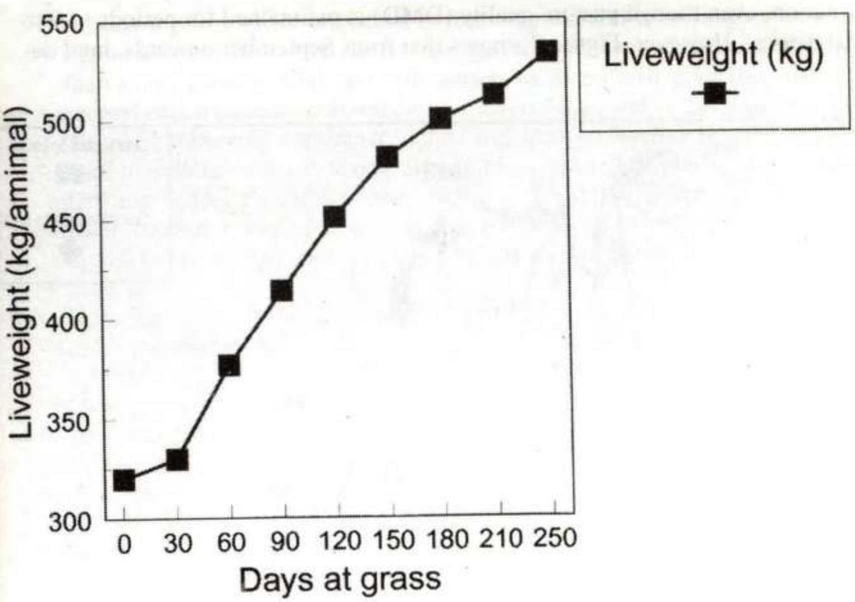


Fig 8. Animal performance at pasture (Dairy calf to beef 1995)

that where pasture quality is maintained and when herbage supply and herd demand are matched, animals can grow at a steady rate from April through to November. Similarly, where overstocking took place in Autumn, performance was poor. Most pastures will only support 1200 to 1400 kg liveweight/ha from October onwards and for higher stocking rates a carryover of pasture from earlier in the season (August/September) is necessary. A rotational grazing system makes this approach more practical. The demand and supply of grass on the Grange Suckler and Dairy Calf to Beef Systems are shown in Figure 9. The data shows grass growth rates and herd demand per hectare on a daily basis. Once grass growth starts to increase, grass supply exceeds demand for mid April onwards until late August, at which time all of the farm is needed to supply the herd demand. With, for example, a demand for grass of 20 kg DM/ha/day on the full farm or 50 kg DM/ha/day on 40% of the area a yield of 1000 kg DM at turnout has sufficient grass for 20 days. For suckler cows before the end of the first grazing cycle, all animals will be at pasture (all cows calved) and the herd daily requirement is increased from 50 to 75 kg DM/day. With 1000 kg DM/ha on offer, there are only 13 to 14 days feed available. Grass growth rates will increase each day and will exceed 75 kg DM/ha/day before the end of the first grazing cycle resulting in grass supplies building up.

Transferring grass from times of surplus to times of scarcity has been much discussed in recent years. There is surprisingly little scientific data relating to the practice of what has become known as extended grazing. Grange results over the past 3 years have shown that the grass, if available, can be carried as a standing crop in Autumn for 6 weeks or more with no advantage of a longer rotation, even though pasture quality (DMD) is maintained for periods of 9 to 10 weeks. However, Figure 9, shows that from September onwards, herd de-

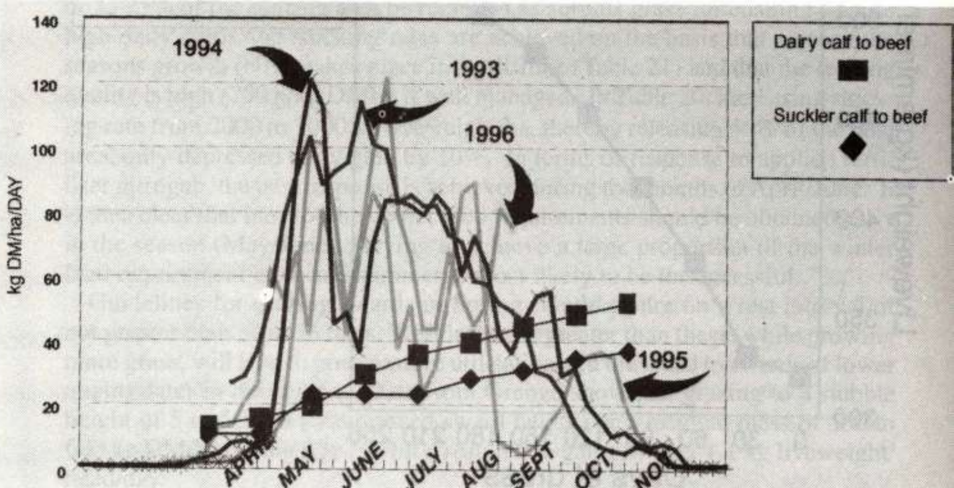


Fig 9. Herd Demand for Grass

mand matches supply, so that carrying feed supply for 6 weeks into October or November is unlikely to take place as there is not sufficient grass to do so. As provision of sufficient winter feed is a key issue in attaining high stocking rates, and conserving 35 to 40% of the farm in late July is an integral part of the management programme, the scope for surplus grass in the absence of omitting some second cut areas seems limited. However, on farms where most or all of the Winter feed comes from a single May/June harvest, the chances of carrying feed from August/September should be an option, but have yet to be assessed.

d) Forage for Winter feeding

Provision of adequate winter feed is a key to efficient, high levels of animal output. Silage quality is of major importance where farmers want high rates of animal production from silage-fed cattle. Consistently achieving well preserved silage of high digestibility (DMD) is difficult but attainable. Weather patterns, both directly and indirectly, impact in a very major way on the yield, dry matter concentration, digestibility, preservation and unit cost of silage. Consequently, there is a clear limit on the extent of the control that can be exercised over the weather-induced variability, and the flexibility of reducing variation will therefore depend on the ability to react or respond quickly and with flexibility to particular circumstances that arise due to weather. This ability to respond is often difficult to achieve, especially if it is remembered over 80% of silage is harvested by contractors.

(i) Silage yield

The following factors are important in reducing variability in silage yield:

- Perennial ryegrass swards can be managed to produce more consistent yields than other grasses. Mid and late season cultivars will give less variable second cuts than early cultivars.
- To assist achieving consistent yields, soil analysis each 5 years should be used to determine the P, K and lime status of the silage fields. Appropriate fertiliser inputs should be based on these results, together with replacing what the crop removed and what was supplied by slurry. Maintenance of high fertility is important as it leads to less fluctuation in yield from year to year.
- Nitrogen fertiliser should be applied as early as possible, ground conditions and weather permitting. In many cases where silage ground is not grazed in Spring, N can be applied in early March. In all cases, at least 6 weeks should elapse between spreading N and harvesting. On many lighter soils, sulphur should be applied for second-cut silage.
- Slurry spreading should be completed by mid March for first cut silage and should not be applied to high grass. It should only be applied to bare stubble for regrowths (rates dealt with later).
- Assuming that soil fertility, structure drainage and nutrient supply are satisfactory, the yield of a particular sward is substantially dependent on weather. At that stage, the main mechanism for achieving a given yield is by altering the harvesting date. However, delaying harvesting date to increase yield is

normally accompanied by a decrease in digestibility. The correct balance between yield and quality will depend, among other factors, on the type and intensity of enterprise on the farm and the relative costs of forage, concentrates and animal product. However, relative variability in dry matter yield can often be reduced by harvesting the first-cut in the final week of May rather than in mid May. Variable yields usually occur in July/August harvests, and on farms that are prone to severe drought this may be an insurmountable problem.

- Grass dry matter concentrations at harvesting impact on the fresh yields, as well as on effluent losses and the ease of preservation. The progression in grass dry matter concentration from 200 g DM/kg to 180, 150 and 120 g DM/kg reflects the effects of dew, a heavy rain shower and several days rain, respectively, and would increase the fresh yield at a 25 t/ha crop to 28, 33 and 42 t/ha, respectively.

(ii) Digestibility

As silage digestibility increases cattle eat more of it, utilise it more efficiently and produce correspondingly more meat or milk. Farmers who want to produce highly digestible silage on a reliable basis should incorporate the following into their management system.

(a) Use ryegrass swards. This is a long-term investment and, provided the cultivars in the seed-mix have fairly similar heading-out dates, makes identifying the optimum target harvest date straightforward.

(b) Harvest the crop when seedheads are beginning to emerge from the grass (do not wait until seed-heads have fully emerged). This is the grass growth stage that tends to give the best balance between yield and quality for farmers seeking high levels of animal production.

(c) Ensure there is not an accumulation of dead or old stemmy vegetation at the base of the crop. This can readily happen where swards were not grazed bare in autumn or where considerable winter growth occurred. The effect of thus accumulating what by silage-harvesting date will be old, low quality herbage at the base of the crop could be to decrease grass DMD at harvest from 750 to 690 g/kg.

(d) Have sufficient flexibility to be able to alter the harvesting date, if necessary. For example, if high yielding lush crops are subjected to heavy rain and strong winds they can lodge and lie on the ground under very wet conditions. If this occurs, the normal rate of decrease in digestibility can triple, leading to up to a 10% unit drop in DMD in a week. Such crops need to be harvested quickly after lodging if such large drops in DMD are to be avoided. However, the risk of lodging is reduced where excessive rate of total nitrogen-applications (including slurry) are avoided.

(iii) Preservation

The major aims in preserving grass as silage are to store the grass in a genuinely air-free environment and to then inhibit the activity within the silo (or bale) of undesirable microbes. This means fast filling and perfect sealing of silos, ensiling clean grass that is free of contamination and, if necessary, further facilitating preservation by wilting, using additives or using other management practices that encourage good preservation by producing "easy to preserve" crops. The following are the main guidelines:

(a) Use ryegrass swards. This long-term investment produces crops of higher sugar concentration that are easier to preserve than other grasses.

(b) Complete slurry-spreading by mid March, with undiluted cattle slurry being evenly spread on short grass at not more than 33 t/ha (3000 gal/ac.) - spread again **immediately** after the first-cut is 17 t/ha (1500 gal/ac.).

(c) In a two-cut silage system, apply N fertiliser as early as practicable, using rates of 110 to 140 kg N/ha (90 to 110 units N/ac) and 75 to 100 kg N/ha (60 to 80 units N/ac) for first and second cuts, respectively. In some circumstances higher rates may be justified. Reduce the above fertiliser N rates by 1.1 to 1.8 kg N/t undiluted cattle slurry (i.e. 10 to 15 units N/1000 gallons) applied in February/March. The corresponding adjustments for slurry applied after the first-cut are 0 to 1.1 kg N/t slurry.

(d) Only apply lime to silage land before March or after the silage-harvesting season is completed (i.e. do not apply to crops actually growing for silage.

(e) Wilting has both advantages and disadvantages. It should only be considered when drying conditions are good, and should **not** be attempted in large narrow rows. Ideally, if a farmer wants to wilt, the grass should be fully tedded and given complete ground-cover. At a minimum, where a large mower conditioner is being used, the gates at the back of the mower should be opened wide to allow the grass be spread in wide rows. If wilting, aim at a target of 250 to 300 g DM/kg (i.e. 25% to 30% DM), to be achieved within 24 hours of mowing. Besides its obvious effects on effluent production, successful wilting will virtually ensure good preservation, but the improved intake of dry matter is not correspondingly converted to additional animal product.

(f) Additives can be beneficial in some circumstances, but must be chosen carefully and appropriately, and applied properly, if an economic response to their use is to be obtained. Where grass is harvested at an advanced state of maturity (i.e. very stemmy) or has been heavily wilted, conventional additives are not normally justified. On the other hand, if leafy crops of grass that have received none or a little wilting are being ensiled, the following three steps should be followed:

    (i) obtain an estimate of grass ensilability. At a minimum this involves measuring grass sugar concentration (expressed as a proportion of grass juice) and preferably also buffering capacity. Sugars can be measured on farms, while both sugars and buffering capacity can be measured on samples submitted to laboratories. It is critical that the samples taken propely represent the grass to be harvested, and that they are properly processed prior to analysis. Based on an ensilability index, the category of additive required, as well as the appropriate application rate, will be indicated.

(ii) make an estimate of the fresh yield being harvested. This is necessary since the additive will be applied per tonne of weight harvested, and cannot accurately be assessed without weighing a strip or trailer-load of grass. Doing this is time well spent as a 40% underestimation of the actual yield of grass would lead to applying 40% too little additive and consequently obtaining an inferior return on the investment in the additive.

(iii) evenly apply adequate sugar or acid based additives where grass ensilability is difficult, and effective inoculants where ensiling conditions are very good. However, the recent major drop in beef prices now puts the economic merit of inoculant additives under considerable doubt on cattle farms.

(g) Fast filling and perfect sealing of the silos (or bales). This is crucial and the single most important factor in achieving good preservation.

(iv) Aerobic deterioration

The three main factors affecting aerobic deterioration once silos are opened are (1) management, (2) weather, (3) silage characteristics. Of these, management is the most important factor. The aim of management practices must be to minimise the contact time between silage and air. In bunker silos, this involves (a) moving through the silage face quickly, (b) presenting easy-fed animals with only so much silage as they can eat in a day, (c) keeping the silage face as undisturbed as possible. Rough or careless removal of silage from the silo leaves behind a tattered and tossed face into which air can penetrate deeply, (d) keeping polythene on top of the pit fully weighted down and taut to the front of the silo and (e) not covering the silage face with polythene at feeding time as this creates a mushroom-house environment. Unfortunately there are no chemicals available to spray on the silage face at feedout to prevent aerobic deterioration at and behind the face.

All else being equal, slower filling of a silo is likely to make the silage more prone to aerobic deterioration at feeding time.

With regard to weather, it has been shown in Grange experiments that warmer weather at feedout increases the susceptibility of silage to aerobic deterioration. The management recommendations already described are crucially important during periods of mild weather as deterioration is more extensive in such conditions.

Certain silage characteristics such as the degree of stemminess or dryness of silage or its density may influence susceptibility to aerobic deterioration. As demonstrated in the Grange experiments, the major chemical components in well preserved silages exert relatively little impact on aerobic stability. However, other experiments have demonstrated that small amounts of as yet unidentified chemicals are formed in some silages and do improve aerobic stability. The microbial composition of silage when exposed to air and in particular yeast numbers, has a major effect on aerobic stability. The factors which influence this still need to be defined.

4. FUTURE POTENTIAL

Irish grassland has the potential to support highly efficient beef production, and allow a competitive advantage over beef producers in other countries. Taking grass yield, quality and efficiency values under a current good-management system for a geographical location such as Grange, carcass output per ha grass can be estimated at 553 kg per year. There exists a realistic potential, as shown in Table 22, to radically increase the efficiency of producing beef per hectare of grassland by increasing grass production, increasing the proportion consumed by grazing rather than after conserving, and improving quality and efficiency of utilisation, to produce almost 1000 kg carcass/ha each year.

Strategies for achieving such an enormous improvement in productivity will depend on the adoption of improved technologies, intensive monitoring allied to the prompt use of accurate, quantified information for decision-making and the operation of newer production systems incorporating both flexibility and continuous, active management.

Critical to improving the annual yield of grass are maintaining good soil drainage, structure (i.e. prevent compaction) and fertility (P, K, lime and micro-nutrients). Improved grass varieties (and possibly grasses selected specifically for grazing or conserving), together with high rates of N application spread in a time-critical pattern throughout the year and the use of variable length grazing cycles to provide optimal regrowth recovery intervals, will be central to delivering the high yields. Alternatively, some clover-based systems will offer the potential to increase beef output per forage hectare compared to the current standards, but probably not as much as proposed in Table 22.

Considerable scope exists to increase the proportion of annual grass DM production consumed by grazing, and correspondingly reduce the proportion conserved, by operating systems involving as early a turnout to grass and as late a

Table 22.
Potential to increase beef carcass production per ha grassland (Grange)

		Current	Potential
Annual grass yield (t DM/ha)		10	15
% of DM yield assigned to grazing		58	70
% of DM yield assigned for conserving		42	30
Grazing efficiency (consumed as % of grown)		74	80
Conservation efficiency (consumed as % of grown)		76	82
DMD of forage consumed (g/kg)			
-grass		77	77
-silage		70	73
Carcass output (kg)/ha/year	- from grass	403	789
	- from silage	150	181
TOTAL		553	970

removal from grass as possible, staggered turnout and removal, and a manipulation of the seasonal grass supply pattern based on the cultivars used and the strategic seasonal pattern of N fertiliser use. Furthermore, the feeding of some of the supplementary concentrates at grass that would otherwise have been subsequently fed indoors, will allow the finishing of cattle off of grass, with the consequent reduction in winter forage requirements.

Improvements in the efficiency with which cattle consume the grass produced will depend on the use of rotational grazing systems involving paddocks. Selection of grasses on the basis of their palatability and intake characteristics, together with more frequent (and possibly semi-automated) allocation of fresh grass supplies during the day, will be necessary. Critical also however, will be a more comprehensive knowledge of grass growth rates, actual supplies available, grazing rate and animal behaviour. Considerable scope still exists to reduce conservation losses, and will hinge primarily on reducing losses via effluent (e.g. feeding effluent essentially eliminates this loss completely) and restricting aerobic deterioration at filling, during storage and at feedout. The scope to reduce losses during fermentation appears more limited at present.

Relatively little opportunity seems available to improve the nutritive value (e.g. DMD) of grazed grass in a situation where the aim is to increase grazing efficiency markedly. However, the use of ryegrass actively selected for higher DMD, quite possibly of late heading-out date, together with a greater extent of control on aerobic deterioration of silage at feedout, should readily achieve the improvements suggested in Table 22.

