FODDER AND FEED EVENTS

CLONAKILTY COLLEGE, CO CORK, FEBRUARY 14TH

KILDALTON COLLEGE, CO KILKENNY, FEBRUARY 16TH

PROCEEDINGS

DIET FEEDS

DERMOT FORRISTAL, TEAGASC OAK PARK AND TOM RYAN, TEAGASC WEXFORD

THE RELATIVE COST OF FEEDS

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INTRODUCTION

The **structure** of Irish farming is changing rapidly and the **market** environment now requires that the industry concentrate on producing what the market needs rather than simply supplying what industry produces. The **genetic make-up** of the national beef and dairy herd has and is continually changing to more efficient, higher genetic merit, breeds and lines. Furthermore, **convenience** is an increasingly important element, particularly in light of recent labour shortages and the growing number of part-time farmers.

Ireland is a **deficit animal feed country**. It has been known for many decades now, that grazed grass is the cheapest source of feed available to ruminants in Ireland provided the environment and management permit the production and utilisation of high yields of high digestibility herbage throughout the grazing season. Grazed grass can supply a major proportion or the total nutrient requirement of the animal depending on their production level, sward quality and climatic conditions. However, cognisance must be taken of the fact that cereals and by-product feeds are getting cheaper compared to forage, particularly grass silage. Even high quality, grass silage is no longer a “cheap” feed due to higher land prices, increasing costs of mechanisation, energy, methods of harvesting, storage and feeding. Indeed the cost of grass is not as inexpensive as portrayed either.

GRAZED GRASS

Grass either grazed or conserved (silage/hay) accounts for the largest component of ruminant diets in Ireland. There is tremendous variation within the island in annual grass yield and length of the grass-growing season and / or grazing season.

Most Irish grassland is **old pasture** and only about 3% of agricultural land is **reseeded** annually, primarily for winter-feed production. As a result, animals tend to graze old pasture for most of the season.
Old pasture generally contains high proportions of **inferior grasses** (e.g. Poa and Agrostis species), which have lower digestibility, lower yield, shorter grazing season, poorer ensilability characteristics, etc. than perennial ryegrass.

Grass is a very erratic feed source with **annual dry matter (DM) yields** varying by up to 90% at the same site. Likewise there is colossal variation in **daily** grass growth. Climate changes mean that the farmer cannot know the quantity or quality of grass that will be produced over the grazing season or the conditions that will prevail for utilisation. While a flexible grassland system involving rotational grazing, grass measurement etc. is advocated, the reality is that most of the fundamental problems associated with grass as a feed are not alleviated.

Very large vertical gradients are found in the **chemical constituents** of grazed perennial ryegrass from the upper to the lower layer of the sward, essentially reflecting the proportions of blade, sheaths, stems and dead tissue. For example, digestibility % decreases by a massive 25 units from the upper to the lower layer. Evidently, grazing severity has enormous consequences on the quality of the material ingested. There are even significant differences in the composition of grass within a day.

Grass **dry matter** is highly changeable with daily variation of over 100%. Even under consistent experimental management, the **energy value** of grass fluctuates by 20%. Obviously under farm conditions this will be much greater. Furthermore, grass later in the season has a lower dry matter digestibility (DMD) than spring grass and even at similar DMD values, it has a lower feeding value and lower intake characteristics, in comparison with grass available earlier in the season.

In a grazing situation, the **utilisation of herbage** per ha is reduced relative to that obtained under a cutting regime due to the effects of more frequent defoliation and due to the impact of treading and fouling of herbage during grazing. Research at Teagasc Grange, has demonstrated that even with excellent grazing management, beef cattle will consume only about 74% of the annual grass DM produced, while with poor grazing management the value is likely to be under 64%.

In all grazing systems, the “dilemma” between maintaining pasture quality via high levels of utilisation and maintaining good / adequate animal performance is a problem.

It should be noted that there are adverse consequences to **extending the grazing season** in Ireland. It is well established that compared to earlier closing, defoliation of swards late in the autumn/winter, results in delayed growth and reduced herbage mass in spring and often by substantially more than was removed in the autumn (e.g. delaying closure from Oct. to Dec. reduces spring grass yield by between 36 and 44%). The effect of autumn / winter soil damage or poaching has a dramatic negative effect on spring grass yield reducing it by 20 to 80% depending on the severity of the damage, as well as weakening the soil structure subsequently making it susceptible to water-logging.

Where turnout to grass is early, subsequent pasture production in spring and early summer is reduced and the reduction increases the greater the severity of the grazing. Potential annual grass yield may be reduced by over 10% as a result of early turnout. Likewise, the practice of grazing the silage ground in early spring reduces the yield of first cut silage by up to 56% with the magnitude of the reduction increasing the lower the defoliation height and the later the defoliation or the earlier the cut.

GRASS SILAGE

As Irish grass growth is seasonal with 60-80% occurring in a four-month period, a source of feed is required for the winter period, which can vary from 2-7 months depending on location of the country and the weather. The main winter forage in Ireland is conserved grass. It should be noted that, silage making is also required as a management tool for our seasonal grass growth.

Approximately 4.4 million tonnes of silage DM are produced annually for winter feed. Nevertheless, although decreasing, a substantial acreage of **hay** is still conserved. Currently, **maize silage** makes a very small, niche contribution.

Contractors harvest approximately 85-90% of the silage cut. Irish silage is almost exclusively from **permanent grass swards**. Silage produced from old permanent pastures usually has lower digestibility than silage produced from perennial ryegrass swards.

There is relatively little successful field **wilting** for conventional silage in Ireland. Requirements for achieving a rapid wilt (<24 hours) are spreading the crop, dry weather and the presence of sunshine. If wilting is attempted during poor weather conditions, no drying occurs, effluent production will not be reduced, poorer preservation is likely and in severe cases complete crop loss can occur. Beef and dairy cattle fed wilted silages have a higher intake than those fed unwilted silages but the effects of wilting on animal production are generally negative or small. Wilting depresses output per hectare of both beef and dairy animal product by about 13%

The aim of ensiling is to retain as much of the animal production potential of the harvested crop as feasible. However silage **fermentation** under farm conditions is not a controlled process. A plethora of factors with interactions affect the nutritive value of silage. Delays in harvesting reduces DMD by 0.5 percentage units per day or over 1.0 unit per day if lodged. As almost 90% of silage is harvested by contractors, inevitably, delays in cutting are widespread. In addition, bad **preservation** reduces DMD by on average 5 units but can be up to 11 units. Weather patterns, both directly and indirectly have a massive impact on the yield, dry-matter, digestibility and preservation and thus unit cost of silage. As a result, there is a clear limit on the extent of control over the weather induced variability and rapid response to weather circumstances is difficult to achieve as most silage is harvested by contractors.

The **quality** (as analysed by Teagasc, Grange over a 10-year period) of both first cut and second cut Irish grass silage is highly variable and on average poor to medium i.e. average DMD of 1st cut = 670g/kg & 2nd cut = 656g/kg. Furthermore, the average quality has not consistently improved over that time period despite the widely published silage-making strategies available.

The nutritional quality of **big bale silage** tends to be worse than first cut and similar to second cut conventional silage. Over 87% of Irish farms have mould on their baled silage and 33% of all farms have some proportion of substantially rotted bales.

Silages also vary widely in their **aerobic stability** upon exposure to air at feeding time. Aerobic deterioration can result in a decrease in silage quality and animal performance, reduce the amount of edible silage present and facilitates mould growth. High losses from aerobic spoilage can result in over 10% of the conserved grass not being available for consumption by the animal.

Silage **effluent** is a serious pollutant with an extremely high biochemical oxygen demand making it almost 200 times more polluting than raw domestic sewage. Most of the grass ensiled in this country will produce between 75 and 200 litres of effluent / tonne while wet crops will produce up to 500 L/t. This must be collected and disposed of, usually via land spreading, which is an additional cost, often ignored. Data from the National Farm Survey shows that silage effluent is generally drained into purpose-built concrete effluent tanks rather than slurry tanks which further increases the cost of silage production.

Maintenance of **total conservation losses** below 20% of the DM is an achievable target where very good silage-making practices are used but on most farms this target is not achieved and losses of 25-30% are common.

GRASS/GRASS SILAGE DIETS

Intake is one of the key limitations of forages. Reviews of the literature have shown that the reduction in voluntary intake of ensiled forage is on average 27% when compared with the corresponding fresh herbage. Forage diets, particularly grass silage, are also inherently imbalanced in **energy / protein**, as well as having multiple imbalances in **major** and **trace elements**.

ENERGY VALUE OF FEEDSTUFFS

Recent research at Hillsborough has shown that the Metabolisable Energy (ME) system underestimates the maintenance nutrient requirements of lactating dairy cows on grass silage-based diets (and grass) by up to 56% with a mean underestimation of 40%. Similar results were also obtained for cattle and sheep. It is now firmly established that ME values are not necessarily related to animal maintenance or production and should NOT be used to compare the energy value of concentrates and forages. **Comparison of feedstuff costs on a DM, digestible DM, utilisable DM or ME basis is misleading, as it hugely overvalues forages**, particularly poor quality forage. The deficiencies of the ME system have led to the development of an "Irish" Net Energy (NE) System. NE ranks a feedstuff on the basis of animal performance or productive value, which is the proper way to determine the true energy value.

Feed Costs

Costs cannot be considered in isolation - partial analysis is erroneous. In examining the merits of feedstuffs, **all associated costs must be included** while mindfulness of factors such as convenience, the uncertainties involved, variation, residual effects, the long-term sustainability of a system, the product produced and market implications is critical. In terms of the animal, effects on body reserves, reproduction, longevity and health must be incorporated.

The tendency to assign partial costs to forages is overwhelming and results in grossly misinforming conclusions. Furthermore, many publications present best-case scenarios for forages i.e. assume perfect / niche conditions and very high levels of technical efficiency, without putting it in context. While others readily acknowledge the massive variation in forage yield and quality on-farm, only the theoretical is proclaimed. Of course, reality falls along way short of this. Most feed cost ratios published to date have omitted key costs, only presented best-case scenarios and did not use NE values.

The purpose of the following three tables is to highlight the variation in and the often, high cost of producing forages. This exercise does not attempt to take into account the intake potential / fill value (or protein) of the feedstuffs, a factor, which would further increase the cost of forages, particularly grass silage. **It is fully realised that individual circumstances will vary and ideally all costings need to be carried out on an individual enterprise basis.** The input costs used in this exercise are as per Teagasc, (*Management Data for Farm Planning*, 1999) and the Contractors Supplement, (*Irish Farmers Journal*, March 25, 2000) with an inflationary adjustment where appropriate. Forage costs are presented with and without a land charge.

Table 1. Cost (£) of Grazed Grass in terms of NE

Yield/annum	**11.0 t/ha**			**14.0 t/ha**		
Utilisation %	**65***	**75****	**85****	**65***	**75****	**85****
No Land Charge						
Cost/t DM produced	35	35	35	27	27	27
Cost/t DM eaten	54	46	41	42	37	32
Cost /UFL	***59***	***48***	***43***	***46***	***39***	***34***
Land Charge included						
Cost/t DM produced	63	63	63	49	49	49
Cost/t DM eaten	96	83	73	75	65	57
Cost /UFL	***105***	***87***	***77***	***82***	***68***	***60***

** = associated UFL of 0.91 ** = UFL of 0.95*

Note: This exercise is carried out assuming a predominantly Perennial Ryegrass sward. As UFL values are generally much lower for "inferior" grass species, evidently under such circumstances (as per most of the country) the cost will be greater than outlined in the table.

Table 2. Cost (£) of Grass Silage* in terms of NE

Yield of cut (t DM/ha)	**4**			**5.5**			**7**		
DMD (g/kg)	**600**	**660**	**740**	**600**	**660**	**740**	**600**	**660**	**740**
No Land Charge									
Cost/t (to be eaten)	25	25	25	19	19	19	16	16	16
Cost/t DM (to be eaten)	118	118	118	92	92	92	77	77	77
Cost / UFL	***180***	***161***	***141***	***140***	***126***	***110***	***117***	***105***	***92***
Land Charge included									
Cost/t (to be eaten)	33	33	33	25	25	25	21	21	21
Cost/t DM (to be eaten)	158	158	158	121	121	121	100	100	100
Cost / UFL	***241***	***216***	***189***	***185***	***165***	***145***	***152***	***136***	***120***

***=** *precision chop, harvesting inefficiency of 26%, additive used, walled silo*

Table 3. Cost (£) of concentrates* in terms of NE

Cost / t	100	120	140	160	180	200
Cost / t DM	116	140	163	186	209	233
Cost / UFL	***100***	***120***	***140***	***160***	***180***	***200***

** Assume ration with UFL = 1.0*

Note: When selecting the relevant purchased concentrate price, deduct an allowance (varies depending on ration type) for the included cost of Minerals and Vitamins per tonne as there are no added mineral/vitamins in grass silage. Where applicable, an on-farm storage cost + interest should be included (e.g. £10 + £3 / tonne).

CONCLUSIONS

While grass and grass silage is the foundation to ruminant production systems in Ireland, it has its limits, particularly with high producing animals and changing market requirements. Due to our seasonal grass growth a proportion of the land area will have to be harvested to provide forage for the winter period but also as a means to manage the grazing system. The relativity's calculated seriously question the role of grass silage on many Irish Farms. Obviously in situations where the cost of grass silage is greater than the cost of purchased concentrates, recommendations should be to minimise the amount of silage produced. This particularly applies to second and third cuts of silage, which are generally not required to manage grass. A more pertinent question for the future is “what is our second-cheapest main source of feed?”

HOME MIXING

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INTRODUCTION

Increasing pressure to reduce costs, declining cost of feed ingredients, availability of alternative feeds, technological advancements in the treatment of grain on farm and a depleted supply of labour, have led a lot of farmers to consider home mixing as a strategy to reduce feed costs, reduce labour demand, improve feeding management, improve animal performance and consequently profitability on the farm. Up to £30 per tonne can be saved by buying suitable straights rather than compound rations. However, there are hidden costs associated with home mixing that the farmer very often does not cost in. The savings made from home mixing must be balanced against the extra cost incurred. In this paper I will discuss the following areas:

- Benefits and limitations of home mixing
- Practicalities of home mixing
- Legislation applicable to home mixers
- Sample rations

BENEFITS AND LIMITATIONS OF HOME MIXING

Benefits

- Feed cost savings -

Purchasing straight ingredients and feeding home-grown cereals can lead to savings of up to £30 / tonne on ingredient prices alone.