5. FINAL COMMENT

The optimal, rigorous management of Irish grassland is the route to a viable ruminant livestock industry in the future, assuming we will have to operate in a progressively more open economic market-place but where there will be greater regulations regarding food quality, animal welfare and environmental considerations. Fundamental to Irelands ability to take full advantage of the opportunities provided by our grassland is a national, co-ordinated, focussed, comprehensive and fundamental research effort to understand grass production, consumption and conversion to quality beef - we must **pursue the science of grass and beef.**

This technology must be quickly transferred to beef farmers in the form of flexible, adaptable systems (not blueprints) and management support mechanisms (that will permit prompt and appropriate decisions based on accurate knowledge) so they can **cash-in on grass.**

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APPENDIX

RELATIONSHIP BETWEEN SWARD HEIGHT AND HERBAGE YIELD

The use of POST GRAZING sward surface height as a grassland management aid has been advocated for a number of years. However, the use of PRE-GRAZING sward surface height as an estimater of the HERBAGE YIELD available for grazing animals has not been widely used in Ireland. Where pre-grazing sward height is being used, tables which relate sward height to herbage yield are those derived in other countries. During the past 3-years, research at Grange has examined the relationship between pre-grazing sward surface height and herbage DRY MATTER yields. Over this period close to 3,000 plots had both their height recorded and actual yields determined, and these height and yield data have been used to generate IRISH height to yield conversion tables. This article outlines the main results of this research.

WHY USE PRE-GRAZING SWARD HEIGHT?

The pre-grazing sward height can be used as a grassland management tool, helping the grassland manager become familiar with herbage yield and thereby facilitating a process where animals may be offered "known" herbage allowances.

MEASURING SWARD SURFACE HEIGHT

Sward surface height (i.e. the height of the grass) may be measured in a number of ways.

1. Ruler

   The simplest means of measuring sward height is with a ruler, where a ruler is inserted vertically into the standing crop and the height from the ground to the "top" of the sward is then measured. However, big variation can emerge in deciding what is the "top" of the sward.
2. Sward Stick

   A sward stick consists of a graduated metal rod (with marks each 0.5 cm) fitted with a perspex arm. The sward stick is inserted vertically into the sward and the perspex arm is lowered until it comes in contact with a leaf. The reading on the shaft is taken as the sward height. Both ruler and sward stick are somewhat slow to use, especially if large areas are to be measured, and many readings are needed. Readings are manually recorded.
3. Plate meter

   Sward height can be measured with a plate meter, of which there are many types. In general, a plate is allowed to settle on and compress the sward, the height between the ground and the plate being measured as the sward height. Readings may need some degree of manual recording, but considerable scope exists to automate and streamline this process.
4. Other techniques that for example bounce light or sound waves off the sward have also been investigated, with varying degrees of success.

The use of plate meters is becoming more common and some are now being manufactured in Ireland.

SWARD STICK

At the lower sward heights (4-6 cm) the sward stick resulted in height values which were 1 to 2 cm GREATER than those from the AFT meter. In taller swards this difference between the two approaches to measurement was increased and, as a result of these large differences, yields based on uncompressed sward height CANNOT be read from Table 1 and therefore the sward stick needs to have its own conversion tables developed.

CHARACTERISTICS OF PLATE METER

As plate meters measure compressed sward height, the heavier the plate the greater the degree of sward compression and the lower the resulting sward height. Thus, various meters need to be standardised so that each meter results in the same degree of sward compression and height. The plate meter used in the present experiment was developed by An Foras Taluntais (AFT) in the early 1980's and consisted of a 30 cm diameter plate which places a force of 2.8 kg/m^2 on the sward. The meter was designed to automatically record the sward height and calculate the average height for a large number of readings and display the results on a LCD panel.

HEIGHT/YIELD RELATIONSHIP

Table 1 shows a range of sward heights and the corresponding measured dry matter yields. The swards used were generally at the end of a 3-week rotation. The data in the Table are based on almost 3,000 plots where height and yields were actually measured. Eleven different swards were measured over the three full growing seasons during the course of the Grange study. While height was measured from the ground to the plate, the yield (in kg DRY MATTER per hectare) was measured in the grazing horizon above a stubble of 4 cm (not to ground level).

Table 1 covers sward surface heights within the range 6 to 25 cm, that is, within the limits of "normal" PRE-GRAZING conditions. At heights greater than 25 cm, the height to yield relationships are much less accurate because the sward tends to fall over and lodge under the weight of the plate. Consequently, the values in Table 1 should not be extended for use on silage swards.

The relationship between sward surface height and herbage dry matter yield DOES VARY from sward to sward (i.e. one crop (field) to the next) and also varies with season. Thus, for example, stemmy swards give a higher height reading as the plate is supported on the stems. Measurement taken on lush pastures after heavy rainfalls or in frosty conditions will also be associated with errors. The way the meter is lowered into the sward has an effect on height. Dropping the plate meter with force onto the sward will compress the sward surface to a greater extent than doing the procedure gently. When measuring sward height, the more readings that are taken the closer the average height value will be to the true field value. Aim to take at least 50 readings per paddock.

USE OF THE TABLE

Table 1 has five columns. The FIRST column is the compressed sward surface height measured in centimetres. The SECOND column relates sward surface height to HERBAGE DRY MATTER yields (in kg DM/ha) in the early part of the season and spans the Spring/Summer period from the start of the growing season to mid-June. This is the stage when grass swards are in their reproductive growth phase (after the winter). The THIRD column covers the height to yield relationship for the period mid-June to late August, when, depending on management, sward quality can vary widely and some grasses will tend to form seed heads. The FOURTH column covers the remainder of the year to late October/early November when grasses are in the vegetative stage. The FIFTH column, gives an overall yield value for the whole season for each of the sward heights.

NOTE that the yields given in Table 1 are the AVERAGE values for each sward height over the range of swards used in the study. There IS variation from one sward to the next. The analysis of the Grange data relating height and yield show that at any sward height DRY MATTER YIELD may vary by PLUS or MINUS 500 kg DM/ha from the value predicted in Table 1. **THUS, VALUES IN THE TABLE CAN ONLY BE USED AS AN INDICATOR OF YIELD AND NOT THE "ACTUAL" YIELD AT ANY SWARD HEIGHT.**

USING THE TABLE UNDER FIELD CONDITIONS

If the average pre-grazing sward height is 12 to 15 cm then herbage on offer is equivalent to approximately 1600 to 2100 kg DM/ha. At a herbage availability 2000 kg DM/ha and offering dairy cows a herbage allowance of 20 kg DM/head/day, there are 100 grazing days per hectare (40 grazing days/acre). Likewise, if 15 kg DM/head/day is being offered suckler cows or drystock, there are the equivalent of 133 grazing days/ha (or 54 grazing days/ac) on offer. If pre-grazing sward height is 18 to 20 cm, then herbage on offer is equivalent to 2600 to 3000 kg DM/ha. Herbage yields of greater than approximately 3500 kg DM/ ha or a pre-grazing sward height of 23 to 24 cm, is probably indicative of surplus grass.

If grass allowances are offered on the basis of sward height, the actual allowance may be at most plus or minus 1 kg DM/head/day from the expected allowance for cattle. Consistency in measurement is important if the operator's eye is to be trained in assessing herbage yield and thus be an effective judge in estimating herbage availability. As mentioned previously, the main benefit of correctly using the plate meter is to train the grassland managers eye into assessing herbage yield in the standing crop. AS A "GENERAL" RULE EACH CENTIMETER RISE IN COMPRESSED SWARD HEIGHT WILL REPRESENT AN INCREASE IN YIELD OF 150 TO 200 KG DM/HA.

OTHER PLATE METERS

The AFT meter has been compared with a second plate meter, manufactured in Cork. The Cork meter consisted of a 32 x 32 cm, 11/2 mm, stainless steel plate which exerts a compressing force of 5.4 kg/m2 on the sward (nearly twice the force of the AFT meter). The Cork meter being heavier resulted in sward heights which were lower (10%) than the AFT meter. However, as the percentage difference was relatively small, the error associated will be of little practical consequence and the Cork meter may be used to record sward height and read from the herbage yield values in Table 1.

The plate on the Cork meter is carried on a central shaft and as the meter is lowered into the sward the plate rises on the shaft which is notched at 0.5 cm intervals. A counter with a sprocket wheel counts the notches as the plate rises (not as the plate falls as it is removed from the sward). The number of height readings taken is recorded on a second hand operated counter. Using the reading on the shaft counter and the number of individual height readings taken, the average sward surface height and herbage yield can be calculated.

If the Cork meter is to be used to estimate sward height and thus herbage DM yield from Table 1, the following procedure should take place.

1) Record the starting reading on the shaft recorder.
2) Record the final reading on the shaft recorder.
3) Record the number of height readings taken.

Then use the following formula to get the sward height (in cm):

$$\text{Sward height (cm)} = \frac{\text{[Final reading] minus [starting reading]}}{\text{[number readings taken x 2]}}$$

Example 1: 10 height readings taken, starting value = 17,096 and final value = 17,568

$$\text{height (cm)} = \frac{[17{,}568\text{-}17{,}096]}{[10 \times 2]} = \frac{472}{20} = 23.6 \text{ cm}$$

Example 2: 25 height readings taken, starting value = 19,000 final value = 19,250

$$\text{height (cm)} = \frac{[19{,}250\text{-}19{,}000]}{[25 \times 2]} = \frac{250}{50} = 5 \text{ cm}$$

NOTE that these height readings will be some 10% lower than those taken with the AFT meter. The mathematical process above is not necessary with the AFT meter, as all calculations are carried out automatically.

SUMMARY

* Sward height is a useful management aid and is a help in training the "eye" to herbage supply.
* Sward height and pasture dry matter yield available for grazing are related, but the relationship varies with pasture type and season.
* The Grange Table can be used as a guideline for farmers who want to relate sward height to herbage dry matter yield.
* Not all means of measuring pasture height - are directly comparable. Different conversion tables are needed for each instrument.

TABLE 1.

COMPRESSED PRE-GRAZING SWARD SURFACE HEIGHT AND ASSOCIATED HERBAGE DRY MATTER YIELDS.

COMPRESSED SWARD SURFACE HEIGHT (cm)	DRY MATTER YIELDS (kg/ha) (above 4 cm stubble)			
	PERIOD 1 (Spring to mid-June)	PERIOD 2 (Mid June to late-August)	PERIOD 3 (September to end of year)	OVERALL (ignoring seasonal effects)
6	684	729	470	604
7	848	876	626	773
8	1012	1023	782	942
9	1176	1170	938	1111
10	1340	1317	1094	1280
11	1504	1464	1250	1449
12	1668	1611	1406	1618
13	1832	1758	1562	1787
14	1996	1905	1718	1956
15	2160	2052	1874	2125
16	2324	2199	2030	2294
17	2488	2346	2186	2463
18	2652	2493	2342	2632
19	2816	2640	2498	2801
20	2980	2787	2654	2970
21	3144	2934	2810	3139
22	3308	3081	2966	3308
23	3472	3228	3122	3477
24	3636	3375	3278	3646
25	3800	3522	3434	3815

NOTE. Sward herbage dry matter yields and not green (fresh) yields are used

Exploitation of the Genetic Potential of the National Herd for Beef Production

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INTRODUCTION

Unlike improvements in feeding and management which have ongoing costs associated with them, genetic improvement is permanent and is largely free of on-going costs. Furthermore, genetic improvements do not have the negative connotations which often accompany feeding and management improvements (e.g. hormones and feed additives, environmental risks from excessive nutrient loads as fertiliser or as slurry, animal welfare considerations of confinement and housing). With the increasing competitiveness of the other livestock sectors such as pigs and poultry, the Irish beef industry must improve and exploit genetic potential to the maximum. Otherwise it will become even more uncompetitive relative to the pig and poultry meat industries than at present. Furthermore, it could also fall behind its international competitors in beef production whose breeding programmes are already well advanced. There are two components to the production of animals of high genetic quality (1) identification and production of genetically superior breeding stock and (2) exploitation of this genetically superior breeding stock through their widespread use within the industry. The first requires comprehensive breeding programmes while the second requires the use by commercial producers of the genetically superior animals produced from the breeding programmes.

IMPROVING GENETIC MERIT

Improvement of genetic merit involves the identification and selection of genetically superior animals in structured breeding programmes. The performance of an animal is a function of its genotype and environment. There have been considerable improvements in environmental factors such as nutrition, disease control and housing but these are not passed on from generation to generation and generally require ongoing costs in order to be maintained. The genotype of the animal on the other hand is the genetic material it inherits from its parents, half of which is passed on from generation to generation. To bring about genetic improvement, it is necessary to separate out the proportion of performance (growth, carcass traits, feed efficiency etc.) which is due to the genes it carries (genotype) and then select for the desired traits.

ESTIMATED BREEDING VALUES (EBVs)

Since true breeding value cannot be measured, estimates of it are made.

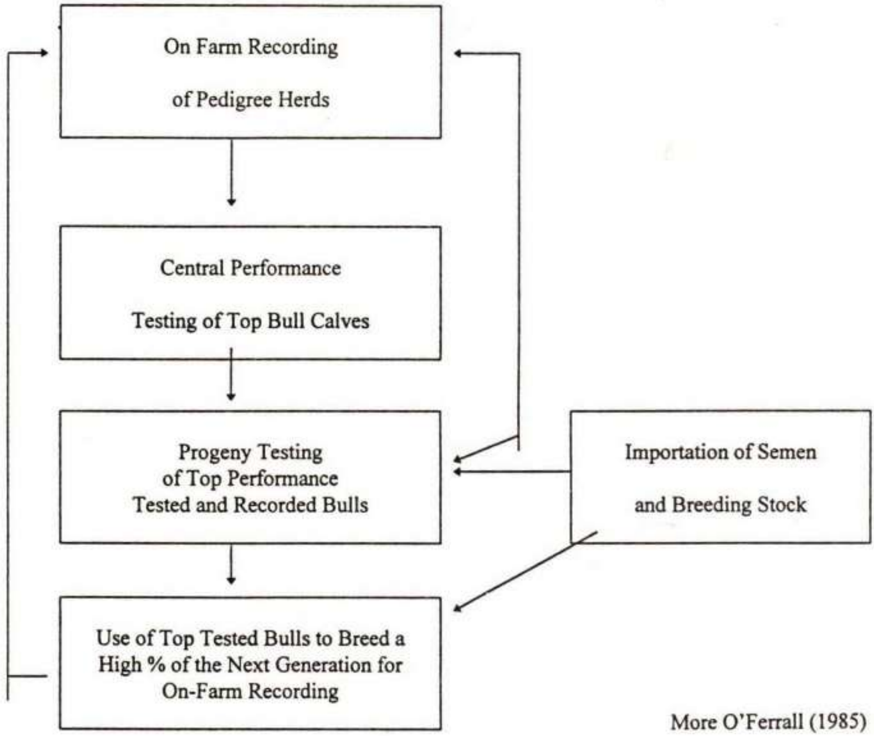
Sire: In the past the estimation of breeding value was done by the contemporary comparison method having corrected for environmental effects such as sex and age of dam. However, contemporary comparison was only applicable to animals reared under the same conditions and as pedigree herds are generally small, relatively few breeding values could be calculated and/or their accuracy was low.

The development of BLUP (best linear unbiassed prediction) has overcome the major limitations of contemporary comparison. This technique uses all the records available on an animal and on all its relatives, to partition the genetic and environmental effects and give a more reliable EBV. Genetic linkages between herds allow evaluations to be made across herds. BLUP can also account for associations between traits which further improves its accuracy. For example 200 day weight is positively associated with 400 day weight. EBVs are expressed in the units in which they are measured (e.g. weights in kg, muscle scores in points) and relative to the breed average for a specified year. EBV is an estimate of the genetic merit of the animal itself but only half of this is passed on to the progeny. It is expected that EBVs for Irish pedigree beef bulls will be available shortly.

Dam EBV: The performance of a calf is also influenced by the genetic maternal and milk production traits of its dam. BLUP can separate out these and thus produce EBVs for dams similar to those for sires. The maternal genetic traits will be passed on to the progeny of both sexes but of course they can only be expressed by the female progeny. Of particular interest is the genetic potential of the dam for milk production, a major factor determining calf weaning weight. In beef breeds this EBV is designated 200-day milk.

IRISH BREEDING PROGRAMME

The main elements of a structured breeding programme are outlined in Figure 1. They are (1) on-farm weight recording in pedigree herds, (2) central performance testing of young bulls, (3) central progeny testing of bulls, and (4) importation of genetically superior breeding stock as live animals, semen or embryos. All these elements are used in the Irish cattle breeding programme which has been described in detail by Grogan (1992). Up until now the Irish programme has been operated by the Department of Agriculture, Food and Forestry in cooperation with the breed societies and the AI stations. At present, a national cattle breeding authority is being established to take over the control of cattle breeding. In Ireland, beef bull proofs are expressed as relative breeding values (RBVs) with the breed mean = 100. The RBV for a trait is an estimate of the bull's genetic merit for that trait relative to an average bull of the breed. The superiority/inferiority of a bull is indicated by the extent to which his RBV deviates from 100. Bulls of 110 or greater are from the top 15% of the breed population while bulls of 90 or less are from the bottom 15% of the breed. One half of a bull's superiority or inferiority is passed on to his progeny. RBVs are reported separately for growth rate, carcass conformation and carcass leanness, and feed efficiency values are available for some performance tested bulls. From these an overall beef merit index is calculated. This combines the individual trait values into a single index of economic worth. AI bulls are also surveyed for calving ease, calf mortality to 48 hours and gestation length. The results are expressed as the expected levels for matings to Friesian cows.