- Tailor-made diet formulation -

The farmer has greater confidence in the ingredients that he is mixing himself than when buying a compound feed. The concentrate portion of the diet can be tailor-made to match the feeding value of the forages available on the farm.

- Flexibility in ingredient usage -

There is a large number of by-product ingredients available on the market that are of good feeding value and competitively priced.

Technological advancements have seen significant developments in the processing of cereals (sodagrain and crimping) on farm. Home mixing allows easier inclusion of these in the diet and reduced feed costs.

- Labour saving –

The reduction in labour requirements where a diet feeder is being used is of utmost importance, particularly at a time when labour is simply not available on farms. There is also the saving involved in being able to carry out all the feeding requirements using the one unit, for all stock. However where ingredients are being mixed manually this can be very labour intensive.

- **T**otal **M**ix **R**ations (TMR) -

Traditionally, animals were fed forage on an ad-lib basis and offered concentrates one or two times per day. The relatively new concept of formulating a complete diet (**T**otal **M**ix **R**ation – **TMR**) has been used in this country for feeding our livestock since the early 80's. Cattle / dairy farmers considering home mixing are most likely to consider investing in a diet feeder, possibly grow and store home grown cereals / protein sources on farm or buy in straight ingredients. There have been many claims on the benefits of TMR feeding. The mixing of the concentrate portion of the diet with the forage means that the animal is consuming a more uniform diet, leading to better animal performance. The health benefits of the TMR diet have been highlighted. The claimed benefits include a reduced incidence of sub-clinical acidosis, laminitis, better herd fertility, reduced incidence of acidosis, reduced laminitis and less stress.

For dairy cows there are two primary sources of independent information based specifically on Irish data:

Moorepark Studies –

A review of production data over the 10-year period from 1980 to 1990 looked at TMR feeding compared to separate feeding of forage and concentrates.

Concentrate proportions ranged from 37:63 to 60:40. The conclusions drawn were:

- Where concentrate ratios were greater than 60% of the total DM (11 kg concentrate approximately), milk yield or milk fat was increased by TMR feeding.
- Where concentrates were less than 50% of the total DM (9 kg concentrate approximately) TMR feeding did not give a positive effect on yield or milk constituents.
- TMR feeding tended to increase total dry matter intake but this did not result in improved utilisation of the diet.

Hillsborough Studies

The Hillsborough results are as follows:

- A trial comparing TMR feeding and separate feeding of two concentrates (ground cereals or sodium hydroxide treated wheat), fed at 8 kg per day, showed method of feeding had no effect on intake, milk yield or composition. The separate feeding of the ground cereal diet gave higher milk fat and milk protein concentrations.
- At high concentrate input levels (13.5 kg or 62% of the DM) in a TMR diet compared to separate feeding 4 times per day, milk yield & yield of fat and protein were higher on the TMR diet. But intake was similar on the TMR diet and the 4 times per day feeding concentrate.

Tables 1 and 2 present the results of Hillsborough work on complete diet feeding. In Table 1 there is a response of 3 kg milk to complete diet feeding. The proportion of forage is approximately 33% in this experiment. In Table 2 there is no response to complete diet feeding and the proportion of forage in the diet is 67%.

These results agree with the theory that the response to complete diet feeding is related to the proportion of forage/concentrate in the diet.

Table 1. Effect of Method of Feeding on Animal Performance (1)

	Complete Diet Feeding	**OPF***
Silage DMI (kg/day)	6.53	6.99
Concentrate DMI (kg/day)	12.89	12.67
Milk yield (kg/day)	33.8	30.8
Fat concentration (g/kg)	37.9	38.3
Protein concentration (g/kg)	31.4	31.7
Fat yield (kg/day)	1.27	1.17
Protein yield (kg/day)	1.05	0.97

*OPF = Out of parlour feeders Gordon et al., 1995

Table 2. Effect of Method Feeding on Animal Performance (2)

	Twice Daily	**Four Times Daily**	**Complete Diet**
Silage DM intake (kg/day)	8.5	8.7	9.3
Concentrate DM intake (kg/day)	4.3	4.3	4.7
Forage proportion in the diet	0.67	0.67	0.66
Milk yield (kg/day)	19.8	20.1	20.0
Protein concentration (g/kg)	27.6	27.7	27.3
Fat concentration	37.8	38.1	39.1

Agnew et al., 1996

Overall feeding at moderate levels showed no improvement in performance from TMR diets. At higher concentrate feeding levels there is probably a benefit from 3-4 times per day feeding or TMR feeding.

There is limited data on the effect of TMR feeding on the performance of beef animals but it might be expected that the factors affecting the response to TMR feeding in dairy cows also apply to beef animals i.e. the proportion of concentrates and the number of feeds per day. Work from Grange concluded that where concentrate levels of up to 3 kg daily are offered, once daily feeding is satisfactory but where levels greater than 4 kg are fed, twice daily feeding or complete diet feeding should give improved performance.

Limitations

- Quality control of raw materials -

  Ingredient quality is critical to the home mixer. The lack of screening of batches of ingredients and a quality control procedure make it difficult to quantify ingredient quality.

- Capital investment – There is a large capital investment in home mixing, particularly when a diet feeder must be purchased. Ancillary costs include the equipment needed to load the diet feeder and the cost of storage of raw materials on farm. Storage costs can range from £0 to £7 / tonne feed produced over a 20 year period. The cost of diet feeding will be dealt with in detail in the paper by Tom Ryan on "Diet Feeders".

- Less flexibility in ingredients -

  In theory there is greater flexibility in the ingredients that can be used, but in practice handling any more than 3-4 ingredients plus forages on the farm is time consuming and expensive.

- Absence of bulk discounts on ingredients –

  There are greater bulk discounts to be had when buying as part of a producer group. The discounts to be had may not be as great when buying as an individual.

PRACTICALITIES OF HOME MIXING

- Quality and Consistency of Ingredients -

  These are critical points to be considered when the home-mixer is buying straights. All feeds vary from batch to batch, even the unadulterated cereals. This is due to differences due to variety, soils, weather etc. By-product feeds have the additional source of variation of the process that they have undergone. Some of the most variable feeds include cottonseed meal, malt combings, sunflower meal, pollard and distillers grains. It is advisable for home mixers to stick with less variable feeds to lessen the risk of getting a batch of poor quality material.

Decisions on what ingredients should be used should be based on feeding value as well as monetary value. Ideally ingredients should be valued on their energy and protein value. Ingredients that are good value will vary from one year to the next.

Maximum inclusion levels (Table 3) applied to feed ingredients should be adhered to - to avoid digestive upsets, toxicity, unpalatability of diets, off-feed and a negative effect on animal performance.

Table 3. Maximum Inclusion Levels of Ingredients in the Concentrate Mix

Feed	Inclusion Level, %		Comment
	Dairy	Beef	
Barley Wheat Maize	40 30 30	80-100 50 50	Cereals can make up a large proportion of the energy requirements of the animal but must be balanced for protein. If high levels are being used great care needs to be taken to avoid digestive upsets
Beet pulp Beet pulp molassed Citrus pulp	50 50 50	60 60 50	Pulps can be fed safely at high inclusion levels. Protein supplementation is generally needed.
Maize gluten feed	40	40	Has been fed to dairy cows and beef cattle as the sole concentrate. Protein quality is not ideal.
Distillers grains	40	40	Protein quality and oil content can be problematic. Feeding maize gluten feed and distillers grains in the diet to dairy cows – limit both ingredients to 30%.
Pollard Malt sprouts Soya hulls Copra meal Palm kernel meal ext.	15 15 20 10-15 10-15	50 50 50 15 20	Limited experience at high levels. Generally low energy feeds. Quality (pollard, palm kernel meal, malt sprouts) and palatability (palm kernel) could be problematic.

Cottonseed meal	20	15	Any can be used to supply protein in the diet. Both cottonseed meal and sunflower meal are generally low energy and poor protein quality feeds.
Rapeseed meal	20	20	
Soyabean meal	-	-	
Sunflower meal	10	20	

- Number of Ingredients -

  Keep the number of ingredients to a minimum and be able to include each ingredient at a high level. Feeds such as cereals, pulps and maize gluten feed are high quality and while they can vary from batch to batch they can be included at high levels. This will reduce the storage space required on the farm. A well balanced diet can be achieved with a small number of ingredients. An alternative option may be to purchase a blend of ingredients, particularly when looking for a protein balancer.

- Consult a Nutritionist -

  Correct ration formulation is vital. Formulating, mixing and feeding the diet is critical to achieving target animal performance. It is important to consult a nutritionist to ensure that diets are correctly balanced for all nutrients, including minerals and vitamins.

- Minerals

  It is critical that all diets are correctly balanced for minerals. Many co-ops formulate specifications based on Teagasc recommendations for dry cow, lactation and drystock. Shop around when purchasing minerals and consult your nutritionist.

- Labour saving –

  When considering the work rate of the feeding operation in a home mixing situation, it is important to consider the following factors:

  a. Feeding system that the new system is being compared to
  b. The feed mix being used
  c. The size of the wagon, in the case of wagon feeding
  d. Distance between feed storage and feeding area

LEGISLATION ON HOME MIXING

Inform yourself on the legislation regarding home mixing. The main elements of the legislation are presented below:

1. If you produce feedingstuffs on your farm i.e. feed containing a mixture of ingredients, and if you include additives or certain protein products either directly or as part of a premixture or mineral mixture, then you must be either approved or registered.

2. Determination of whether you need to be approved or registered will depend on the type of additive you use, as follows:

   (a) Approval

   You will need to be approved if you use any of the following additives:

   - Antibiotics
   - Coccidiostats and histomonostats
   - Growth promoters

   (b) Registration

   You will need to be registered if you use any of the following additives:

   - Vitamins
   - Trace elements
   - Enzymes
   - Micro-organisms
   - Carotenoids & xantophylls
   - Anti-oxidants with a fixed maximum level

The majority of farmers will fall under the second heading of needing Registration rather than Approval. Registration will be on foot of a written declaration by the livestock producer that he/she fulfills the minimum conditions laid down below. A registration number will be assigned to each home producer.

3. Minimum conditions for registration cover

a. Facilities and Equipment

Facilities and manufacturing equipment must be located, designed, constructed and maintained to suit the manufacture of the products concerned.

b. Production

Written documentation must be prepared for the procedures used in the mixing of feeds on farm.

c. Quality Control

In order to ensure traceability, samples of all raw materials coming onto the farm must be taken. These must be kept in storage at the disposal of the competent authorities for a period appropriate to the use to which the feedingstuffs are put.

d. Storage of Raw Materials

Raw materials must be stored in places designed, adapted and maintained in order to ensure good storage conditions - dry, clean and vermin free. They must be stored in such as way as to avoid any confusion or cross-contamination. Preventative measures must be taken to avoid, as far as possible, the presence of harmful organisms with the introduction of a pest control program.

e. Record keeping

The farmer must record the following information:

- The nature and quantity of the feedingstuffs manufactured, with the date of manufacture
- The nature and quantity of additive used and the names and addresses of the additive manufacturers.
- The names and addresses of the pre-mixture manufacturers with the batch number, the nature and quantity of the pre-mixture used.

Sample Rations for Beef Cattle and Dairy Cows

Animal Class	Comments	Sample Rations
Finishing cattle*	Energy is most important - Protein @ 12-13% in dry matter is adequate, unless grass silage is low in protein	50% rolled barley 50% maize gluten or 33% rolled barley 34% maize gluten 33% citrus pulp
Weanlings*	Need medium to high energy - 16% crude protein	33% rolled barley 33% distillers grains 33% citrus pulp or beet pulp or 50% maize gluten 50% rolled barley or 30% distillers grains 70% rolled barley
Milking cows	Maintain high energy levels in the diet – Require an overall crude protein of 16-17% in the dry matter. 18-20% dairy concentrate fine on grass silage – Higher protein concentrate needed to balance maize silage, fodder beet & super pressed pulp	<u>Grass silage balancers</u> 35% barley 30% maize gluten 26% distillers grains 6.5% rapeseed meal 2.5% minerals / vitamins or 33% beet pulp 33% maize gluten 32% maize distillers 2% minerals / vitamins <u>Maize silage balancer</u> 27% soyabean meal 20% maize gluten 17% beet pulp 17% rapeseed meal 16.5% distillers grains 2.5% minerals / vitamins or 30% beet pulp 30% distillers grains 37% soyabean meal 3% minerals / vitamins

*Diets for finishing cattle and weanlings should be balanced for minerals and vitamins

FEEDING OPTIONS FOR CATTLE

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INTRODUCTION

Winter feed constitutes 60-80% of variable costs on cattle farms depending on the system. Any serious attempt to reduce production costs must include an examination of winter feed alternatives. The traditional winter feeding programme is based on grass silage, supplemented with purchased concentrates. In recent years maize silage, whole crop cereal silage and home grown, treated cereal grains have been increasingly used particularly for finishing cattle. Treated grain can be caustic, crimped or urea treated. Do these feeds have performance, management or financial advantages over grass silage based diets?

SYSTEMS

To examine the role of these alternative feeds on beef farms we have looked at two case studies. The first unit is an integrated 60 suckler cow to beef farm of 150 acres (130 adjusted). All the progeny (except replacements) are finished to beef, heifers at 20 months (530kgs) and steers at 24-26 months and at 700kg live weight. The second farm is an all beef unit of the same size. Basic premium stocking density allows for 100 weanling steers to be purchased each autumn for finishing 18 months later, again at 700kg live weight. As in all cattle farming systems, the availability of premia and, possibly, extensification is critical to profitability. The impact of any feed supply changes on stocking density has also to be taken into account.

Table 1. Case Studies

	Suckler to Beef	**Weanling to Beef**
Total acres	150	150
Adjusted acres	130	130
Suckler cows	60	
Weanling/beef		100
Steers finish	700 kg (24 mths)	700 kg (24 mths)
Heifers finish	530 kg (20 mths)	

Options

The base system on both farms is grass silage plus purchased concentrates. The alternatives considered are

(i) Maize silage / whole crop cereal (WCC) replacing some grass silage.
(ii) Home grown, treated grain (HGG) replacing purchased concentrate.
(iii) Home grown, treated grain (HG) replacing silage giving high concentrate diets.