More O'Ferrall (1985)

Fig. 1 Illustration of genetic improvement programme for beef cattle breeds

The relevant genetic data needed by the users of AI are published each spring in the Approved AI Beef and Dairy Bull Lists. Approved beef bulls are categorised as approved for widespread use (W) or approved for limited use (T). The W category are high genetic merit bulls which have been progeny tested and surveyed for ease of calving and for which semen is readily available. T bulls have good performance test and/or ease of calving ratings and are undergoing progeny test.

GENETIC PROGRESS

An important measure of the success of a breeding programme is the rate of genetic improvement over time. In dairying for example, the rate of genetic progress in milk fat and protein yields has almost trebled (0.4% to 1.1% per year) for sires born over the 10 year period 1980-1990 (Dillon. Crosse, Buckley and Flynn, 1996). There are no published estimates of the changes in beef breed mean values over time but some indication of genetic change can be deduced from the ratings of the bulls entering the Approved Bull List compared with those of the bulls leaving it.

Growth rate: The mean growth rate RBVs for the Charolais, Hereford, Limousin and Simmental bulls approved for widespread use in 1991 and 1996 are shown in Table I. Also shown are the RBVs for the bulls included in the list in 1991 but since removed, and the new bulls added to the list in 1996. In 1991 there were only 5 Charolais approved for widespread use and they had a mean growth rate RBV of 107. Since then, 4 of these (mean growth rate RBV 106) have been removed from the list. By 1996 there were 14 Charolais bulls (mean RBV for growth rate of 110) approved for widespread use. Only one new bull was added to the list in 1996 and he had an RBV for growth of 115. Thus, there is evidence of some improvement (107 to 110) in the genetic merit for growth rate of the approved AI Charolais bulls from 1991 to 1996. However, this improvement only brought the mean of the Charolais bulls into line with that of the other breeds.

TABLE 1.
Relative breeding values of bulls approved for widespread use in 1991 and 1996

	Charolais		Hereford		Limousin		Simmental	
	1991	1996	1991	1996	1991	1996	1991	1996
No. approved bulls	5	14	22	16	12	15	11	15
Mean growth RBV	107	110	109	110	109	108	110	109
No. removed+/added++	4	1	14	7	4	2	6	4
Mean growth RBV	106	115	109	110	106	102	107	105

+ Bulls present in 1991 but not in 1996
++ Bulls present in 1996 but not in 1995

In 1991 there were 22 Hereford bulls with a mean growth RBV of 109 approved for widespread use. Since then 14 of them (also with a mean growth RBV of 109) have been dropped from the list. By 1996 there were 16 Hereford bulls approved for widespread use. Their mean growth rate RBV of 110 was little different from the 1991 value. The 7 new bulls added in 1996 also had a mean growth RBV of 110. Thus, there has been little change in the growth RBV of approved Hereford bulls over the past 5 years so the only change in genetic merit of approved AI Hereford bulls is that which has occurred in the breed mean.

For the Limousin and Simmental breeds, mean growth RBV for approved bulls was in fact one point lower in 1996 than in 1991. In both breeds also, the bulls dropped from the list were 3 points below the list mean suggesting that to some degree it was the poorer bulls which were dropped. However, it is also true for both breeds that the bulls added to the list were below the list mean.

Generally, there is little to suggest that there has been any significant increase in RBV for growth rate over the last 5 years in the approved AI bulls. There is little difference between the breeds in the growth RBVs of the bulls approved for widespread use. Therefore, the only improvement in genetic merit of AI bulls has been that which has occurred in the breed means (of which there are no published estimates).

Calving ease: It might be argued that improvement in growth RBV was constrained by selection for ease of calving. The mean calving difficulty scores for 1991 and 1996 for the Charolais, Hereford, Limousin and Simmental breeds are shown in Table 2. Mean calving difficulty score for Charolais actually increased (4.1 to 5.7) from 1991 to 1996 but most of this was due to a single bull with a high calving difficulty (19.8%) which was added to the list in 1996. For all the other breeds there was little change in mean calving difficulty percentage between 1991 and 1996.

TABLE 2.
Calving difficulty percentage for bulls approved for widespread use in 1991 and 1996

	Charolais		Hereford		Limousin		Simmental	
	1991	1996	1991	1996	1991	1996	1991	1996
No. bulls	5	14	22	16	12	15	11	15
Mean calving difficulty	4.1	5.7	1.9	2.1	3.9	3.7	3.3	3.6
No. removed+/added++	4	1	14	7	4	2	6	4
Mean calving difficulty	4.0	19.8	1.9	2.2	3.7	2.9	3.5	4.3

+ Present in 1991 but not in 1996
++ Present in 1996 but not in 1995

EXPLOITING GENETIC POTENTIAL

At producer level, genetic improvement comes mainly from the widespread use of genetically superior sires. This is discussed under two headings (1) the mean differences between beef breeds and (2) the genetic differences between sires within a breed. In addition to the genetic merit of the sire, breed type of the suckler dam is also considered.

DIFFERENCES BETWEEN SIRE BREEDS

The relative merits of the different beef sire breeds have been well documented and are summarised in Table 3. Other than the Angus which had a lower value, slaughter weight for age differed little between Friesian, Hereford, MRI, Limousin and Blonde, while Simmental, Belgian Blue and Charolais were 4-7% superior to these. All beef crosses had higher kill-out values than Friesians with the continentals having higher values than the British breeds. Hereford, MRI and Limousin were 4%-5% superior to Friesians and Angus in carcass weight for age while the other breeds were 8%-11% superior. Muscle weight for age was similar for Friesian and Hereford even though the latter had 4% more carcass. All continentals produced 11%-19% more muscle than Friesian and Hereford with the Belgian Blue having the highest production of muscle. Muscle size essentially paralleled muscle weight for age. There was relatively little difference across breeds in the proportion of higher value muscle which was identical for the dairy and British breeds and was 2%-3% higher for the continentals. All beef crosses had considerably superior conformation to

Friesians. Limousin, Belgian Blue and Charolais had the best conformation. Fat score was considerably higher for the British breeds than for the dairy and continental breeds. There was little difference in fat score between Friesian, MRI, Limousin and Simmental, but Blonde d'Aquitaine, Belgian Blue and Charolais had lower fat scores than the others.

TABLE 3.
Ranking of progeny from different sire breeds and Friesian cows.

Sire Breed	Sl. Wt./ Age	KO	Car.Wt./ Age+	Muscle Wt./ Age	Muscle Size	Higher Value Muscle	Conf.	Fat Score
Friesian	100	100	100	100	100	100	100	100
Angus	96	102	99	94	100	100	127	120
Hereford	102	102	104	100	102	100	131	124
MRI	102	103	105	106	107	100	118	102
Limousin	99	105	104	110	118	103	140	101
Blonde	102	105	107	116	119	103	132	91
Simmental	106	103	109	114	118	102	134	101
B. Blue	104	105	109	119	122	102	140	91
Charolais	107	104	111	117	123	103	144	95

Sl. Wt. = Slaughter Weight; KO = Killing-out proportion; Car. Wt. = Carcass Weight; Conf. = Carcass Conformation

DIFFERENCES BETWEEN SIRES WITHIN A BREED

The mean productivity differences between the breeds described above are now widely appreciated by producers and there has been a large change in beef breed usage from predominantly British breeds 10-15 years ago to predominantly continental beef breeds at present. This change has been accompanied nationally by a marked increase in mean carcass weight and an improvement in carcass traits. The next major improvement in productivity must now come from the identification and widespread use of genetically superior bulls within each breed. For some traits, the difference between bulls of the same breed can be as great as the mean differences between breeds. The AI bulls approved for widespread use are on average 11% (Angus), 8% (Belgian Blue), 10% (Charolais), 10% (Hereford), 8% (Limousin) and 9% (Simmental) above their respective breed means for growth rate. Thus, a change from a bull of unknown genetic merit (and therefore assumed to be average for the breed) to an average approved AI bull automatically improves performance of the progeny by about 5%. A further change from the average approved AI bull to the best approved AI bull within a breed would give about a further 3% improvement in performance. Therefore, within a breed, performance can be improved by 8-10% by using the best approved AI bull compared with a an average bull of that breed. In suckled weanling production, a bull with an EBV of +30 kg for weaning weight would produce weanlings 15 kg heavier than the average bull. This would be worth about £700 annually in a 50 cow suckler herd or £3000 to £4000 more over the lifetime of the bull.

RANKING BULLS ACROSS BREEDS

Where bulls have beef ratings they can be ranked for performance across breeds. This permits the best or most suitable bull to be selected for use almost irrespective of breed. The 1996 Approved AI Beef Bull List (Department of Agriculture. Food and Forestry, 1996) contains 127 bulls of which 71 are approved for widespread use. All these have RBVs for growth rate, carcass conformation and carcass leanness and some have a feed efficiency rating. In addition they all have been surveyed for ease of calving.

TABLE 4.
Ranking (Angus=100) of beef breeds for growth rate, conformation and leanness.

	Angus	Hereford	Limousin	Simmental	Charolais	B.Blue	Piedmontese
Growth	100	104	105	108	111	109	102
Conformation	100	100	111	103	112	112	106
Leanness	100	96	119	119	124	132	141

TABLE 5.
Relative across - breed values (Angus = 100) for approved bulls of different breeds

Breed Bull		Growth	Conformation	Leanness	% calving Difficulty	% calf Mortality
Angus	Mean	100	100	100	2.7+	2.0+
	RUH	108	97	93	2.1	0.7
	RHD	116	118	97	4.0	1.9
Hereford						
	LRA	105	94	98	2.7	2.0
	SDB	121	106	99	1.6	0.8
Limousin						
	FL10	104	115	120	4.0	2.2
	DWB	123	117	121	4.5	2.6
Simmental						
	HGO	110	100	121	7.5	2.6
	SUE	127	111	113	1.1	2.0
B.Blue						
	CRK	115	125	128	4.2	2.6
	IOS	119	105	136	4. 1	3.0
Charolais						
	BOA	115	102	128	2.2	2.9
	CF44	130	115	120	3.9	2.0

+Mean values for Angus bulls approved for widespread use (1996)

Using a combination of the Beef Progeny Test Data included in the Approved AI Beef Bull List, and the data from the Grange Beef Breed Evaluation Programme, an across-breed beef value (ABV) was calculated for all the AI bulls approved for widespread use in 1996. This was done using the Angus breed mean as the baseline (i.e. Angus breed mean = 100) for growth rate, carcass conformation and carcass leanness (Table 4). Feed efficiency was not included because only a small number of bulls have feed efficiency ratings. From this, together with the published within breed RBVs, ABVs were calculated. A sample of the values for the poorest and best growth rate bulls of each breed are shown in Table 5 and the results were expressed as the expected superiority/inferiority (£ per head) of the male progeny (ideally it should be the mean of the male and female progeny) of a bull. A sample of these values relative to the breed mean for an Angus calf are shown in Table 6.

TABLE 6.
Value (£) of male calves+ from approved bulls relative to Angus breed mean.

Breed	Bull	Growth	Carcass	Calving	Total
Angus	Mean	0	0	0	0
	CUO	22.5	1.2	-0.3	23.4
	RHD	40.0	9.9	-1.1	48.8
Hereford					
	CWR	22.5	-0.5	0.6	22.6
	SDB	52.5	2.7	3.5	58.7
Limousin					
	FL10	10.0	13.5	-1.7	21.8
	PYR	55.0	18.5	2.4	75.9
Simmental					
	HGO	25.0	6.3	-6.6	24.7
	SUE	67.5	9.4	1.6	78.5
B.Blue					
	CRK	37.5	20.9	-3.3	55.1
	JAT	45.0	21.1	-4.8	61.3
Charolais					
	BOA	37.5	9.4	-2.2	44.7
	CF44	75.0	13.5	-1.2	87.3

+Value of females calves should also be considered

While recognising the greater suitability of certain breeds to certain production systems no account could be taken of this, and the bulls were compared directly on the basis of growth rate ABV. The range in ABV was as follows: Angus 108 to 116, Hereford 105 to 121, Limousin 104 to 123, Simmental 110 to 127, Belgian Blue 115 to 119 and Charolais 114 to 130. Of the total 71 bulls approved for widespread use in 1996, 19 had growth ABVs of 120 or greater (10 Charolais, 2 Hereford, 3 Limousin, 4 Simmental). Thus, about one-quarter of the AI bulls approved for widespread use were more than 20% superior in growth rate to the mean of the Angus breed.

Compared with the Angus breed mean, all bulls approved for widespread use increased male calf value for beef production. This increase ranged from £23 to £49 for Angus, £23 to £59 for Hereford, £22 to £76 for Limousin, £25 to £75 for Simmental, £55 to £61 for Belgian Blue, and £45 to £87 for Charolais sired calves. Calves from the best Angus bull were more valuable than those from the poorest bulls of all other breeds except the Belgian Blue. At the top of the scale the male calves from the best Charolais bull were about £10 more valuable than those from the best Simmental and Limousin bulls which were similar. These in turn were £15-£20 more valuable than the calves from the best Hereford and Belgian Blue bulls which in turn were about £10 more valuable than the calves from the best Angus bull. At the extremes the calves of the best bull (Charolais CF44) were worth about £65 per head more than those of the poorest bull (Angus CUO).

GENETIC MERIT OF SUCKLER COWS

Suckler cows should be of moderate size and should produce a calf of high weaning weight every year. Due to hybrid vigour, crossbred cows are superior to purebreds for suckling. Compared with purebreds, crossbreds have earlier puberty, better fertility, shorter calving interval, better calf survival and better calf growth rate. In a large scale US experiment (Cundiff, Gregory and Koch, 1982), crossbred (Hereford x Angus) cows were compared with purebred cows (Hereford and Angus) both rearing calves from the same sires. Weaning weight was 23 kg (15%) greater per cow exposed to breeding for the crossbred cows than for the purebreds. There were two components to this superiority. Two-thirds of it was due to an increase in the calf crop weaned reflecting better overall fertility in the crossbred cows. The remainder was an increase in weaning weight, reflecting higher milk production by the crossbred cows. This increased production from crossbreds over purebreds was due to heterosis or hybrid vigour. Increasing heterosis in the calf by using a sire of a third breed on crossbred cows further increases calf weaning weight. In the US study referred to above, the addition of the heterosis of the crossbred calves (8%) to that of the crossbred cows (15%) resulted in a 36 kg increase (23%) in the weight of calf weaned per cow of which about two thirds was due to the crossbred cows. Clearly, therefore, in suckled beef production the cow should be crossbred and the bull should be from a third breed.

Dairy cross cows

Certain beef x dairy cows are quite suitable as suckler dams because they are crossbred (heterosis), are of moderate size (low maintenance costs), and are good milkers (good calf growth rates). In terms of these criteria the more suitable beef x dairy suckler cow types are Angus x Friesian, Hereford x Friesian and Limousin x Friesian. Other continental x Friesians (e.g. Charolais x Friesians) are larger and have higher maintenance requirements. In the past, the most common suckler cow was the Hereford x Friesian. With the decline in the use of Hereford, and the increase in the use of continental breeds in dairy herds, Hereford x Friesian cows are now less readily available and the closest continental cross in size is the Limousin x Friesian. These two breed crosses were compared in an experiment at Grange.

TABLE 7.
Comparison of progeny Hereford x Friesian (HF) and Limousin x Friesian (LF) suckler cows.

	Males+		Females	
Weights (kg)	HF	LF	HF	LF
Birth	45	44	41	41
Weaning	329	338	288	292
Slaughter	610	620	545	547
Carcass	345	360	296	299
Kill-out (g/kg)	566	579	541	544
Carcass gain (g/d)	721	755	476	483
Conformation	3.8	3.7	3.2	3.2
Fatness	3.5	3.2	4.2	3.7

+ Reared as young bulls

Drennan, M.J. (personal communication)

Mean cow liveweight throughout the year was 16 kg (507 v. 523 kg) greater for the Limousin cross cows. There was very little difference between the two breed types in the performance of their female progeny (Table 7), but when the males were reared as young bulls where they had the opportunity to express their full growth potential, the Limousin cross progeny were 15 kg carcass weight heavier. This was mainly due to a better kill-out for the progeny of the Limousin cross cows rather than to a better growth rate. Carcass fat score was 0.3 (males) and 0.5 (females) lower for the Limousin crosses indicating that they could be taken to a greater weight than the Hereford crosses without becoming overfat. In summary, therefore, substituting a Limousin x Friesian for a Hereford x Friesian suckler cow would increase mean cow liveweight by about 3%. However, carcass output per cow would also be increased by about 3% at the same age and carcass quality would be better. The progeny of the Limousin cross cows could also be taken to a heavier weight, thereby further increasing carcass output per cow.

Sources of suckler herd replacements

The breeds of sire used on dairy cows are about 50% Friesians, 20% early maturing beef breeds, 10% Limousin and 20% other continental. Thus, the number of beef x dairy heifers suitable as suckler herd replacements (early maturing plus Limousin crosses) is about 150,000 in total. Inevitably, some of these are slaughtered as maiden heifers for beef so in practice not more than about 100,000 suckler herd replacements can come from the dairy herd annually. Since the suckler herd requires up to 200,000 replacements annually, at least half of these (100,000) must come from within the suckler herd itself. Indeed, to minimise disease risks and simplify management, many farmers prefer to replace from within, rather than buying-in. This raises the question of how replacement heifers with the desired attributes of heterosis, milkiness, and moderate size can be produced within a suckler herd where the main objective must be the production of high quality meat animals.

TABLE 8.
Comparison of dairy cross and upgraded continental suckler cows.

	Dairy cross+	Upgraded++
Cow liveweight (kg)	598	695
Calf birthweight (kg)	48.6	50.6
Milk yield (kg/day)	12.2	7.9
Calf growth rate (kg/day)	1.17	1.08

\+ Mix of Hereford x Friesian and Limousin x Friesian
++ Charolais

Drennan, M.J. (personal communication)

Where an existing crossbred cow herd is being mated to a terminal sire of one of the large continental breeds (e.g. Charolais), retention of the heifer progeny for breeding will ultimately result over a few generations in cows which are almost pure bred and which are quite large. Such cows (upgraded Charolais) were compared with Hereford x Friesian cows in an experiment at Grange (Table 8). Mean cow liveweight was about 100 kg heavier for the upgraded Charolais but their milk yield was only two-thirds (7.9 vs. 12.2 kg/day) that of the dairy crosses. Consequently, their calf growth rate was lower (1.08 v. 1.17 kg/day) during the suckling period and weaning weight was 20 kg lower. Although not evident in this experiment, later puberty and lower fertility would also be expected in the upgraded Charolais cows. While the superior genetic potential of the upgraded Charolais progeny would manifest itself in a higher post weaning growth rate and superior carcass merit at slaughter, this may not be sufficient to compensate for the higher maintenance requirement and poorer fertility of the dams and the poorer pre-weaning growth rate of the calves.

Where replacements are kept from within the herd, ideally they should have the desired suckler cow attributes (heterosis, milk, moderate size). This could be achieved by criss-crossing two beef breeds one of which is of moderate size and one of which has reasonable milking ability. Two such breeds are the Limousin (moderate size) and the Simmental (milkiness). Then, any of the other large breeds (Charolais, Belgian Blue, Blonde d'Aquitaine) can be used as a terminal sire thus maximising heterosis in the calf and ensuring good calf growth rates both before and after weaning, and good carcass quality.

Where the existing herd is beef x Friesian, replacements could be produced by using a Limousin AI bull on 40%-50% of the cows. In genotype, the resultant progeny would be 50% Limousin, 25% beef and 25% Friesian (the 25% beef could also be Limousin giving 75% Limousin). Such animals would maintain heterosis for reproductive traits and milking ability and would still be of moderate size. To produce the next generation of replacements, these would be crossed with a Simmental AI bull giving heifers which would be 50% Simmental and 50% other. These in turn would be crossed with Limousin and so the genotype of the herd would fluctuate between about two-thirds Simmental plus one-third Limousin and two-thirds Limousin plus one-third Simmental.

Where AI cannot be used, an effort should still be made to maintain heterosis in the suckler cow herd. This could be achieved by rotational use of a different breed of bull every few years when the bull is replaced. Unfortunately, this involves some compromises in both cow and progeny potential but judicious selection of the breed mix should ensure good overall herd performance .

In summary, using replacements from the dairy herd permits the use of the best beef bulls on all the suckler herd thereby maximising the value of the calves or beef produced. However, the dairy herd can provide only about half of the replacements required by the suckler herd, so producers must provide up to half of their own replacements. Suitable replacements can be produced by a strategic cross breeding programme based on the use of selected AI sires from the appropriate breeds on 40-50% of the herd. Alternatively, where AI cannot be used, heterosis can be maintained by rotational use of a different breed each time the bull is replaced.

CONCLUSIONS AND RECOMMENDATIONS

1. The National Cattle Breeding Authority should be established and functioning as quickly as possible. On-farm recording followed by performance and progeny testing of the commercially important beef breeds should be expanded in a rigidly integrated breeding programme. Superior bulls must be used to produce the next generation of breeding stock and inferior bulls must not be used for breeding.
2. Because of the small pedigree herd size and the lack of genetic linkages between herds, it will not be possible to produce EBVs for all pedigree bulls. Nevertheless provided the level of accuracy is reasonable, EBVs should be produced for as many pedigree bulls as possible. This would facilitate producers who are not using AI to identify and purchase genetically superior bulls. As is currently the case in Britain, EBVs would increasingly determine the price of pedigree bulls which in turn would lead to breeding programmes in pedigree herds designed to improve EBVs. Thus the generation of EBVs would itself act as a catalyst for increased genetic progress.
3. Every effort must be made to ensure that the current and future cattle identification systems are used in such a way as to contribute to genetic progress. With accurate and reliable records, at least a proportion of commercial animals could contribute genetic information. A huge source of potential genetic improvement will be wasted if the data from commercial cattle cannot be used.
4. The international trade in semen (and also in embryos and breeding stock) has contributed enormously to the genetic improvement of dairy cattle, particularly in Ireland. While similar progress is not possible in beef (because of the multiplicity of breeds, absence of genetic linkages between countries etc.), nevertheless the Irish beef industry would benefit greatly if it could avail of semen from the genetically superior animals being identified through much larger and more sophisticated breeding programmes abroad. This would require the testing of bulls in a number of different countries using internationally agreed and uniform evaluation criteria. From this conversion formula could be derived which would allow the conversion of breed-

ing values from one country to another. This would permit objective comparisons of bull ratings across countries.

5. There are large genetic differences both between and within breeds. The between breed differences have been widely recognised and exploited by producers but the within breed differences have not. This should be the next area of progress. Genetically superior bulls of all breeds are available through AI and it will be possible to identify genetically superior bulls for natural service when EBVs are produced. Producers must become more aware of the genetic differences between animals and ways must be sought of passing on the information on genetic merit from calf to weanling to store to finishing producer. This would facilitate pricing on the basis of genetic merit.
6. There should be a definite replacement policy in suckler herds. Replacements may come from outside the herd as beef x dairy heifers or as specially bred beef x beef heifers. Where replacements are produced within the herd they should have heterosis, good milking ability and be of moderate size. This can be achieved by criss-crossing 40%-50% of the herd with selected AI bulls of appropriate breeds. The remainder of the herd should be bred to a terminal sire breed to maximise beef output and carcass quality. Where AI cannot be used rotating the breed of bull can go some way towards ensuring heterosis and some other desirable attributes in the replacement heifers.

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Developments in the Australian Beef Industry

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1. Introduction

The Australian red meat industry commenced in January 1788, when the two Africander bulls, six cows and 44 fat-tailed sheep imported from the Cape of Good Hope by Governor Phillip arrived in Sydney. History records that five months after the landing, only one sheep was alive and all of the cattle had strayed when their convict keeper fell asleep! Surprisingly the lost cattle were recovered seven years later, when it was found that they had multiplied to a herd of 60.

From this very modest beginning, livestock numbers in Australia have increased to 26.2 million cattle, including 2.8 million dairy cattle, and 121 million sheep, producing beef and sheep meat worth almost $5 billion annually. (In August 1996, an Australian dollar was equivalent to 0.49 Irish punts). Beef exports alone are worth $2.85 billion per year. Although not the largest producer, Australia is now the largest net exporter of beef in the world and the second largest exporter of sheep meat.

Sheep in Australia are kept primarily for wool production, and of the 730,000 tonnes of wool (greasy) produced annually, 65% is exported for a return of some $4 billion. Sheep numbers are currently the lowest for almost 50 years because of the depressed world wool market. The prime lamb industry is virtually a 'by-product' of the wool industry, and is based on 'first-cross' ewes (Border Leicester x Merino) mated to a terminal sire breed, usually Dorset or Poll Dorset. In 1995, lamb and mutton production in Australia was valued at $833 million.

Table 1:
Australian Meat Production and Exports, 1995 (AMLC). (Thousand tonnes carcase weight)

	Production	Exports
Beef and Veal	1719.5	1104.6
Mutton	292.2	209.6
Lamb	255.1	55.1

Australia is a large country with a land area similar to that of north America, but vast areas of the continent are unproductive due to inadequate rainfall or low soil fertility. Livestock are produced in production environments ranging from the tropical summer rainfall areas of northern Australia to the temperate, winter rainfall zone of southern Australia. Livestock producers receive no government subsidies, and must contend with the effects of climatic and environmental extremes. Various forms of government assistance in times of drought, bushfire and flood are rapidly being phased out

With a population of only 19 million people, Australia is heavily dependant on exports, and livestock producers are also exposed to the vagaries of world markets. The beef industry is currently suffering a serious downturn due to depressed prices on the Japanese market. This has occurred primarily in response to massive over-production in the United States, resulting in intense competition with Australia for market share. Problems have been exacerbated by the strength of the $A, high grain prices in Australia and reduced beef consumption generally associated with the British 'mad cow disease' scare.

Almost half of the national cattle herd, but very few sheep, are now run in the tropical and subtropical regions of northern Australia. Over the past 20 years, Bos indicus breeds of cattle have largely replaced British breeds in these regions because of their heat tolerance, tick resistance and capacity to utilise low quality roughage. The beef industry in northern Australia is characterised by large herds (1,000 breeding cows is considered necessary for a viable family operation) extensively managed on very large properties (2,000 to 100,000 ha or more, depending on location). Historically these herds have produced large quantities of low grade manufacturing beef for the American Hamburger trade. Over the past decade however, both herd productivity and product quality has been increased significantly as the result of improved breeding and management, and improved pastures.

With a temperate climate and more reliable rainfall, conditions in southern Australia are more favourable for high quality pasture production, and livestock are managed more intensively on smaller properties (around 500 ha). Beef cattle are usually run as a sideline to a sheep or cropping enterprise, and the average herd size is about 134 head. British and European beef breeds and their crosses predominate, and are used to produce high quality pasture fed beef and as a source of feeder cattle for feedlots throughout Australia. Perennial ryegrass and white clover pastures are grown in the higher rainfall areas, but much of southern Australia has been sown to phalaris, cocksfoot and subterranean clover. Pasture productivity is currently well below potential.

As the production environment and nature of the beef industry in northern Australia bears little resemblance to that in southern Australia, and is far less relevant to the situation in Ireland, most of the technical information presented in this paper relates to the beef industry in southern Australia.

2. Structure of the Australian Beef Industry

Planning, Policy Setting and Industry Development

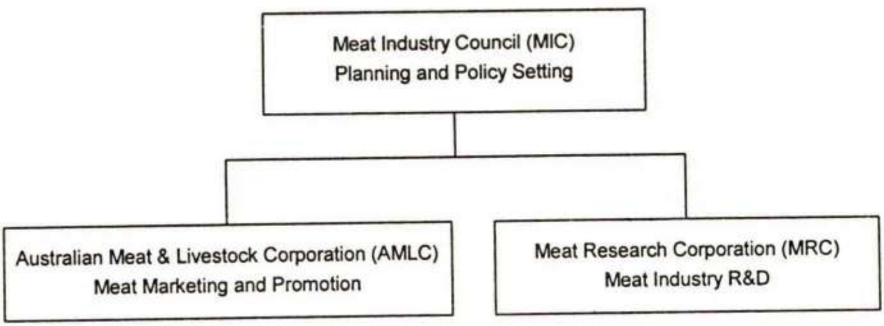
The Commonwealth Government's Meat and Livestock Industry Act (1995) established the Australian Meat Industry Council (MIC) to:

- develop the vision and strategic direction for the industry
- formulate broad industry policy (particularly across sectors)
- approve strategic plans for meat marketing, promotion and R&D
- set the funding levels for industry activity

• evaluate the performance of industry
• develop directions for industry self regulation
• resolve issues which run across industry sectors

The MIC board is comprised of 17 members representing all major sectors of the industry, including cattle and sheep producers, feedlotters, export and domestic abattoir operators, retailers (butchers and supermarkets), the federal government and the meat industry employees union. A 'Meat Industry Strategic Plan' developed by the MIC earlier this year will be implemented mainly through the activities of the Australian Meat and Livestock Corporation (AMLC) and the Meat Research Corporation (MRC). The AMLC is responsible for the marketing and promotion of meat both on the domestic and export markets, and the MRC establishes priorities and manages the funding of research and development (R&D). The MRC is currently finalising its Corporate Plan comprised of 17 'Key programs' designed to address the issues identified in the Meat Industry Strategic Plan.

Figure 1: Agencies Responsible for Meat Industry Development.



Meat industry R&D in Australia is funded by levies on livestock producers and meat processors, matched by an equal contribution from the Commonwealth Government. Last year the MRC managed a budget of some $51 million.

Over the past decade, a more systematic and thorough approach to planning R&D has been adopted by the meat industry. In 1986 the MRC implemented the first of a series of 'Five Year Plans' designed to maximise returns to the industry investment in R&D. Prior to the completion of the first plan, a comprehensive 'Research and Development Investment Study' was conducted as the basis for the second 'Five Year Plan', which commenced in 1991. An on-going industry auditing process is now being considered as a means of benchmarking progress and identifying industry strengths, weaknesses and opportunities.

All levy payers now have an opportunity to contribute to industry planning and the identification of R&D priorities through the various organisations represented on the MIC board, and through MRC advisory committees. The MIC and the MRC use a range of techniques to assess opportunities and industry R&D needs. Consultants and market analysts are engaged to conduct international benchmarking studies and to collect and analyse data from around the world. Staff are sent overseas on 'fact finding missions' and to identify new technology which may have application in Australia. Extensive consultation with industry occurs at a variety of levels, from the 'Annual General Meeting' through to workshops and seminars on specific subjects and invited submissions. All new R&D project proposals are subjected to a rigorous benefit-cost analysis and scrutiny by industry through 'Technology Transfer Advisory Groups', prior to funding.

In the past, the MRC has invited research organisations to submit R&D proposals for their consideration on an annual basis, and a significant proportion of the total MRC budget has been allocated to these submitted projects. Although this practice continues, the emphasis now is on commissioned R&D that addresses industry priorities identified in the strategic plan. This year for example, only 2% of the budget ($ 1 million) will be available for submitted projects.

Production Sector

Most beef in Australia is produced from cows kept exclusively for beef production. The majority of the calves born to the nation's 2.8 million dairy cows, that are surplus to dairy industry requirements, are slaughtered for veal production at less than 2 weeks of age. A very small 'pink veal' production system in which dairy/beef calves are artificially reared and lot fed for 20 weeks before slaughter and export to Europe, is struggling to become established in the face of high production costs.

Australia has vast tracts of land suitable only for grazing, and the meat industry has therefore always been pasture based. In southern Australia, the cost of pasture dry matter production is in the vicinity of $25/tonne, whereas in recent years, the cost of feedlot rations has varied from $130 to $220/tonne of dry matter.

Despite this, Australia has had a small feedlot industry since the late 1960s, located mainly in northern Australia. In response to the increased demand for grain-fed beef since the liberalisation of the Japanese market in 1988, the industry has grown rapidly to the current capacity of 825,000 head. Last year, 82% of cattle in feedlots were fed for the Japanese or other export markets, but the demand for grain-fed beef on the domestic market, particularly for use by the hotel restaurant trade, is also expected to grow.

In formulating feedlot rations, the aim is to maximise feed intake and liveweight gains, and to minimise health problems and digestive upsets, at the least possible cost. Key ingredients are:

• Roughage or fibre, which is required to maintain normal rumen function. This requirement conflicts with the need to maximise the grain component of the diet to achieve high growth potential, but the risk of acidosis and severe digestive upsets is greatly increased when the proportion of roughage in the diet is less than 20%.

• Energy, which determines growth rate. For rapid growth, steers under 12 months of age need a ration containing 12 megajoules (MJ) of metabolisable energy (ME) per kilogram of dry matter, and yearling cattle need 11 MJ/kg.

• Protein is essential for growth, and to maintain health and appetite. Young cattle need more protein than older cattle, and feedlot rations contain 11 to 15% crude protein, depending on the age and weight of cattle being fed.

• Minerals are required to maintain feed intake, health and feed conversion efficiency. The ratio of calcium to phosphorous is particularly important for feedlot cattle, as grain contains high levels of phosphorous but low levels of calcium. Extra calcium is therefore included by adding agricultural limestone to the ration at the rate of 1%. Depending on the amount of protein in the diet, extra sulphur may also be required, and salt is normally included at the rate of 0.5 to 1% to provide sodium, stimulate appetites and reduce urinary problems.

• Trace minerals are necessary for enzyme function, protein transport, blood composition and for the action of rumen microbes and vitamin synthesis. These are normally provided by using commercially available 'premix'.

• Vitamins are also essential to maintain the health of feedlot cattle, which have a daily requirement for the three fat soluble vitamins A, D and E. These are also provided in a commercial 'premix'.

Feedlot rations in northern Australia are based on sorghum, barley, maize (silage and grain), cottonseed meal and lupins, whereas in southern Australia, wheat, barley, triticale, lupins and peas are the main ingredients. Rations are commonly comprised of up to 80% processed grain, 15 to 20% roughage and a 'premix' of minerals, vitamins and ionophores and buffers to reduce the risk of acidosis. The feedlot industry currently competes with the milling and brewing industries for wheat and barley and there is considerable interest in the establishment of a stock feed industry based on new high yielding varieties of red wheat.

Because of their superior carcase characteristics and greater propensity to produce marbled meat, the feedlot industry has a clear preference for British beef breeds (particularly Angus and Shorthorn) and Murray Greys (a composite breed developed in Australia from Angus and white Shorthorns) in meeting the stringent quality requirements of the Japanese grain fed beef market. The potential to increase growth rate and carcase yield by using European breeds is now widely recognised however, and European by British cross-bred cattle are commonly fed for markets where marbling is not required (such as the domestic and Korean markets).

In southern Australia, beef calves are typically weaned at 8-11 months of age and 240 to 300 kg liveweight. Depending mainly on breed, fatness and seasonal and marketing conditions, these calves may then be:

- slaughtered immediately for the domestic supermarket trade
- transferred to a feedlot and fed for the domestic market
- grown out and finished at heavier weights on pasture for either domestic or export markets

- grown out at pasture to a heavier feedlot entry weight (typically 450-500 kg) prior to feeding for export markets.