The production costs assumed for these feeds are as follows:

Grass silage	£14/tonne
Maize silage (30% DM)	£18/tonne
Home grown cereal (treated)	£100/tonne @ 84% DM Equiv.
Purchased concentrates	£130 (normal protein)
Purchased concentrates	£140 (Including some maize balancer)

Grazing Plan

Taking out grassland for cereals or maize reduces the area available for first and second cut silage and for autumn grazing. In both systems there is a deficit of grazing area in autumn, which looks significant in the weanling to beef system. A reduced requirement for second cut silage would affect this deficit with good grassland management.

A grazing plan for the weanling to beef unit is shown in Table 2.

Table 2. Grazing Plan Weanling/Beef System 130 Adjusted Acres

	All Grass Option		Maize/Cereal Option	
	Grazing (ac)	**Silage (ac)**	**Grazing (ac)**	**Silage (ac)**
Spring	60	70	60	50
Summer	100	30	110	0
Autumn	130	0	130	-20
Total Silage	870		500	

The deficit in autumn grazing is 20 acres, but there were 10 acres of surplus in mid summer, with no second cut silage being taken.

Effect on Premia

In the suckler system there is no problem claiming basic premia for all cattle, in any of the options. After 2001, extensification will be very tight in the base all-grass option, and unattainable if maize or cereals is grown, since this ground cannot then be included for extensification purchases. The impact of losing extensification would be much greater than any feed savings possible, but this will not apply in all situations.

In the weanling to beef system, extensification qualification is not an issue, all options qualify for the low rate from 2002. Basic premia will be affected where arable aid is claimed. The net result of this is that arable aid will not be claimed in these circumstances.

Animal Performance

Finishing steers are the main category of livestock affected by the dietary alternatives in both systems. The assumptions made regarding performance of these animals are as follows:

		Period (days)	Performance
Base	**Ad-lib silage + 5kgs conc.**	**140**	**1.0 kgs/day**
Option 1	Maize / WCC silage + 3 kgs conc.	140	1.0 kgs/day
Option 2	Ad-lib silage + 5 kgs HGG	180	1.0 kgs/day
Option 3	Ad-lib conc. HG/Purchased	107	1.3 kgs/day

In the suckler system some cereal silage or home-grown grain is fed to weanlings or finishing heifers. The impact of this is minimal.

Summary of Feed Costs

Table 3 outlines the differences in winter feed costs across the alternatives. For example growing 10 acres of maize silage in the suckler system results in a saving of £1,437 in winter feed costs. If the land is eligible for Area Aid, then this is a further reduction in feed costs of £1,100, leading to a total of £2,537 (£1,437 + £1,100). In the current example there is no effect on basic premia but there are situations where, due to tighter stocking rates, there is a loss in basic premia, which would have the effect of reducing the advantage of growing maize to £1,137 (£2,537 - £1,400) (See Table 3). The above calculations also apply to the other options. Twenty acres of maize silage grown in a weanling to beef system reduces the feed bill by £2,090. Eligibility for arable aid could add £110 per acre grown where cattle premium claims were unaffected.

Table 3. Effect of feeding alternatives on winter feed costs

	Suckler to Beef	**Weanling to Beef**
Base Cost	£15,187	£23,230
Effect of diet change:		
Maize silage[1]	-£1,437	-£2,090
HG grain (+ Silage)	-£1,008*	-£2,100*
HG grain (all Conc.)	-£801	-£780
Effect of Premia:		
Area Aid eligibility?	-£1,100	-£2,200
Lose Basic premia	+£1,400	+£2,800
Lose Extensification	+£3,120	+£5,200

* Serious silage deficit; [1]See text for explanation

The production of cereal grain crops to replace purchased concentrates is not as attractive as it might seem. The reduction in silage production leads to a deficit situation requiring the purchase of roughage. The end result is the purchase of forage rather than concentrate, with all the supply, transport and cost difficulties which can follow.

Silage Cost

The assumption of a cost of £14/tonne of good quality grass silage as fed is very much at the root of all these calculations. A variation of £2/tonne in the cost would have a significant effect on the comparisons, particularly in the non-suckler situation (see table 4).

Table 4. Effect of £2/tonne increase in grass silage costs

	Suckler to Beef	**Weanling to Beef**
Base Cost	£16,927	£24,748
Effect of diet change:		

Maize	-£1,755	-£3,030
HG Grain (+ Silage)	-£1,008	-£2,100
HGG (all Conc.)	-£1,013	-£1,520

CONCLUSIONS

Alternative feeds such as maize or whole crop cereal silage or home grown treated cereals can have a role to play in reducing feed costs on cattle farms. They need to be planned into the system so that grazing management, overall winter feed budgets and premium eligibility are not adversely affected. The cost of all these crops is very sensitive to good husbandry and high yields. Tillage skills required may not be available on the typical cattle farm, but good contracting services can overcome this. These costings are based on maize silage, whole crop wheat costs an extra £10 per tonne of DM. Excellent whole crop is similar to excellent maize silage for cattle finishing.

A uniform price for silage is assumed here. In reality, second cut silage is more expensive and of inferior quality to first cut. Replacing second cut is therefore a viable option for many cattle farmers. First cut silage plays a large role in spring grassland management as well as providing winter feed, and will continue to be part of most cattle farming systems.

Overall feed costs reductions of £20-£25 per finishing animal would significantly increase the margins from winter finishing, whether as a stand alone system or as part of an integrated herd. The largest benefits will be obtained where there is a higher proportion of finishing cattle to be fed for the winter.

Finally, none of these alternatives should be considered a substitute for good management. If cattle performance on the existing system is poor, changing the forage or concentrate type alone is unlikely to solve all problems.

REPLACING GRASS SILAGE ON DAIRY FARMS – DOES IT PAY?

George Ramsbottom, Teagasc, Kildalton

Dermot McCarthy, Teagasc, Moorepark

Grass silage is the principal ingredient in the winter ration of most Irish dairy cows. The costs of producing maize silage or cereals have declined relative to silage in pence per kg DM, particularly second cut silage. This has influenced thinking about the material as the main ingredient in winter diets.

Previous studies have not examined:

1. What the economic advantage amounts to in the whole farm context;
2. What are the hidden extra costs involved in the changeover to an alternative wintering programme that have not been included;
3. Does the overall net benefit justify the change from the conventional system of milk production?

Two case studies are presented here comparing the economics of replacing grass silage with either maize silage or concentrates for Spring and Autumn calving herds.

SPRING MILK

In the case of spring milk production, two options are compared with the 'conventional' two-cut grass silage system. The case study farm is a 120-acre; 96,000-gallon dairy farm stocked with 80 dairy cows and 20 replacement units. Yield per cow is held constant (1,200 gallons per lactation) by restricting intake in the maize silage and concentrate systems. The physical details relating to acreage of pasture and maize silage and concentrate inputs are outlined in Table 1.

Table 1. Area of pasture, grass and maize silage and concentrate input (kg/unit) for the three spring milk production systems.