Approximately 60% of slaughter cattle in southern Australia are still sold through saleyards, normally by liveweight auction after pre-sale weighing. Saleyard throughputs are declining however, in favour of modern, more objective direct marketing systems, including various forms of 'over the hooks' selling. This trend is expected to continue as more producers recognise the potential to improve their returns by breeding and managing cattle to accurately meet market specifications, and then using marketing systems in which price is determined by objective assessment of carcase weight and quality.

A similar trend is evident in the marketing of store cattle and feeder steers. At present, over half of these cattle are sold by auction through saleyards, and the majority are not weighed but simply sold on a per head basis. However, changes to store cattle marketing are being driven by feedlot managers, who are now well aware of very large differences in performance between lines of cattle from different properties. Feedlots are now showing a clear preference for purchasing cattle direct from farms, and particularly from producers who are able to supply reliable information about the genetic potential and health of their cattle.

The declining role of saleyards in the marketing of both slaughter and store cattle is also related to the higher cost of saleyard selling, the stress associated with the extra transport and handling of stock through saleyards, and the inability of saleyards to provide 'feedback' to producers on the true quality of their cattle.

Farmers throughout Australia face rising costs, record levels of farm debt and declining terms of trade. Last year and before the current downturn, the Australian Bureau of Agricultural Resource Economics reported that over the 3 years to 1995, 71% of beef enterprises in Australia were not profitable. Other studies have demonstrated enormous differences in profitability between beef herds operating in similar production environments (-\$29 to \$296 per hectare in southern Australia), with larger herds and improved management practices being associated with greater profitability. There is evidence to suggest that herds of less than 200 cows are no longer viable in southern Australia. Large numbers of producers have left the industry in recent years, and many of those remaining now rely on off farm income to survive. Further 'rural adjustment' is inevitable.

In southern Australia, 'livestock equivalent' systems are used to compare the feed requirements of different classes of stock, and livestock enterprises in different production environments. The 'Dry Sheep Equivalent' (DSE) system is widely accepted, where a 'dry sheep' is a non-pregnant and nonlactating two year old sheep weighing 45 kg and maintaining its present weight. Thus for example, a dry cow weighing 500 kg is rated at 7 DSE, while the same cow lactating and with a 3 month old calf at foot is rated at 15 DSE. Average beef cattle production costs per DSE in southern Australia are shown in Table 2, and average prices received for cattle and gross margins are shown in Table 3.

Processing and Wholesale Sector

There are 111 export abattoirs in Australia, and approximately 140 abattoirs producing solely for the domestic market (domestic abattoirs).

The export processing sector throughout Australia is regulated by the Australian Quarantine and Inspection Service (AQIS)7 which is responsible for

Table 2:
Beef Cattle Enterprise Costs per DSE in Southern Australia, 1995
(Monitor Farm Study)

	Average ($)	Highest ($)	Lowest ($)
Animal health	0.70	2.63	0
Contract services	0.10	0.60	0
Supplementary feed and agistment	6.92	14.28	0.31
Pasture costs	1.88	2.61	0
Freight and cartage	0.15	0.45	0
Casual labour	0.02	0.22	0
Sundries	0.08	0.48	0
Total excluding selling costs	9.85	17.64	1.66
Selling costs	0.86	2.26	0
Total including selling	10.71	19.47	2.53

Table 3:
Beef Cattle Prices and Gross Margins in Southern Australia, 1995
(Monitor Farm Study)

	Average ($)	Highest ($)	Lowest ($)
Young Cattle prices#			
cents/kg carcase weight	237.4	248.6	214
$/head	427	498	342
Cull cow prices+			
cents/kg carcase weight	186.3	191	179.5
$/head	428	497	361
Stocking rate (DSE/ha)	11.2	20.9	3.7
Gross margin			
per DSE	$7.25	$16.55	$-2.04
per hectare	$83	$296	$-29

Young cattle under 200kg hot standard carcase weight
+ Cows 201-260kg hot standard carcase weight

monitoring food safety and hygiene standards. AUS-MEAT, the national authority for the uniform specification of meat, carcases and livestock, sets standards for and monitors product description in export (compulsory) and domestic (voluntary) abattoirs. Abattoirs slaughtering beef cattle for export are required to meet different standards, depending on the country of destination, in terms of plant, equipment and management practices in order to maintain their export registration. Export abattoirs normally operate as exporters, and as such, must obtain licences and entitlements from the AMLC for export to different overseas markets. Most export abattoirs also supply meat to the domestic market. Domestic abattoirs are regulated by State Meat Authorities, and may on a voluntary basis become accredited under AUS-MEAT.

All export and some domestic abattoirs incorporate their own boning rooms. In recent years, with the rapid expansion of the hospitality and food service industry and the decline in the number of butcher shops, there has been a move towards centralised boning. The number of independent boning rooms has also increased.

International benchmarking studies have demonstrated that processing costs in Australia are considerably higher, and in some cases, almost double that of our major competitors (notably the United States and New Zealand). Australia has surplus processing capacity with many out-dated and inefficient plants still in operation and there is little doubt that failure to invest in modern plant and equipment is a contributing factor. Similarly the high cost of the on-line inspection service contributes to higher processing costs. The efficiency of abattoir management is often questioned, but high labour costs and poor industrial relations has long been a serious issue. Most abattoirs, under pressure from the Australian meat workers union, still work under a 'tally' system, which effectively means that they only operate for a few hours each day. By contrast, abattoirs in the United States and New Zealand are commonly working two shifts, enabling far more effective use of plant and equipment.

Replacement of the on-line inspection service provided by AQIS with a system of industry self regulation based on 'Hazard Analysis and Critical Control Point' (HACCP) and quality assurance principles is seen as an important mechanism for reducing the cost of processing meat in the future.

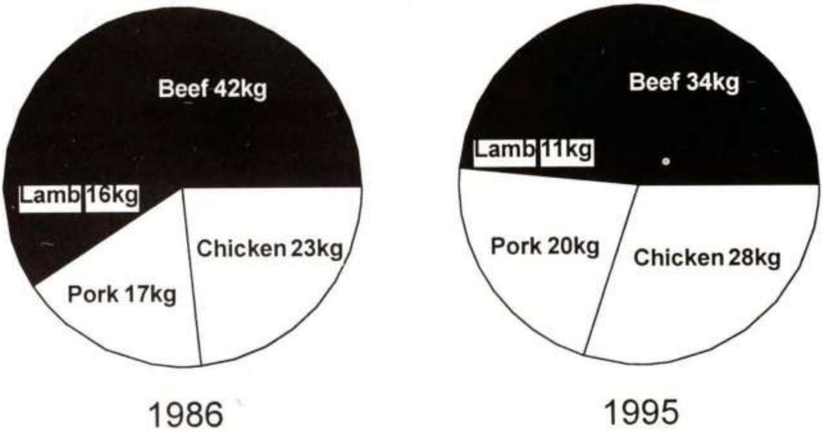
Australian meat processors have also recognised the need to adopt brand name marketing, and many are now working to establish their own brands on both domestic and export markets. Product brands are a particularly important component of marketing strategies in Japan, and individual meat company brands are being used in conjunction with the already well accepted generic 'Aussie Beef' brand.

Retail Sector

In the past, red meat in Australia has been sold mainly through an extensive network of butcher shops, but in recent years, the proportion of meat sold through supermarkets has increased to 37% nationally (up to 70% in some States). Community pressure for extended trading hours and the convenience of 'one stop shopping' at supermarkets has forced the closure of many butcher shops, and this trend is expected to continue. The reluctance of many butchers to adapt to changing consumer requirements has possibly also contributed to the demise of some butcher shops.

As indicated in Figure 2, the per capita consumption of red meat in Australia has also declined over the past decade, in favour of pork and chicken. Concerns about the relationship between saturated fat intake and heart disease have been

Figure 2: Per capita consumption of meat in Australia (kg)



partly responsible, and the industry has attempted to counter this by actively promoting the virtues of lean red meat as a healthy source of highly digestible protein and iron. The increased demand for 'convenience' foods and variability in the eating quality of beef are also likely to be contributing factors.

As in other developed countries, the changing lifestyle in Australia has also contributed to the decline in red meat consumption, with important implications for meat retailers. With almost 70% of Australian women now in the workforce, and 58% of two parent families having both parents working, there has been a growing preference for meals involving little or no preparation. Money spent on 'dining out or fast food' has increased from 22% to 33% of total food expenditure over the past decade. Relative to other food industries, the red meat industry has been slow to adapt to the increased demand for 'oven ready' and takeaway food.

3. Markets for Australian Beef

Last year, 64.2% of total Australian beef and veal production was exported, and the major destinations are indicated in Figure 3. Exports to the EU accounted for less than 1% of total production.

Each market requires quite different types of beef, and for each market destination, a range of specifications are required to meet the needs of different segments of that market. Thus the domestic market, for example, has three main sets of specifications reflecting the needs of the local butcher trade, the supermarkets and the 'hotel-restaurant' trade. Similarly, the Japanese market has at least 8 sets of specifications for grain and pasture fed beef.

Market specifications are expressed primarily in terms of carcase weight and fat depth at the P8 (rump) site, but for most markets, butt shape, fat colour, meat colour, and dentition specifications must also be met. Specifications for the very high quality Japanese grain fed beef market also include marbling scores and minimum periods of feeding a ration comprised of at least 70% grain.

Figure 3: Destination of Australian beef and veal production by volume, 1995

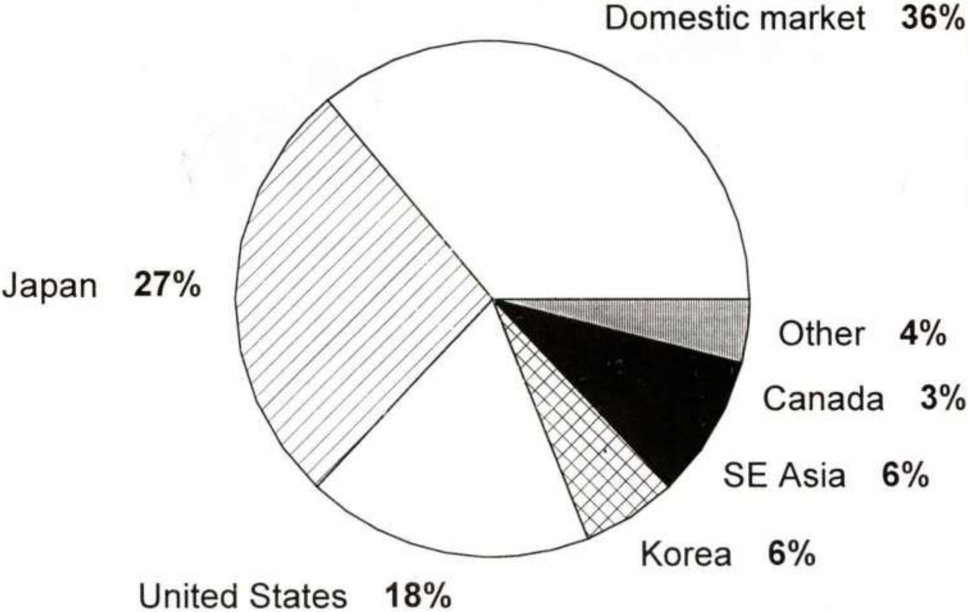


Table 4:
Basic Specifications for the Major Markets for Australian Beef.

DOMESTIC						
Butcher	140-180	4-8	0-3	1A- 1C	steer/heifer	0
Supermarket	180-240	5-9	0-3	1A-2	steer/heifer	0
Hotel/Restaurant	220-300	7-14	0-4	Fig. 1B-3	steer/heifer	0-4
EXPORT						
Japan						
Grain fed	320-400	8-26	0-2	Fig. 1B-4	steers	0-6
Pastured fed	300-400	7-25	0-5	Fig. 1B-4	steers	0-6
Korea						
Grain fed	220-340	13mm	0-5	Fig. lB-5	steers	0-6
(average over carcase)						
Pasture fed	180-280	5-12	0-5	Fig. 1B-5	steer/heifer	0-6

1. HSCW = hot standard carcase weight
2. Fat Colour is assessed on a scale of 0 (white) to 9 (yellow)
3. Meat Colour is assessed on a scale of 1 (pink) to 7 (very dark)
4. Animals showing secondary sex characteristics are not acceptable
5. Dentition (number of permanent incisor teeth)

Note that all markets have a requirement for a butt shape of C or better, on a scale of A (extremely heavy muscling) to E (very poorly muscled).

The Japanese grain fed market also specifies a marbling score of 2 to 3, on a scale of 0 (no marbling) to 6 (very heavy marbling).

The United States and Canada purchase predominantly low grade manufacturing beef from Australia, for which the only specifications are for a high percentage (90% or more) of chemical lean. General specifications for other important markets are indicated in Table 4.

Australia also has a small, but rapidly growing, live cattle trade. Last year, 510,000 head of cattle were exported, mainly to South East Asian feedlots. Australia competes with Ireland for a share of the Egyptian live cattle market; almost 20,000 head were shipped to that market from Australia in 1995.

Asian markets for both beef and live cattle are forecast to continue expansion to the year 2000, but Australian exports are expected to be restricted by intense competition from the United States in particular. Cuts to EU subsidies and the 'foot and mouth disease' status of South American countries are also likely to impact on the future level of Australian exports.

Specifications for the various beef markets are ultimately determined by the end user. Thus, for example, supermarkets in Australia engage market analysts to survey customers and to carefully monitor changes in consumer requirements. As a result, carcase weight specifications for supermarket trade cattle have increased from a maximum of 180 kg to 240 kg, and fat depth specifications have been reduced by at least 30% over the past 15 years.

4. Developments Over the Past Decade

The opening up of the Japanese beef market in 1988 was the catalyst for significant development within the Australian beef industry. Until that time, the United States market for predominantly low grade manufacturing beef was the principal destination for Australian beef exports. By contrast, the Japanese and other Asian beef markets require a very large volume of high quality grain and pasture-fed beef, and this has provided the incentive for industry to improve product quality and competitiveness. On-going financial pressure to increase farm productivity and community concerns about food safety, animal welfare and protection of the environment have also stimulated considerable change. As a consequence of these developments over the past decade, the Australian meat industry has commenced the transition from a commodity based industry to a customer orientated, sophisticated and highly competitive food industry. Much remains to be achieved, but a start has been made.

Feedlot Industry

Investment in the rapid expansion of the feedlot industry has probably been the most tangible consequence of the liberalisation of the Japanese market. Between 1988 and 1994, the industry grew at a rate of approximately 15% per year, and current Australian feedlot capacity is 825,000 head in feedlots ranging in size from 50 to 50,000 head. With high grain prices and depressed returns from beef in 1996, feedlot utilisation has fallen to 56% of capacity. There has also been a recent shift in focus from the Japanese market to the domestic market, where grain feeding is seen by some processors as a solution to problems with continuity of supply of consistently high quality beef.

National Product Description and Trading Language

The establishment of AUS-MEAT in 1987 is widely regarded as one of the most important initiatives in the history of the Australian meat industry. AUS-MEAT, the authority for the uniform specification of meat and livestock, was introduced to develop a national language for the description of livestock, carcases and meat, and to facilitate improved communication up and down the entire marketing chain. The two way flow of information between livestock producers and agents, processors, wholesalers, retailers and consumers is a central theme. Use of the AUS-MEAT language is compulsory in export but not domestic abattoirs. Although it was seen as the imposition of additional costs and was resisted by industry at first, it is now more widely accepted as being a key element in better marketing.

Since its inception, the AUS-MEAT language has evolved as new technology became available. In 1991 for example, the new 'chiller assessment' system was introduced for the assessment of marbling, meat colour, fat colour, the measurement of eye muscle area and rib fat depth and the estimation of lean meat yield. Evidence for the value of measuring pH as means of identifying unacceptably tough meat is becoming available, and it is likely that this too will become part of the AUS-MEAT language. Similarly, recent research in which video imaging technology has been successfully used for the rapid assessment of carcase quality and yield could result in the further refinement of the AUS-MEAT language.

The AUS-MEAT language is a description system, not a grading system. Australia does not have a grading system as such, although the matter is currently the subject of intense debate and two grading systems are under development by different industry groups. Until now, industry policy has been to encourage individual meat companies to use the AUS-MEAT language as the basis for their own product brands. However the alternate view, that consumers need a simple, uniform grading system to assist them with purchasing decisions, now seems likely to prevail.

Livestock and Meat Marketing

Consumers on both domestic and export markets have become more demanding in terms of meat quality requirements, and as a result, more stringent carcase specifications have been imposed. A major problem facing the Australian meat industry however is that there has been no effective mechanism for communicating these specifications to producers. As a result, the industry has not been successful in consistently meeting customer expectations. The AUS-MEAT language was introduced to help resolve this, but the fundamental problem has been the manner in which livestock are traded.

Detailed information on the requirements of different markets and livestock and meat prices both in Australia and overseas is readily available to producers and people servicing the meat industry in a plethora of AMLC publications. However, producers respond to clear 'price signals', not marketing publications, and these signals have not been a feature of the dominant marketing systems used in the past.

The majority of slaughter cattle in southern Australia have been sold by liveweight auction, where an average price (cents/kg liveweight) is paid for each 'lot' or group of animals. Although livestock agents draft animals on the basis of similar weight and body condition, there is no attempt to identify superior animals and price them accordingly. Vendors receive no information about their cattle other than the average liveweight and the average price. Having received no clear 'price signals' from the market, producers are unable to respond by altering their breeding or management systems.

To address this problem, the industry is steadily moving to adopt various 'value based trading' systems. Key elements of these systems are objective measurement of carcase weight, quality and sometimes yield, price related to this objective assessment and the feedback of information to the producer.

'Computer Aided Livestock Marketing' (CALM) was released to the meat industry in 1987 and incorporates the principles of value based trading. In this system, livestock for sale are assessed on farm by an accredited CALM assessor, who prepares a detailed description of the livestock and makes this available to potential buyers on the CALM computer network. During the designated sale period each week, registered CALM buyers throughout Australia can then participate in a computer auction', using their own personal computers to bid on the various lots on the basis of the description provided. Vendors receive feedback on actual carcase quality after their stock are slaughtered. CALM now accounts for around 15% of sheep and 3% of cattle sold in Australia.

Other value based trading systems usually take the form of an 'over the hooks' transaction, with price determined according to a 'quality grid', such as the example provided in Figure 4. This grid provides the premiums and discounts in cents per kg for Yearling (0 dentition) male or female cattle. The base price is represented in the grid as a zero; this is adjusted weekly and is readily available from the abattoir. Conditions of sale specifying acceptable breed types and trading terms accompany the quality grid.

Figure 4:
A Quality Grid Currently Used in Southern Australia.

HSCW (Kg)	FAT CLASS (mm)						
	0-2	3-5	6-10	11-12	13-15	16-17	18-27
16--170	20	-15	-10	-10	-15	-20	-40
170.1-180	-15	-10	0	0	-10	-15	-40
180.1-200	-10	-5	+5	+5	-5	-10	-40
200.1-220	-10	-5	+5	+5	-5	-10	-40
220.1-230	-15	-10	0	0	-10	-15	-40
230.1-240	-20	-15	-10	-10	-15	-20	-40
240+	-25	-20	-15	-15	-20	-25	-40

ButtShape	A	B	C	D
	+5	+5	0	-15
Meat Colour	1A	1B	1C	2 Plus
	+5	+5	0	0

In the southern Australian environment where approximately 75% of total annual pasture dry matter production occurs in the 3 spring months, continuity of supply of pasture-fed beef and lamb has always been a problem. To encourage out of season production, over the past 3 years processors have offered forward contracts to producers for the delivery of both beef and lamb to specification, during months of under supply. These contracts enable producers to 'lock in' to a satisfactory price some months in advance of delivery, giving them the confidence to incur the additional expense of 'out of season' feeding systems. Forward contracts also provide a means through which processors can accurately communicate their requirements to producers. Early experience with forward contracts has been extremely positive.

As a further means of improving the level of communication and building trust between the various sectors of the meat industry, the concept of 'strategic alliances' is now starting to be taken up. The 'Festival Alliance' established in southern Australia earlier this year is an example. In this alliance, 8 producer groups are supplying beef and lamb to specification to 4 domestic abattoirs, who are now supplying branded beef and lamb carcases to the 'Festival' chain of supermarkets, comprised of some 82 retail outlets. Customers are being offered a '200% guarantee' (product exchanged and money refunded if they are not satisfied), and they are being actively encouraged to provide feedback on the product. Retailers provide regular feedback to processors on the extent of compliance with carcase specifications. Processors purchase livestock over a quality grid, and producers receive detailed information about the quality and price of their livestock. Forward contracts with a choice of 4 pricing options are being offered to producers. In return for their commitment to the alliance, producers able to consistently meet specifications have 'preferred supplier' status, and receive preferential treatment when livestock are over supplied.

The ultimate objective is to develop marketing systems in which price is directly related to saleable meat yield and the eating quality of meat, of which in Australia, tenderness is by far the most important component. Recent research on the use of video image analysis to predict the carcase yield has been extremely promising, but the accurate prediction of tenderness remains elusive. Extensive research on the development of a 'tender tech' probe to measure tenderness on the kill floor has now been abandoned.

Consumer Perceptions of Meat Quality

The meat industry is confronted with two major challenges in this area.

The first is that the type of uncooked meat that consumers select is quite different to the type of meat they prefer to eat. In response to messages from health professionals about the potentially harmful effect of saturated fat intake, consumers generally prefer to purchase very lean cuts of meat with no visible marbling. Numerous studies have shown however that these same consumers prefer to eat meat from fatter animals, and with at least moderate levels of marbling.

The second issue is that although consumers prefer to eat beef over alternative meat products, they do not regard it as being reliable in terms of consistency of eating quality. By contrast, chicken does have a reputation for being reliable, and is often selected by consumers who would otherwise prefer to eat beef. Overcoming the unacceptable variation in product quality for both domestic and export markets will be the subject of a considerable research effort in future years.

Breeding and Genetics

A recently completed study of the performance of steers fed for the Japanese grain-fed beef market has concluded that a sustained and co-ordinated approach to improving feeder steer genetics is needed in Australia. Almost 5000 steers produced from 371 beef sires of 6 breeds and breed crosses were evaluated in terms of feedlot growth, carcase quality and yield. Significant breed differences were found in all traits, but breed alone was no guarantee of performance. Within breeds, the difference in commercial performance between the top and bottom 5% of individual steers, vendor lines and sire progeny groups was \$270, \$130 and \$120 respectively when fed for 200 days.

Breedplan, a world class genetic evaluation system based on 'Best Linear Unbiased Prediction' (BLUP) technology, was released to the industry in 1985 and is now the main avenue for the genetic improvement of beef cattle in Australia and New Zealand. Since its introduction, Breedplan has been expanded to include the 'estimated breeding values' shown in Table 5.

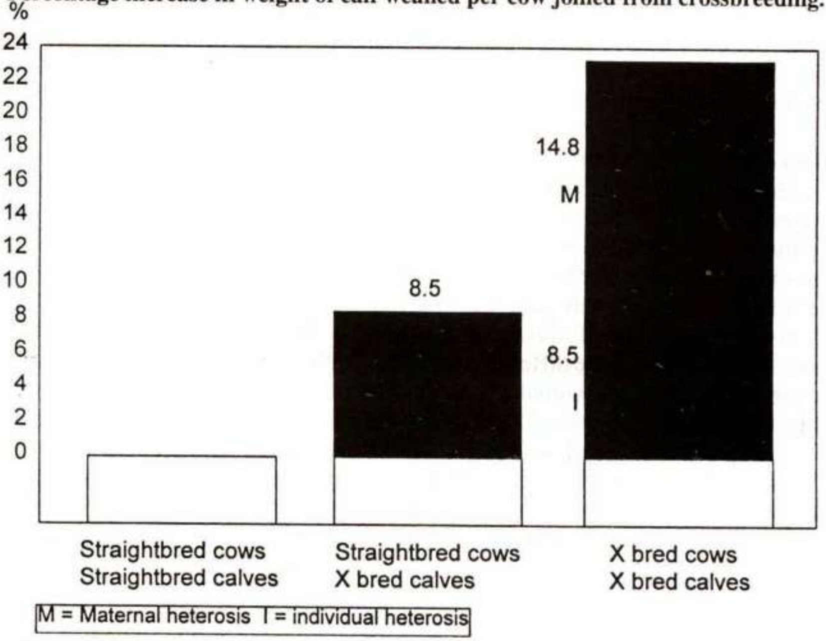
Table 5:
Breedplan Estimated Breeding Values

Weight	Fertility	Carcase
Birth weight (optional)	Scrotal size	Eye muscle area
200-day milk	Days to calving	Fat thickness
200-day growth	Gestation length	
400-day weight	Calving ease	
600-day weight 14		

After a relatively slow start due mainly to resistance to change within the stud cattle industry, Breedplan is now being used and actively promoted by 13 breed societies. Largely as a result of pressure from commercial beef producers wanting reliable information on sale bulls, some 1,500 mainly seedstock producing herds are now registered with Breedplan. A recent evaluation has found that herds using Breedplan technology are producing calves up to 10% heavier at the same age than they were before implementing the genetic improvement program, giving a benefit-cost ratio of 15: 1 .

The potential to increase productivity through the use of crossbred females (Figure 5) has been well known for over 20 years, but prejudice against crossbred cattle and concern about the complexity of crossbreeding programs has inhibited the rate of adoption of this technology.

Figure 5:
Percentage increase in weight of calf weaned per cow joined from crossbreeding.



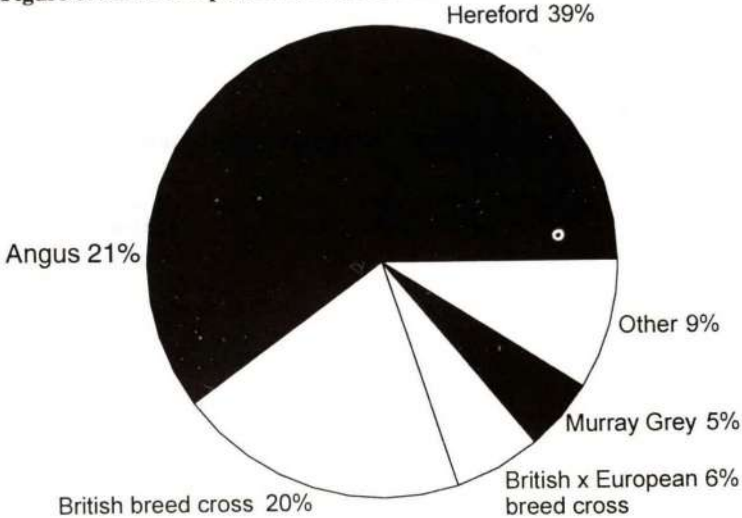
A four year comparison of the profitability of straightbred Hereford, Angus X Hereford and Fresian X Hereford cows mated to Hereford bulls for autumn calvings in southern Australia during the 1980's produced the results summarised in Table 6.

Table 6:
Average production and profitability for cows of different milking capacity

Stocking rate (cows/ha)		**0.9**	**1.3**	**1.7**
a)	Calf weaning rate (kg)			
	Hereford	287	252	236
	A X H	301	292	264
	F X H	334	308	268
b)	Calving rate (%)			
	Hereford	99	88	90
	A X H	99	93	91
	F X H	99	82	66
c)	Gross margins (S/ha)			
	Hereford	128	132	105
	A X H	143	165	143
	F X H	152	144	33

In recent years there has been a steady increase in the adoption of crossbreeding, as producers have recognised the need to increase productivity and adjust their breeding programs to target the requirements of different markets. In 1994, 33% of beef cattle in Australia were crossbred, and of these, 58% were Bos indicus x Bos taurus cross in northern Australia. Data for southern Australia in 1994 are summarised in Figure 6.

Figure 6: Breed composition of the beef herd in southern Australia, 1994



Approximately 65% of commercial beef producers in southern Australia are now practising crossbreeding with at least some of their cattle.

Pasture Productivity

Over the past 20 years, only 3-4% of pastures in southern Australia have been upgraded, and as a result, many pastures are dominated by unproductive species of low nutritional value. Research has highlighted the need to focus on:

- the introduction of improved species such as clovers and perennial grasses
- ensuring a high and balanced soil fertility status (particularly soil phosphorous level)
- ensuring that stocking rates are high enough to effectively utilise the extra pasture produced.

The relatively high cost of upgrading pastures (over $150/ha) combined with the risk of failure has been a major barrier to adoption, and numerous demonstration trials have been established in recent years to help overcome this. These trials have invariably demonstrated spectacular improvements in productivity, with stocking rates and gross margins/ha for upgraded pastures frequently double those for 'typical pasture'. There is little doubt that for the foreseeable future, the largest productivity gains to be made in southern Australian beef herds will come through upgrading pastures.

Out of Season Feeding Systems

The increased demand for high quality pasture fed beef for export markets and the requirement for branded product to be available all year round has focused industry attention on the related issues of continuity of supply and consistency of product quality. Forward contracts combined with cost effective pasture based 'out of season' feeding systems are seen as the means by which the southern Australian beef industry can increase the supply of suitable cattle during winter and early spring.

Historically hay and to a lesser extent grain have been the main supplements fed to cattle at pasture, but research conducted over the past 2 years has highlighted the potential for increased use of high quality pasture silage (Table 7).

Table 7:
Profitability of 'Out of Season' Feeding Systems in Southern Australia

	Average Daily Gain (kg/day)	No. Carcases Meeting Specifications	Profit ($/ha)
Control, pasture only	0.45	4/12	-$5.30
Pasture plus whole triticale fed daily	0.8	11/12	$45.32
Pasture plus ad lib hay and ad lib grain fed through a 'Waste Not' feeder	0.8	12/12	-$5.03
Pasture plus whole grain with virginiamycin fed once weekly, stocking rate 2.1 steers/ha	.69	10/14	-$7.74
Pasture plus whole grain fed through a 'Limit Lick' feeder	.86	12/12	$49.72
Pasture plus oats and 'Rumentek' fed daily	.81	11/12	-$33.00
Pasture plus whole grain with virginiamycin once fed weekly, stocking rate 1.5 steers/ha	.73	8/12	-$10.88
Autumn deferment using silage followed by winter grazing on Concorde ryegrass	.81	9/12	-$16.57
Pasture plus ad lib silage	.90	12/12	$112.57
Pasture plus rolled grain with virginiamycin fed once weekly	.73	12/12	$20.34

Virginiamycin is an antibiotic used to reduce the risk of acidosis in cattle being fed grain. 'Rumentek' is a feed supplement containing high levels of protected fat and protein.

Food Safety

Incidents involving contamination of meat with organochlorines (dieldrin and DDT), chlorfluazuron and veterinary chemicals, and isolated but extremely serious cases involving microbial contamination of meat around the world have focused consumer attention on the issue of food safety.

Australia has had a national property registration and compulsory tail tagging system in place since the early 1970's when the Brucellosis and Tuberculosis Eradication Campaign began. Both brucellosis and TB have since been eradicated from all but a few isolated properties in northern Australia, but the property identification and tail tagging system has been retained to facilitate the traceback to property of origin of carcases found to be contaminated or affected by disease. This, combined with abattoir monitoring, enables the Australian meat industry to respond to breaches in food safety issues that may occur.

Cattle in Australia commonly change ownership and may be grazed on a number of properties between birth and slaughter, and the lack of a national system for the permanent identification of cattle is a significant deficiency in existing traceback procedures. State and federal governments have agreed to establish a national permanent cattle identification and tracking system. Last year consultants were engaged to review the cost and feasibility of cattle identification systems currently available, including electronic devices, and to develop recommendations in consultation with government and industry. The consultants have since recommended a dual tagging system in which cattle would be permanently identified by the breeder with a whole of life 'birth tag' and, in addition, would be identified with a temporary transaction tag at the time of each sale or dispatch for slaughter. This system is now being field tested against an agreed set of standards, including a retention rate for permanent identification of at least 99% over 3 years. Four identification methods are being tested, including intra-rumen radio frequency capsules, metal tags, small plastic radio frequency ear tags and medium sized radio frequency plastic tags.

At this stage only one market, the EU, specifies that beef must not be produced from animals treated with hormonal growth promotants (HGP's). Although the EU is a very small market for Australia, a declaration system for the identification of HGP free cattle, using special pink ear or tail tags, was introduced in 1994. Legislation controlling the sale and use of HGP's has also, been introduced.

In July this year, a voluntary national 'vendor declaration' system was introduced, enabling producers to declare the chemical residue status of their cattle. Meat processors have strongly endorsed the system by indicating that they will not compete for sale lots without vendor declarations, and in the first few weeks of operation, the compliance rate at saleyards has been in excess of 90%. Cattle without declarations have been discounted by up to $100/head.

Animal Welfare and Environmental Considerations

In addition to food safety, community concern about animal welfare and environmental issues has increased dramatically over the past decade, and this is now reflected strongly in government policy.

By comparison with the intensive livestock industries where issues such as battery cages for laying hens and the tethering of sows have evoked a strong reaction, the cattle and sheep industries have generally not been targeted by the animal welfare lobby. Both state and federal governments have produced 'Codes of Practice' for the welfare of sheep and cattle, but the only significant issues to emerge have been drought and feedlot management. It is no longer acceptable to simply allow livestock to die due to drought, and producers are now prosecuted for failing to either provide adequate feed and water for livestock or having them humanely destroyed. The welfare issues in feedlots are mud in winter, provision of shade in summer and the identification and care of sick animals. In practice, most 'animal welfare cases' involving sheep or cattle occur on small 'hobby' farms where absentee owners or people without adequate animal husbandry skills are responsible for the care of animals.

Land degradation due to soil erosion and salinity, and water quality are now serious issues in Australia, and government spending on addressing these problems and promoting sustainable agricultural practices has increased. Rabbits have been responsible for massive environmental damage throughout Australia, and it is hoped that the recently released rabbit calicivirus will achieve effective biological control. In northern Australia, overgrazing by cattle is a major cause of soil erosion, and in southern Australia, the planting of deep rooted perennial pasture species and agro-forestry is being promoted to lower the underground water table and help to prevent soil salinity problems. Feedlots are also a sensitive environmental issue. State governments strictly regulate the location, design and operation of feedlots to prevent the contamination of soil and both surface and underground water with feedlot waste, and to avoid problems with air pollution (odour and dust).

Quality Assurance

The Australian meat and livestock industry is now moving to embrace a culture of quality, with all sectors now either developing or actually implementing quality assurance (QA) programs. Many are 'Hazard Analysis and Critical Control Point' (HACCP) based programs certified to the International Standards Organisation (ISO) 9002 standard.

From an overall industry perspective, food safety is of paramount importance, and QA is seen as the foundation on which to build consumer confidence in meat products. Some sectors have also been motivated by the need to meet community expectations in relation to animal welfare and protection of the environment, and to reduce the cost of government regulation.

Under criticism from the community in relation to animal welfare and environmental issues, the Australian Lot Feeders Association (ALFA) was one of the first organisations to adopt the principles of self regulation through QA, largely to avoid the burden of government controls. The ALFA/AUS-MEAT national 'Feedlot Accreditation Scheme' commenced operating in August 1995, and already 763 feedlots are accredited. There is a requirement that all grain-fed beef for export must be sourced only from cattle fed at accredited feedlots.