	Control	Maize	Concentrate
Silage harvested (acres)			
Grass 1st cut	50	38	50
Grass 2nd cut	28	7	0
Maize	0	12	0
Short-term letting	0	8	28
Concentrate input (kg/unit)			
Milking cows	500	360	638
Dry cows	0	0	216
Replacement (0-1yo+1-2yo)	500	500	1050

Assumptions

1. Control Diet

   The control diet for the milking cows is based on the Teagasc blueprint diet for spring calving dairy animals (assuming a mean calving date of 1st February). It is assumed that the silage fed to the dry cows is of sufficient quality to maintain/increase condition to the target score at calving. The grass silage yields for first and second cuts were assumed to be 2.2 and 1.4 tonnes DM/ac respectively. The concentrate allowance per replacement unit is sufficient to achieve the target liveweight for two-year-old calving. The cost of the concentrate fed to the dairy cows was £150/tonne and the allowance for the milking cows in all three systems was calculated using the *Net Energy System*. Dietary allowances were calculated to feed cows to a yield potential of 6 gallons/day at peak yield indoors. The cost of the concentrate fed to the replacement heifers was £120/tonne.

2. Maize Silage System

   Replacing grass silage with maize silage pre- and post-turnout increased the cost of the concentrate fed to £160/tonne (because of the higher protein content required) but reduced the concentrate requirement of the spring calving cows by an estimated 140kg. The dry cows and replacement heifers were fed the standard diet of grass silage similar to the control group. The acreage of second cut silage is reduced because the yield of maize is sufficient to meet the forage requirements of the milking cows with surplus maize silage being fed to the dry cows. The maize yield was assumed to be 5 tonnes DM/ac. After the first cut of silage is taken, the 8 acres for second cut silage now no longer required is assumed to be short-term leased for second cut silage making (at £85/acre).

3. Concentrate system

   Eliminating the second cut of silage increases the acreage of grassland available for short-term letting to 28 acres. An extra 216kg concentrates are fed to dry cows and an increased quantity is fed to replacement animals and milking cows (550kg/unit and 138kg/head respectively) to maintain performance and spare silage. The cost of the additional concentrates fed to dry cows and replacement heifers was valued at £120/tonne.

The cost of producing milk based on the three production systems is outlined in Table 2.

Table 2: Estimated costs of production (£/system) for the three spring milk production systems.

	Control	Maize	Concentrate
Gross output	**98,900**	**98,900**	**98,900**
Variable costs			
Fertiliser/silage making costs	13,736	14,258	12,210
Concentrate costs	7,200	5,840	12,250
Other variable costs	9,920	9,920	9,920
Total	**30,856**	**30,018**	**34,380**
Fixed costs	**20,000**	**20,000**	**20,000**
Plus let land	**0**	**680**	**2,380**
Net margin	**48,044**	**49,562**	**46,900**
Change over control system	**-**	**+ 1,518**	**- 1,144**
Sensitivity analysis of dairy concentrate costs ± £10/tonne	± 400	± 288	± 510

Economic Evaluation

1. Control diet

   The control diet for the milking cows leaves a margin of £48,044 or 50.0p/gallon. The variable costs for fertiliser, silage making and contractor costs are calculated using the Teagasc publication *Management Data for Farm Planning 2000* while the other variable costs and fixed costs are calculated using the *National Farm Survey 2000* (mainly dairying data). On individual farms the costs of milk production will vary from the figure presented here of 48.6% of gross output as net profit. A range in the cost of milk production of from 35% to 80% is commonly observed at farm level.

2. Maize silage

   Net margin increased compared with the conventional system by £1,518. Over half of the increase in net margin came from a reduction in variable costs and the balance came from the release of land from second cut silage production. Concentrate costs fell by £1,360 because of the reduction in the quantity of meal needed by the dairy cows to maintain milk production. Fertiliser/silage making costs rose by £522 principally because all of the machinery required to grow and harvest the maize silage is hired.

3. Concentrate System

   Overall the variable costs increased by £3524. The savings made through the reduction in fertiliser/contractor costs of an estimated £1,526 were lost because concentrate costs rose by £5,050. Ultimately net margin decreased compared with the conventional system by £1,144 even though the 28 acres of land used in the conventional system for second cut silage was let at £85/acre.

WINTER MILK

In the case of winter milk production, the same two options are compared with the 'conventional' two-cut grass silage system. The case study farm is a 120-acre; 107,200-gallon dairy farm stocked with 80 dairy cows and 20 replacement units. Yield per cow is held constant (at 1,400 gallons for the 32 winter calving cows and 1,300 gallon for the 48 spring calving cows) by restricting intake in the maize silage and concentrate systems. The physical details relating to acreage of pasture and maize silage and concentrate inputs are outlined in Table 3.

Table 3: Area of pasture, grass and maize silage and concentrate input (kg/unit) for the three winter milk production systems.

	Control	Maize	Concentrate
Silage harvested (acres)			
Grass 1st cut	50	38	50
Grass 2nd cut	28	11	0
Maize	0	12	0
Short-term letting	0	15	28
Concentrate input (kg/unit)			
Spring calving cows	500	360	638
Autumn calving cows	1,180	945	1,590
Dry cows	0	0	216
Replacement (0-1yo+1-2yo)	500	500	1,050

Assumptions

1. Control diet

   The control diet for the milking cows is based on the Teagasc blueprint diet for spring and autumn calving dairy animals (assuming a mean calving date of 1st February and 1st November respectively). Assumptions for the target condition score at calving, replacement heifer management, net energy allowances and the cost of the concentrates fed are as for the spring calving case study. Dietary allowances were calculated to feed spring and autumn calving cows to 6 and 6.5 gallons/day at peak yield respectively.

2. Maize silage system assumptions as per spring calving case study. Replacing grass silage with maize silage pre- and post-turnout increased the cost of the concentrate fed to £160/tonne (because of the higher protein content required) but reduced the concentrate requirement of the autumn calving cows by an estimated 235kg.

3. Concentrate system

   Assumptions for the spring calving cows, dry cows and replacement heifers are as per the spring milk case study. An estimated extra 138 / 410kg concentrate are fed to the spring / autumn calving cows respectively compared with the control system.

The cost of producing milk based on the three production systems is outlined in Table 4.

Table 4: Estimated costs of production (£/system) for the three winter milk production systems.

	Control	Maize	Concentrate
Gross output	**121,380**	**121,380**	**121,380**
Variable costs			
Fertiliser/silage making costs	13,736	14,631	12,210
Concentrate costs	10,469	8,803	16,108
Other variable costs	10,144	10,144	10,144
Total	**34,349**	**33,578**	**35,252**
Fixed costs	**25,000**	**25,000**	**25,000**
Plus let land	**0**	**1,275**	**2,380**
Net margin	**62,031**	**64,077**	**60,298**
Change over control system	**-**	**+ 2,046**	**- 1,733**
Sensitivity analysis of dairy concentrate costs ± £10/tonne	± 618	± 475	± 823

Economic Evaluation

1. Control diet

   The control diet for the milking cows leaves a margin of £62,031 or 57.9p/gallon. This is the equivalent of a net margin of 50.5% of gross output. On most winter milk farms the fixed costs are normally higher than those observed on spring milk farms. The fixed costs included in this case study are again based on those recorded in the *National Farm Survey 2000* but adjusted to reflect the higher fixed costs generally observed with winter milk production. However the assumption that they remain constant across all milk production systems allows the fixed costs to be included for comparative purposes within the case study.

2. Maize silage

Net margin increased compared with the conventional system by £2,046. In this example over one third of the increase in net margin came from a reduction in variable costs and the balance came from the opportunity cost of the released land from second cut silage production. Concentrate costs fell by £1,666 because of the reduction in the quantity of meal needed by the dairy cows to maintain milk production. Fertiliser/silage making costs rose by £895 principally because all of the machinery required to grow and harvest the maize silage is hired.

3. Concentrate system

Overall the variable costs increased by £903. The savings made through the reduction in fertiliser/contractor costs of an estimated £1,526 were lost because concentrate costs rose by £5,639. Ultimately net margin fell compared with the conventional system by £1,733 even though 28 acres of land was let for second cut silage making at £85/acre. Thus, similar to the spring calving system, the letting of land did not compensate for the increase in variable costs.

CONCLUSIONS

1. Alternative systems of milk production may improve margins on dairy farms. Most of the increase in net margin obtained from the maize silage, milk production systems came from the opportunity cost of letting some of the land for second cut silage. Where such an opportunity cost could not be realised, the improvement in net margin would be reduced.

2. The above figures for the maize silage system relate to a situation where no area aid payments are being collected on the maize silage area. Where eligible land is available but not being utilized, net margin would potentially increase by an additional £1,300. If area aid payments are currently being drawn on such eligible land, the economic benefit of area aid is not a relevant consideration. The same considerations apply if cereals are grown on the farm for animal feeding.

3. Where land is limiting, this analysis suggests that it makes more economic sense to include a higher concentrate level than to take land at the costs and production levels assumed in the study only if such dairy rations can be obtained at approximately £20/tonne less than the cost used here.

4. The potential benefits of feeding higher levels of concentrates are greatly reduced where we are feeding to a fixed quota (assuming that the milk : concentrate price ratio remains constant). If we allowed performance to increase, further benefits would accrue to the high concentrate system depending on the return from the alternative use of the released land.

5. It was assumed in both systems that no changes were needed in the adoption of the alternative system. Maize silage may be fed without using a diet feeder. However if one is purchased to feed the maize silage, fixed costs would increase by approximately £2,000 p.a. for the feeder. Similarly fixed costs would increase by approximately £500 p.a. for a meal bin or cereal bunker if one was required to storing concentrates/cereals in the high concentrate system. The cost of purchasing an additional tractor to operate a changed milk production system was not included either. In both case studies, the additional costs would eliminate most of the extra profits or further reduce margins accruing to the change in system.

UNDERSTANDING THE VALUE OF FEEDS

Pat Clarke, Teagasc, Kildalton

The easiest way to value feeds is on a cost per tonne basis. It is easy to see that a feed costing £155/t is 20% more expensive than a feed costing £130/t. But it is not that simple. Instead of looking at cost per tonne the nutritive value of the feed should be considered i.e. energy and protein. This will give a better indication of the true value of the feed.

Table 1 illustrates the relationship between cost per ton and cost per kg dry matter (DM) for some common energy sources. A unit of energy is one UFL(I). When ranked on a DM basis citrus pulp is cheapest at 9.7 pence / kg DM and molasses is next cheapest. But when the energy is valued these ratings change. Citrus is still the cheapest form of energy at 8.5 pence/UFL(I), but barley and wheat are next.

Table 1: Energy feeds ranked as pence / kg dry matter (DM) with associated pence /unit net energy (UFL(I))

	£ /t Fresh wt.	DM%	£/t DM	P/kg DM (rating)	UFL (I) /kg DM	p/ UFL (I) (rating)
Citrus pulp	85	87.5	97.1	**9.7 (1)**	1.14	8.5 (1)
Molasses, beet	86	76.1	113	**11.3 (2)**	1.03	11.0 (4)
Wheat	103	86.6	118.9	**11.9 (3)**	1.16	10.3 (2)
Barley	105	86.6	121.2	**12.1 (4)**	1.16	10.5 (3)
Soya hulls	108	87.9	122.9	**12.3 (5)**	1.01	12.2
Molassed beet pulp	114	88.1	129.4	**12.9 (6)**	1.14	11.4
Maize gluten	131	86.5	151.4	**15.1 (7)**	1.04	14.6
Maize	132	86.0	153.3	**15.3 (8)**	1.22	12.5
Distillers grain	148	89.0	166.3	**16.6 (9)**	1.16	14.3

The same situation applies to protein sources. Table 2 outlines some common protein feeds. A unit of protein is one PDIE. On a DM basis sunflower is the cheapest at 14 pence / kg. But when protein is valued soya is cheapest at 0.104 pence/PDIE.

Table 2: Protein feeds ranked as pence / kg dry matter (DM) with associated pence /unit protein (PDIE)

	£/t Fresh wt.	DM %	£/t DM	p/kg DM	PDIE /kg DM	p/PDIE
Sunflower	125	85.6	140	14.0 (1)	119	0.118 (2)
Maize gluten	131	89.0	151	15.1 (2)	121	0.125 (4)
Distillers grain	148	86.5	166	16.6 (3)	136	0.122 (3)
Peas	152	91.5	177	17.7 (4)	100	0.177
Rape seed	168	86.4	194	19.4 (5)	143	0.136
Cotton seed	188	86.0	218	21.8 (6)	141	0.155
Soya	225	86.4	260	26.0 (7)	249	0.104 (1)

**It is the amount of energy and protein in a feed that should be valued when buying a feed. Also remember that some ingredients have a maximum inclusion level.*

MAIZE PRODUCTION

Brian Hilliard / Jerry McCarthy, Teagasc

Maize produces very high quality forage with the potential for high dry matter intake and high animal performance. Where target yields are achieved and where Area Aid is claimed the cost per tonne of dry mater is significantly less than grass silage. There are no rotational constraints with the crop and it utilizes slurry very efficiently. The key targets for the crop are as follows:

- Forage DM yield 15.0t/ha
- Silage dry matter 28%
- Starch 25%

Site Choose a sheltered south-facing field with good drainage and ideally immediate access to a roadway. A pH of 6.0 – 6.8 is satisfactory. Avoid altitudes greater than 100m.

Sowing The optimum sowing date is mid April to early May.

Seed Bed Prepare a fine firm seedbed similar to that for root crops

Plastic In Teagasc trials the use of plastic has resulted in on extra 3.7t/ha of dry matter and an extra 2.5t/ha of starch. Plastic also advances maturity date.

Weed Control Control weeds early. *Atrazine* will suffice for the first two years in the rotations. As nightshade becomes a problem tank mixes will be required.

Pests Check for Leatherjackets and Cutworms and spray if required.

Harvesting Ideally harvest by 20th October. The cob should be fully mature and whole crop dry matter between 28-32%.

Ensiling Keep chop length short i.e. less than 2cm. Consolidate the clamp well and seal properly.

Whole Crop Cereals

Jim O'Mahony, Crops Specialist, Teagasc, Kildalton

Any cereal crop can be ensiled as whole crop but it is now considered that wheat produces better quality feed. It is usually grown in areas unsuitable for maize silage and it must receive the same treatment as would a high yield potential grain crop. The proportion of grain (and hence starch) is the crucial factor in determining feeding quality. Crops should be cut at about 30-40% dry matter when the grain is at the cheesy stage.

Whole crop has a similar capacity to maize silage to increase feed intake and the most recent indications from Grange are that substantial benefits in terms of carcass gain are achievable compared with very good grass silage.

Whole crop wheat can be produced at a cost per tonne of about £60 per tonne without claiming arable aid. It is more expensive to produce than maize silage and, on average, has a lower value for feeding by about £10/tonne of DM. It also needs to be balanced for protein and minerals.