Meat processors are also moving to implement QA. The potential to reform the regulation of export abattoirs is constrained by the requirements of our overseas customers, but the domestic processing sector has begun to reduce costs by replacing traditional on-line inspection with QA. In 1993 the Victorian State government established the Meat Industry Act which provides for the implementation and auditing of QA programs in domestic abattoirs. Already two major domestic abattoirs have achieved ISO 9002 accreditation, and others are working towards this goal.

In 1995, the 'Cattlecare' on-farm QA program for beef producers was launched, and 'Flockcare' is currently under development for sheep meat producers. Cattlecare currently incorporates 15 key elements addressing the contamination of beef with chemical residues, carcase bruising and hide damage, but the program will be developed further to include other aspects of quality. Producer organisations are now moving to provide ISO 9002 certified third party auditing services for participating beef producers.

The 'Q Award', a HACCP based and externally audited QA program for retail butchers, was launched in May this year. The program includes advanced product handling techniques, a systematic approach to hygiene and food safety and improved methods for product display.

Other sectors of the industry, including livestock transporters and saleyard operators, are also beginning to develop QA programs.

5. Future Challenges Facing the Australian Meat Industry

By comparison with their counterparts in many other countries, Australian beef and lamb producers operate in an open market, without government subsidies. Their products must compete not only on international markets with red meat produced in other countries, but also with alternative sources of food protein, particularly pork and chicken meat. To remain viable in this environment, the industry must meet consumer expectations in terms of food safety, quality and consistency, and at a competitive price. Further structural change will also occur, with a move to fewer but larger and more efficient livestock enterprises and processing facilities.

The 'Meat Industry Strategic Plan' released by the Meat Industry Council this year recognises that despite past success, the profitability and competitiveness of the meat industry are currently not at acceptable levels, and that further change is urgently required. Future prosperity depends on the industry 'doing things better and differently', and the plan identifies strategic directions and actions for achieving this to the year 2001.

The overall aim of the Meat Industry Strategic Plan is to 'increase industry competitiveness and profitability in a sustainable way', and to achieve this, six strategic imperatives have been identified. These are:

1. Achieve 'best in class' marketing

To achieve food industry 'best in class' performance from enterprise and industry marketing and access activities.

2. Guarantee eating quality

To guarantee palatability to domestic consumers of beef and lamb.

3. Guarantee food safety

To guarantee food safety through a 'plate to paddock' quality assurance system.

4. More consistent supply

To achieve a consistent (quality and volume) and predictable supply of product that meets customer specifications at all stages of the production and marketing chain.

5. Facilitate structural change

To facilitate rationalisation and development of alliances that will achieve the optimal industry structure for international competitiveness.

6. Improve leadership and management

To achieve leadership in innovation and cost efficiency through improved management, training and a culture of partnership within enterprises and between industry sectors.

Rapid and substantial progress in all six areas will be required for a significant impact on profitability, and the Meat Research Corporation is now developing a comprehensive R&D plan comprised of 17 key programs to address all elements of the Meat Industry Strategic Plan.

Options for Cattle Farmers

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The current beef crisis will force many producers to examine their cattle enterprises and assess their options. The major challenge facing producers is to:

- maintain a viable stable income as best they can
- avoid significant deterioration in overall farm finances

This paper highlights some of the key issues a producer should consider and what advice Teagasc might give. The main points addressed are:

1. Lower versus higher stocking rate systems
2. Importance of farm efficiency
3. Which cattle system?
4. Borrowing capacity
5. Overall viability

ASSUMPTIONS

- The producer is already operating a relatively intensive system
- Adequate housing and facilities are available
- Costs, output and performance levels are generally based on the excellent level of efficiency in the Teagasc Management Data for Farm Planning 1996
- Premium rates are at 1996 levels. It is assumed that the Deseasonalisation Premium will be available for the immediate future.

1. LOWER VERSUS HIGHER STOCKING RATES

What are the merits of higher stocking versus lower stocking rate systems? This decision is primarily dependent on individual farm circumstances. In this paper the relative profitability of lower versus higher stocking rate is compared for a 40 ha. farm. It is assumed that the farmer is already operating a high stocking rate system and adequate buildings and facilities already exist for either option.

The lower and higher stocking rate systems are classified as follows:

Lower Stocking Rate:

- Physical stocking rate approximately 1.66 LU per ha. (1.5 ac./LU).
- EU stocking density less than 1.4 LU per ha.
- Eligible for maximum REPS payment
- Eligible for basic EU (Suckler cow and Special Beef) Premiums and Extensification and Deseasonalisation Premiums

Higher Stocking Rate:

- Physical stocking rate approximately 2.5 LU per ha. (1 acre/LU)
- EU stocking density 2.0 LU/ha. maximum
- Eligible for basic EU Premiums and Deseasonalisation Premiums
- Not eligible for Extensification Premium or REPS payments

Two systems of cattle production (Suckler to Beef and a non breeding system - Weanling to Beef) were compared using these criteria. Full details are given in Appendix 1 and 2. A summary table is presented below.

Table 1.1:
Income From Lower Versus Higher Stocking Rate Systems

	Steer Beef Price £ per kg Carcase			
	£1.80 (82p/lb)		£2.10 (95p/lb)	
System				
Suckler to Beef	Total	Per ha	Total	Per ha
Lower Stocking Rate	£12,990	£325	£16,130	£403
Higher Stocking Rate	£12,120	£303	£17,320	£433
Weanling to Beef Lower Stocking Rate	£12,193	£305	£15,554	£389
Higher Stocking Rate	£11.563	£289	£17,295	£432

The higher stocking rate systems are dependent on a high beef price to maximise income. With the lower stocking rate systems maximising support payments (Premiums and REPS) is crucial.

In a low beef price environment the lower stocking rate systems have significant advantages such as:

- Greater income stability (in the short term at least) if a higher proportion of income comes from support payments.
- Reducing stock numbers may facilitate a reduction in borrowings.
- Reducing winter feed costs, grazing costs and maximising individual animal performance at grass.
- Lower stocking rate systems are also more environmentally friendly.

Disadvantages include:

- If implemented, proposed changes in the Extensification Premium Stocking density levels will adversely affect the lower stocking rate option.
- For larger farms the capping of REPS payment at 40 ha dilutes the overall REPS income benefit per hectare.
- Participation in REPS involves commitment to a five year plan.
- Tax implications of destocking must be considered.
- Longterm implications of very heavy reliance on support payments.

Comment

Beef prices are likely to remain depressed for the forseeable future. It is clear that even intensive cattle farmers must assess the income implications of lower stocking versus higher stocking rate systems. The merits of either option will be unique to each farm situation and cattle system. In practice farmers may meet REPS and Extensfication Premium requirements with less change in stocking levels than shown here, depending on the ratio of overall area owned to adjusted area farmed.

Note: Lower stocking rate levels do not and should not imply a general lowering of efficiency standards. Key efficiency factors (e.g. cow productivity, animal performance, cost control) still apply. There is an even greater challenge to utilise grassland efficiently.

2. THE IMPORTANCE OF FARM EFFICIENCY

Cattle farmers face an enormous challenge if beef prices remain at their current levels. Production costs equal or exceed the current beef price in some systems. (See Table 2.1)

Table 2.1
Production Costs - Suckler to Beef System

Costs	Cost per kg Carcase (£)	(p/lb)
[1]Replacement/Mortality Charges	£0.11	(5)
[2]Variable Costs	£1.08	(49)
[3]Fixed Costs	£0.63	(29)
Total	£1.82	(83)

[1]Adapted from Teagasc Management Data for Farm Planning 1996
[2]Assumed to be £220 per cow

Scope for Efficiency Improvements

The Teagasc BeefMIS Report on Suckler Farms indicates that there is further scope to improve even on farms operating at a good level of efficiency. See Appendix 3 for detailed breakdown. A summary of the main conclusions is given below.

- fixed costs are generally too high
- silage quality needs considerable improvement
- meal costs per kg. liveweight gain are too high reflecting a need for increased emphasis on silage quality and grassland management
- calving spread is much too wide
- Calving interval and calf mortality also require considerable improvement on some farms

The two major components of efficiency are:

- level and quality of output
- cost structure

Increased Output

Stocking rate, animal performance and cow productivity determine output.

- Intensification beyond the basic EU stocking density limits (2.0 LU per hectare) is not advisable if substantial investment in housing and livestock is required.
- There is considerable scope to improve animal performance (particularly at grass) on many cattle farms. For intensive integrated systems (calf to beef, weanling to beef, suckler to beef) a swing to lighter carcasses could reduce output per animal.
- In breeding herds cow productivity remains a key efficiency factor (calving

rate, calving interval, compactness of calving and calf mortality). A five per cent change in calving rate changes output per cow by £30 in a suckler to beef system.

Cost Structure

Fixed Costs

A reduction in fixed costs is difficult to achieve in the short term. Machinery costs are the significant component of fixed costs. Teagasc National Farm Survey data indicates machinery costs of almost £100 per ha for certain categories of cattle farms.(See table 2.2). Cattle farmers will have to critically assess how much machinery investment they can carry.

Table 2.2:
Breakdown of Fixed Costs

Fixed Costs	% of Total	Per ha Cost (£)
Rent of Conacre	8.5	20.00
Car, Electricity, Phone	12.5	29.00
Hired Labour	4.0	9.50
Interest Charges	10.0	23.50
Machinery Operating and Depreciation	40.0	94.00
Buildings Maintenance and Depreciation	10.0	23.50
Land Improvement Maintenance and Depreciation.	4.0	9.50
Other	11.0	26.00
Average level of Fixed Costs per ha		235.00

Source: Adapted from Teagasc National Farm Survey 1994. Based on Cattle Non Rearing Systems in the 40 to 80 ha category, Soil Group One.

Variable Costs

Winter feed costs are the dominant variable costs in most cattle systems (See Table 2.3)

Table 2.3:
Breakdown of Variable Costs

Variable Cost	Suckler to Beef % of total	Weanling to Beef % of total
Silage	50	38
Concentrates	17	38
Grazing	18	11
Other	15	13

Source: Adapted from Teagasc Management Data for Farm Planning Book 1996

Factors to be considered in reducing winter feed costs include:

Silage:	Ensure adequate quantities of good quality silage. Maximise area available for first cuts. Utilise animal slurry for maximum benefit. Soil test regularly. Minimise wastage. Use cost effective additives when required
Concentrates:	Use economic levels of concentrates. If the beef price is £1.90 per kg carcase and concentrate price is 14p per kg (£140/t) then breakeven response rate is approx. 13:1 (kg concentrate:kg carcase). Unless concentrates can be purchased significantly cheaper, the optimum concentrate feeding level will be about 3-4.5kg on good silage. The cost per tonne of concentrates is very important and producers must ensure good value.
Extending Grazing:	Extending the grazing season (earlier spring turnout and extended autumn grazing) will reduce winter feed costs.

Table 2.4:
Impact of Changing Winter Feed Costs Weanling to Beef System

Factor	Improvement	Impact
Silage Quality	DMD 50g/kg DM	£35
Silage Cost	£1 per tonne	£9
Concentrate Cost	£20 per tonne	£17
Extended Grazing	One tonne silage less	£12

[1]per animal sold

Grazing Costs

The feed costs per kg liveweight gain are substantially lower for grazed grass relative to indoor feeding. (See Table 2.5)

Table 2.5:
Feed Costs per kg Liveweight Gain Weanling to Beef System

	Indoor Period	**Grazing Period**
Gain First Winter (kg)	90	-
Gain Grazing Season (kg)	-	170
Gain Second Winter (kg)	140	-
Total Gain (kg)	230	170
Feed Costs	£242	£35
Cost per kg Liveweight Gain	£1.04	£0.21

• Maximise weight gain at grass. This is the most important efficiency message for cattle producers.

3. WHICH CATTLE SYSTEM

Switching systems can have major implications on cashflow, borrowing requirements, tax liability, housing requirements etc. Radical changes need to be carefully scrutinised. As a broad guideline the majority of producers should pursue systems that:

- Provide a reasonable income.
- Maximise support payments.
- Minimise risk (see Table 3.1).
- Have realistic investment (buildings and livestock) requirements.
- Meet market requirements (carcase weight, carcase quality, Quality Assurance)

Table 3.1:
Effect of Price Fluctuations on Finishing Systems

	Effect on Gross Margin per Hectare	
System	Sale Price (±5%)	Purchase Price (±5%)
Suckler to Beef	£40	-
Weanling to Beef	£87	£45
Autumn to Autumn	£80	£50
Summer Grazing	£170	£140
Winter Finishing	£220	£135

Based on Teagasc Management Data for Farm Planning 1996 with top grade steer prices at £2.02 per kg carcase.

Suckler Systems

Suckler to beef systems comply with most of the above requirements. In the current climate suckler to weanling or store systems are more vulnerable to market forces. However a high proportion of suckler systems are located within the Disadvantaged Areas. This further enhances support payments and provides a buffer against market forces. The majority of cattle producers will continue to need a suckler herd to supply some or all of their raw material.

Long Term Trading Systems

Integrated systems (calf to beef and weanling to beef) are considerably less risky than short term trading systems. They can also maximise support payments. Autumn to Autumn store to beef systems have the advantage that buying and selling occurs at the same time. This lowers the risk factor. Autumn to Autumn systems are compatible with existing EU stocking density requirements for the Extensification Premium.

Short Term Trading Systems

Both winter finishing and summer grazing systems involve a high degree of price speculation. This makes them particularly vulnerable to sudden market changes. It is more difficult to maximise premium payments in these systems. As the risk factor is considerably higher these systems are more suited to specialised producers or particular situations.

Optimum Finishing Age

Premium considerations can have a major influence on the choice of finishing age in an integrated system. In a spring calving suckler to beef system for example;

- Finishing (steers) at 24 months of age maximises 10 and 22 month Special Beef Premium payments and the Deseasonalisation Premium.
- Finishing at 30 months increases the land requirement. The Deseasonalisation Premium is not available. The margin hectare does not increase. The 30 month system is less compatible with the trend towards lighter carcasses.
- A trend towards lighter carcasses may encourage early finishing systems. If finishing earlier than 24 months of age, the 22 month Special Beef Premium and possibly the Slaughter Premium are not collected. This represents a loss of up to £150 in support payments. Bull beef is most suited to early finishing systems. However, the market opportunities for bull beef appear limited.

4 BORROWING CAPACITY

The scope for investment or expansion is limited. The majority of drystock farms cannot carry any significant level of long term borrowings (See Table 4.1).

Table 4.1:
Maximum Level of Longterm Borrowings per Farm

Farm Size (ha.)	Income per Hectare	
	£200	£300
	Max Level	Max Level
40	0	0
60	0	£8, 500
80	0	£30,000

Assumes:

- Interest rate of 13%, 12 year loan period
- Living expenses £12,000
- Allowance made for tax payments
- Producers should not borrow up to maximum levels

5. OVERALL VIABILITY

Viability will be dependent on many factors including; farm size, cattle prices, overall efficiency level of borrowings and family income requirements (See Table 5.2). Farm size is a major determinant of overall viability. Data from the Teagasc 1994 National Farm Survey representing 80 - 85,000 farms with cattle (and without milk) indicate that:

- 45% are less than 20 ha in size
- 18% are over 50 ha in size
- On 40% of cattle farms the holder or spouse had an off farm job. This percentage was considerably higher within certain categories of cattle farming. (See Table 5.1)

Table 5.1:
Percenhge of Cattle Farms where Farmer/Spouse has other Job

Size (Ha)	< 10	10 - 20	20 - 30	30 - 50	50 -100	> 100
Cattle Rearing	56 (50)	45 (41)	27 (15)	57 (40)	-	-
Cattle Other	33 (33)	35 (30)	36 (28)	33 (26)	14 (4)	-

(Figures shown in brackets refer to farmer only)

Source: Teagasc National Farm Survey 1994

Table 5.2:
Viable Farm Size (ha.)

	Current Income Per Hectare	
Farm Income Required	£200	£300
£12,000	60 ha.	40 ha.
£18,000	90 ha.	60 ha.

Income of £300 per ha based on excellent level of efficiency (Teagasc Management Data for Farm Planning 1996) at current prices.
Note: Assumes no significant longterm borrowings.

Many cattle farmers must supplement their farm income with off farm income to meet overall income requirements. This applies even at very high levels of efficiency. At moderate levels of efficiency only the biggest farms can generate a viable income.

CONCLUSIONS

1. **Stocking Rate Levels**
   The major decline in beef prices favours "lower stocking rate" systems which maximise EU support payments. Schemes such as REPS help stabilise and provide a guaranteed income for the immediate future. Even intensive farmers must consider the "lower stocking rate" option and its implications.

2. **Efficiency**
   High levels of efficiency remain crucially important even if lower stocking rate systems are adopted.
   The scope to increase output on intensive farms through higher stocking levels is limited. There is scope to improve animal performance particularly at grass. In breeding herds cow productivity remains a key efficiency factor.
   Fixed costs must be controlled. Machinery costs account for the major share of overheads costs.
   In many cattle systems winter feed costs can account for over two thirds of total variable costs. Cattle farmers must adopt practices which minimise winter feed costs.

The feed costs per kg liveweight gain are substantially lower at grass relative to indoor feeding. Maximising weight gain at grass is a priority.

3. Cattle Systems

Suckler systems and longer term trading systems maximise EU support payments and are generally more stable. Short term trading systems involve the most risk.

A trend towards lighter carcases will militate against long term (over 2 years of age) production systems.

4. Borrowing Capacity

The scope for investment or expansion is limited. The majority of drystock farms cannot carry any significant level of long term borrowings.

5. Overall Viability

Many cattle farmers must supplement their farm income with off farm income to reach a viable income level.

Acknowledgements:

Teagasc Beef and Farm Management Specialists
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Teagasc National Farm Survey Staff

APPENDIX 1
Suckler to Beef System
Impact of lower versus higher stocking rates

	Present Situation A	Alternative Situation B
Farming System	Higher Stocking Rate	Lower Stocking Rate
Farm Size (Area Aid)	40 ha.	40 ha.
Stocking Rate (Physical)	2.5 LU/ha. approx.	1.6 LU/ha. approx.
Stocking Density (EU Schemes)	2.0	1.38
Stock Numbers	50 cows, progeny reared to beef	35 cows, progeny reared to beef
Steer Beef Price (£/kg carcase)	1.80 (82 p/lb)	1.80 (82 p/lb)
Sales (£)	30,900	21,630
Replacement + Mortality (£)	2,250	1,575
..Output (£)	28,650	20,055
Premiums		
-Suckler Cow (£)	7,000	4,900
-Special Beef (£)	4,320	3,060
-Deseasonalisation (£)	1,200	850
-Extensification (£)	-	2,070
Output (include Premiums) (£)	41,170	30,935
Variable Costs (£)	18,550	11,445
Gross Margin (£)	22,620	19,490
Fixed Costs (£)	10,500	9,000
Net Margin (£)	12,120	10,490
REPS (assumes 50% retained income)	-	2,500
Net Margin (incl. REPS) (£)	12,120	12,990
Net Margin (incl. REPS) if Steer Beef price £2.10/kg (95p/lb) carcase (£)	17,320	16,130

Budget Assumptions

Assumptions	Situation A	Situation B
Silage Cost/tonne (£)	12.50	12.00
Silage Requirement per cow unit (tonnes)	15.0	14.5
Concentrates + Calmag cost per cow unit (£)	74	74
Grazing Cost per cow (£)	60	30
Transport Mortality, Bull per cow (£)	49	49
Fixed Costs per ha. (£)	263	225
Carcase Weight - Steers (kg)	390	390
-Heifers (kg)	305	305

Note: Assumed 50% REPS payment retained as farm income. Deseasonalisation Premium averaged at £50 per steer. Heifer price 5 p/kg carcase lower than steer price.

APPENDIX 2
Weanling to Beef System
Impact of lower versus higher stocking rates

Farming System	Present Situation (A) Higher Stocking Rate	Alternative Situation (B) Lower Stocking Rate
Farm Size (Area Aid)	40 ha.	40 ha.
Stocking Rate (Physical)	2.5 LU/ha. approx.	1.6 LU/ha. approx.
Stocking Density (EU Schemes)	2.0 LU/ha.	1.38 LU/ha.
Stock Numbers	66 steers, 40 heifers	46 steers, 25 heifers
Steer Beef Price (£/kg carcase)	1.80 (82 p/lb)	1.80 (82 p/lb)
Sales (£)	67,682	45,638
Purchases (£)	34,270	23,200
Market Output (£)	33,412	22,438
Premiums Special Beef (£)	11,880	8,280
Deseasonalisation (£)	3,300	2,300
Extensification (£)	-	2,760
Output inc. Premiums (£)	48,592	35,778
Variable Costs (£)	27,199	17,235
Gross Margin (£)	21,393	18,543
Fixed Costs inc. Interest (£)	9,830	8,860
Net Margin (£)	11,563	9,683
REPS (40% retained as income) (£)	-	2,500
Net Margin (inc. REPS) (£)	11,563	12,183
Net Margin (inc. REPS) if Steer Beef Price @ £2.10 per kg (95 p/lb) carcase (£)	17,295	15,554

Assumptions Farming System	Situation A Higher Stocking Rate	Situation B Lower Stocking Rate
Silage Cost/tonne	£12.50	£12.00
Silage Requirement		
-Steers/hd.	9.0 t	8.5 t
-Heifers/hd	5.5 t	5.0 t
Concentrates @ £140/t		
-Steers/hd.	£122	£122
-Heifers/hd.	£48	£48
Grazing (per ha.)	£75	£37.50
Dosing/Marketing etc.		
Steers/hd.	£42	£42
Heifers/hd.	£32	£32
Fixed Cost (per ha)	£246	£222
Carcase Sale Weight (kg) - Steers	390	390
-Heifers	305	305
Purchase Weight Weanlings (kg)		
Steers	300 @ £125/100 kg	300 @ £125/100kg
Heifers	280 @ £85/100 kg	280 @ £85/100 kg

Note: Deseasonalisation Premium averaged at £50 per steer. Assumed 50% REPS payment retained as farm income. As a maximum of 66 steers are eligible for 10+22 Special Beef Premium on 40 ha, heifers are included to make up additional stocking rate. Assumes heifer beef price 5p per kg carcase lower than steer price. Borrowing requirement for fifty per cent of livestock purchased. Purchase prices of £145 per 100 kg for weanling males and £100 per 100 kg for heifer weanlings are used at £2.10 kg carcase beef price.

APPENDIX 3
TEAGASC SUCKLER BEEF MIS REPORT

Principal Components of Fixed Costs Per kg Liveweight (P/Kg)

	Top $^{1}/_{3}$	Middle	Bottom $^{1}/_{3}$	Top V Bottom
Tot. Fixed Costs	51	50	47	+4
Machinery & Car	21	24	25	-4
Interest& Labour	11	7	6	+5
Total	32	31	31	+1

Averages and Ranges for a Number of Parameters

Parameter	Av.	Range
Calf Mortality (%)	6.8	19% > 10%
		19% < 4%
St. Rate (Ac/LU)	1.24	21% > 1.4
		21% < 1.0
Silage DMD (%)	64.6	12% < 60 DMD
		18% > 70 DMD
Weanling ADG*	1.10	27% < 1.0 kg
		14% >1.2 kg
Stores ADG*	0.90	20% < 0.8 kg
		30% > 1.0kg *

* Performance at grass

Calving Compactness (% of Herds with Cows Calved within 70 Days)

Top $^{1}/_{3}$	Middle	Bottom $^{1}/_{3}$
88%	63%	45%

Source: Paper presented to Teagasc National Suckler Conference, M. Barlow, Teagasc Chief Adviser Beef, B. Smyth, Teagasc Farm Management Specialists

April 1996

Reform of the EU Beef Regime in the Wake of the BSE Crisis

I. YATES, T.D.

Minister for Agriculture, Food and Forestry

The Association has a long and proud record of achievement in the promotion and practical application of up-to-date research in modern farming practices over the past fifty years. I am very pleased therefore to be present for the 50th Anniversary Beef Meeting of the Association at a time when our cattle industry is facing one of its greatest challenges in that period.

Your first meeting fifty years ago would I am sure have also dealt with a crisis situation. According to the 1946 Annual Report of the Minister for Agriculture the number of cattle in this country at 4.15 million was down by 90,000 on the previous two years due mainly to the slaughter of calves in 1944/1945 for 'economic' reasons. The price paid at the time for Grade A cattle to the UK was 11p per lb. dressed carcase weight. The 11p I might add was in old pennies.

Our accession to the EEC in 1973 which brought hopes of stability and prosperity for cattle producers got off to a bad start when prices, particularly for young cattle, collapsed and input costs soared. There were no premium payments then or compensatory packages to assist the most affected. Certainly the beef sector has had it ups and downs since accession and because of our heavy dependence on exports, particularly to non-European markets, difficulties on the world market were magnified on the Irish market. For example, the BSE crisis in 1990 combined with the Gulf War led to a substantial drop in consumption in Europe and the closure of many important markets to Irish beef for a period. This was reflected in relatively low prices and heavy sales of beef into intervention in the years 1990 to 1992. However, the years following CAP reform heralded a new era with a more balanced market in the European Union, the elimination of intervention stocks, higher market prices and substantially increased premium payments. Unfortunately, what might be seen in the future as a golden era for Irish beef producers came to an abrupt end last March with the announcement in the House of Commons of possible link between BSE and CJD. Since then we have seen consumption drop dramatically, by as much as 50% in some countries in the immediate aftermath of the crisis, and prices right across Europe have fallen by about 16%. It is true that there has been a slow general recovery in consumption levels in most Member States but the recovery has been painfully slow in some Member States and we have to face the prospect that consumption will never recover fully to pre-BSE levels. I will have more to say about this later.

I think that the measures put in place by the Government and the European Commission have made a substantial contribution towards relieving the worst elements of this crisis. The Government strategy was firstly to ensure continued access for Irish beef to Third Country markets, the restoration of confidence in beef as a quality product in the European Union, the introduction of effective market supports and the payment of compensation to processors most seriously affected by the crisis.

Following major efforts by my Department, An Bord Bia and the Diplomatic Services, most of our markets which were temporarily closed have reopened again. However, trade has not yet resumed to a number of key markets – notably Libya and Iran, but we are hopeful of making the necessary breakthrough in the not too distant future. I visited Libya in the middle of July and a Libyan Veterinary delegation is expected to visit here shortly to clear the way for exports, particularly of live cattle, to resume. Iran is also an important market outlet for the autumn and I also am hopeful that this market will come on stream shortly.

As far as the European market is concerned the promotional activities of An Bord Bia were designed to underline Ireland's high standard of public and animal health and to promote maximum guarantees to producers. Understandably, following the BSE crisis the European consumer began to attach considerable importance to traceability of beef and the new measures which I announced recently relating to identification and tracing of animals at slaughter plants and export plants are designed to provide greater reassurance to consumers and customers on the origin of cattle and beef slaughtered and exported.

While intervention purchasing cannot be considered as a complete solution to the problems posed by the BSE crisis, I am pleased that the European Commission responded to my request at the beginning of the crisis to significantly improve the effectiveness of the intervention system by implementing the carcase weight limit at a significantly higher level than provided under the normal intervention rules, by including grade 04 in intervention and by providing for the facility for forequarters to be sold separately into intervention. Since April a total of 27,000 tonnes of beef has been purchased into intervention in Ireland out of a total of 298,000 tonnes in the whole EU. We are seeking more flexible and more effective intervention arrangements for the Autumn/Winter period. I have put a number of proposals to the Commission for further improvements to the intervention system, including an increase in the processor's margin on sales into intervention and special recognition in the intervention system of the fact that there is still a substantial number of heavy animals in Ireland. The Commission have recognised our difficulties with the weight limit and have given a concession which will allow carcases over this weight to be also taken in. The weight limits and other intervention rules for the last quarter will be decided later this month, but I have sought from Commission Fischler the maintenance, at least, of the current carcase weight conditions in order for intervention to put a floor in the market during the upcoming critical disposal period. I also expect some progress on the processor's margin at today's meeting of the Beef Management Committee.

The weight limit will continue to be an issue as long as we need intervention to get rid of our surpluses. Clearly the Commission want to move as quickly as possible to the 340kg carcase limit which they introduced as far back as 1993 and which was upheld by the European Court of Justice. The Commission - and most other Member States - see lower weight limits as a means of reducing production but they are also of the opinion that lighter carcases meet the requirements of the EU market. In the absence of intervention for almost three years, average carcase weights have continued to rise across all categories in the EU. In the ten year period 1986 - 1995 average carcase weights for all cattle rose in the EU by 9% with steers going from 324kg to 353kg and bulls rising from 313kg to 337kg. In Ireland Steer weights rose from 335kg to 365kg and heifers from 246kg to 273kg over the 10 year period with increases of the same order in all other categories also. Ireland is now at a higher weight level than any other Member State and, in a crisis situation with beef surpluses of the order of 1 million tonnes overhanging the market, we can expect very little support from other Member States if we fail to adjust our production systems to meet the new order. Producers therefore need a clear direction on the most suitable production systems which are consistent with farm profitability and meet export market requirements.

Teagasc, and An Bord Bia, in conjunction with the industry should now provide this direction.

Export Refunds have also paid a key role in stabilising the market. The increase granted by the Commission on 1 May has been a major factor in giving processors a competitive edge on third country markets. Export refunds on male sides of beef which are now worth approximately 64p/lb, are at the same level as that which applied last October, before the Commission embarked on its series of cuts which brought the refund down then to 47p/lb for beef. The fact that factories are now getting cattle at 82p/lb, the lowest in the EU, as against 104p/lb in October last should provide them with a competitive advantages on all markets - both in the EU and international.

So far this year live exports are down by 80,000 with steer slaughterings up by a similar quantity. The reopening of the Libyan and Iranian markets for our cattle and beef this autumn would provide the necessary degree of competition in the market place and the consequent improvement in prices. As I said already I am confident that these markets will come on stream.

The very significant BSE compensation package, which is worth some £70m, along with the retention of the Slaughter Premium for 1997, worth another £16m, will make an important contribution towards making up for losses suffered by producers and restoring stability in the industry. I know that it will not cover all losses incurred or likely to be incurred for the year and I will therefore be pursuing this matter at both the Commission and Council of Ministers when a clearer picture has emerged of further income losses suffered by producers.

Despite the various measures put in place since the crisis, prices continued to weaken but I believe that we have now reached the bottom of the downward price spiral. The fact that prices in Europe are beginning to harden and Irish meat factories have offered intervention tenders at higher prices this week than the last tender provides some basis for this. The situation will be helped by the orderly disposal of cattle - not panic selling. The market support arrangements which are in place should provide a basis for this stability as we face into the peak autumn slaughtering period and when winter finishers are filling their sheds.

I mentioned earlier that I believe that beef consumption in Europe is unlikely ever to recover to pre-BSE crisis levels even though markets have improved in recent weeks. The reduction in beef consumption within the EU of the order of 10 to 20% as a result of the crisis means that the market is now in a serious oversupply situation. This situation is compounded by the fact that the Community is constrained under the GATT agreement from getting rid of this surplus through exports on the world market, even through the intervention system. Accordingly, the Commission have now come forward with proposals for reducing production in order to restore balance to the sector. These measures provide farmers with the option of slaughtering some male calves, and the opening up of intervention for weanlings between 7 and 9 months old which are under 300 kgs liveweight. There is also provision for an increase in the extensification premium for producers who are under 1 livestock unit per hectare but at the expense of those with stocking rates between 1.2 and 1.4 livestock units per hectare. In addition, the Commission propose to bring national beef premium quota rights into line with actual utilisation. Finally, the Commission are proposing to increase the intervention ceilings this year and next year to cope with the surplus situation within the EU.

The calf slaughtering scheme and weanling intervention scheme are designed to reduce surpluses in the following two years and therefore reduce intervention intake. However the levels required will be determined by the rate of recovery in consumption. Should this measure be agreed it will be important to ensure that it does not lead to a disproportionate erosion of our production base. The fact that our suckler cow quota remains fully intact under this rebalancing exercise, despite demands by other Member States for reductions, allows Irish producers to maximise premium income and exploit any upturn in the market situation.

The reduction in the stocking rate threshold for claiming the extensification premium from 1.4 to 1.2 livestock units per hectare with a 50% increase to £45 per animal for those producers under 1.0 L.U. per hectare. would be largely budgetary neutral for Ireland. In 1995 almost 95,000 farmers availed of this premium which was worth almost £59m in that year. The payment of a higher rate for more extensive producers is a very positive move in that it is a recognition by the Commission that such systems of production are more in harmony with the environment and accordingly will aid in consumption recovery. While over 66,000 of our beef producers under 1 L.U. per hectare. should benefit from the increases proposed, nevertheless, I will be seeking to ensure that the producers under the current threshold of 1.4 retain entitlement to the premium.

It is expected that the Commission will come forward shortly with proposals on labelling and promotion to assist in consumption recovery. Since the BSE crisis several Members States, notably France, Germany and Italy, concentrated on identifying beef of national or regional origin and while this had the effect of maintaining consumption of domestically produced beef at reasonable levels it did little to improve consumption of imported beef. Accordingly, we favour the promotion of beef as a generic product which is quality assured and can be traced right back from the retailer to the producer. The new measures which have been put in place by my Department relating to identification and tracing of animals slaughtered or exported, while adding further to the paperwork on farm, will be a key feature for marketing our beef in the future.

I mentioned earlier that since CAP reform up to the beginning of the current crisis, income in the sector continued to grow in line with an improved market situation but more importantly through the premium and headage payments which now account for over 50% of producers' income. I am concerned, however, that the level of efficiency in beef production still remains very poor. Income from actual production remains very low when compared with other farm enterprises. While calf and finished cattle prices play a big factor in producers' income it is very clear that the level of efficiency in the sector remains very poor overall. The lack of winter housing and pollution control facilities are being addressed through the various farm improvement schemes administered by my department Since 1986 over 50,000 farmers have invested over £600m with grant aid amounting to £270m. The improvements will allow farmers to keep their cattle longer and attain better and more efficient performance. However, the fact that cattle move up to a half dozen times in their lives is an indication that many producers see profit as more a function of opportunistic marketing than of efficient production.

The development of more integrated systems where cattle are reared longer on the one farm would contribute to more efficient systems of production to the benefit of the industry overall. The operation of the premium payments system that would favour a move in this direction needs to be fully explored.

In conclusion therefore I wish to say that over the past 50 years your Association has encountered many changes and challenges in beef production and seen and helped it evolve to its present state. Difficult situations are seldom far away when it comes to cattle production but the challenges we face today from the BSE crisis probably represents one of the most difficult situations for the industry ever in that we are not just dealing with production issues but more importantly with those related to consumption. We are dealing with a product which has a question mark hanging over it in some quarters regarding its safety as a result of which consumer confidence has hit an all time low. The market balance has been upset and we are now facing into a beef surplus this year of 3/4 million tonnes with the prognosis for next year being little better. Clearly, our beef industry is facing a very uncertain period. I am confident however that the market support measures in place will continue to provide a good degree of stability in the immediate term. The medium to longer term measures which have yet to be agreed are necessary to bring beef supplies into balance. These are EU measures. At home it is clear that we can do much to improve efficiency and bring our production more into line with market requirements.

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