Production - Keys to Successful Winter Wheat

1. Sow top yielding feed variety in October - November.
2. Need pH of of 6.4-7.0 and follow Teagasc recommendations based on S4 soil test for NPK and trace elements.
3. Pest control includes aphids in autumn and at heading and possibly slugs at emergence.
4. Weed control will usually be applied in autumn with aphicide.
5. CCC should be applied for straw strength.

6. Disease control should be based in a 3 spray programme T1 @ first node, T2 @ flag leaf, T3 @ heading.

Harvest at 30-40% DM which is about 2-3 weeks before normal combining.

Whole Crop Wheat

- Alternative forage
  - High DM silage
  - High intake
  - High performance

- Low cost
  - £35/t DM
  - Including Area Aid £306/ha (£124/ac)

Crop Targets

- Grain yield 8.5t/ac + (3.5t/ac +)
  - Winter wheat grown to high standard

- Harvest at 30-40% DM
  - 2-3 weeks before normal harvest

TREATMENT OF GRAIN

Pearse Kelly, Teagasc, Kildalton
Christy Watson, Teagasc, Naas

Caustic Treatment

Sodium hydroxide (caustic soda) properly applied can breakdown the feed coat of cereal grains, and improve degradability in the rumen without the need for further processing (e.g. rolling). The treatment itself is a dangerous operation and is best be carried out using a diet mixer / feeder. This process is time consuming and cooling time must be allowed before final storage. Caustic treatment applies to crops harvested at the conventional growth stage. It is not clear if there are any inherent advantages in caustic grain feeding other than the ability to store home grown grain and to feed without further processing. The alkaline nature of the product would reduce the direct risk of acidosis compared to untreated grain but is not proven to buffer other feeds. Caustic grain is normally fed at a maximum level of 3 kg/day to finishing cattle.

Urea Treatment

Grain harvested at approximately 30% moisture can be treated with urea to produce an effect similar to that of caustic grain. Enzymes in the grain convert the urea into ammonia, which acts on the seed coat, improving degradability in the rumen. Either a mixer wagon or an augur can be used to add the urea, which can be bought in proprietary liquid form.

Following treatment, the product is stored in a pit or clamp under a plastic cover. A long narrow clamp is best, and some compaction at filling is desirable. The urea increases the protein content of the grain to about 18 to 22 %, but otherwise, the feeding value on a dry matter basis is unaltered. It is very important that the correct amount of urea be applied. Urea treated wheat can be fed whole to cattle, but there appears to be a benefit from rolling/milling urea barley, particularly in the early stages of feeding and at very high feeding levels. Grain should never be crimped or rolled pre-treatment and moisture content should not be lower than 28%. The crop must be ensiled for 4 weeks before feeding. The treatment cost per tonne is about £13 to £16.

Crimping

Relatively immature grain at about 30% moisture content (3-4 weeks pre ripening) is subjected to mechanical pressure (special roller) to damage the seed coat, treated with organic acid as a preservative and is stored as for urea treated grain.

Very little feeding information is available on the product as of yet but feeding value should be equal to that of conventional grain on a dry matter basis. The cost of crimping and acid treatment is about £15 per tonne, depending on the tonnage treated and the dry matter.

Advantages

Urea treatment and crimping allow for earlier harvesting, home storage and potential feed cost reductions. Earlier harvesting may maximise the total dry matter production per hectare, certainly spreading the harvest workload and improves the feeding value of the straw. No special machinery is required for feeding.

Poor in-store management could result in high storage losses. Birds and rodents can be a problem with crimped grain.

USE OF ALTERNATIVE FEEDS

Tom O Dwyer, Teagasc Kildalton

There are four commonly available alternative wet feeds – brewers' grains, pressed pulp, fodder beet and molasses. A fifth - is a combination of brewers' grains and dried molassed beet pulp nuts – and is known as pulp ‘n’ brew. This summary reviews the information available on these alternative wet feeds.

Brewers Grains

- By-product of the brewing industry made up of spent grains.
- Dry matter varies from 20-25%
- Introduce gradually into diet and watch out for mould growth if stored.
- High Ca: low P mineral mix required.
- In a UK experiment where approx. 30% grass silage was replaced by brewers’ grains, total DMI (+24%), milk yield (+13%) and milk protein (+7%) increased.
- A simple guide is that 3.75 kg of brewers’ grains will replace 1 kg of traditional concentrates

Pressed Pulp

- Residue after sugar has been extracted from sugar beet
- Dry matter of approximately 22%
- Low in crude protein and therefore needs to be supplemented with a protein source if being used to replace grass silage.
- Can be used either to replace concentrates or as an additional feed.
- In an experiment at Moorepark, total DMI, milk yield, fat % and protein % increased when pressed pulp was fed as an extra feed (10 kg/day). The response in terms of milk yield was 1.06 kg milk per kg supplement.
- Low Ca: high P mineral mix required.

Fodder Beet

- Fodder beet is a cheap source of energy but involves more labour than other feeds e.g. in storing, cleaning, chopping etc.
- Low in crude protein and minerals/vitamins; needs to be supplemented with both for a balanced diet.
- Can be fed as an extra feed with concentrates to increase milk yield with no effect on milk composition.

- Alternatively, fodder beet can be fed to replace concentrates with little or no reduction in milk production (when adequately supplemented with protein, minerals and vitamins).
- High Ca: high P mineral mix required.

Molasses

- Two types - cane or sugar beet. Mostly cane molasses used in Ireland.
- Contains 70-75% dry matter of which 50% is sugars.
- Low in crude protein %.
- High in potassium and salt, known to be a laxative to animals.
- In an experiment at Moorepark, total DMI, milk yield and milk protein % increased when molasses replaced approx. 30% of grass silage.
- Low Ca: high P mineral mix required.

Pulp 'N' Brew

- Combination of dried molassed beet pulp nuts and wet brewers' grains ensiled together. The recommended procedure is to add up to 200 kg of dried molassed beet pulp per tonne of fresh brewers' grains.

Typical Analysis (g/kg DM)

	Brewers' Grains	Pressed Pulp	Fodder Beet	Molasses	Pulp 'n' Brew
Dry matter %	20.5	22.0	19.0	73.5	33.0
Crude protein	300	104	90	111	220
PDIE	189	100	88	68	
UFL (l)	0.92	1.11	1.12	0.91	
Ca	3.3	8.1		12.1	0.40
P	5.7	2.2		0.9	0.40

Relative value of alternative forages*

	UFL (per kg DM)	PDIE (per kg DM)	Value, £ (per t DM)	DM %	Value, £ (per t as fed)
Barley	1.16	103	121.2	86.6	105
Soya	1.18	269	260.4	86.4	225
Brewer's Grains	0.92	189	185.8	20.5	***38.0***

Pressed Pulp	1.11	100	117.2	22.0	***25.8***
Fodder Beet	1.12	88	107.5	19.0	***20.4***
Molasses	0.91	68	84.4	73.5	***62.1***

**The relative value of alternative wet feeds was calculated relative to barley and soya - using the energy and protein values above.*

The above table puts a value of £38/t (as fed) on brewer's grains. Therefore, if you can purchase them for less than this, they represent good value for money (on an energy and protein basis). Other items, such as feeding facilities available on the farm and cost of transport should also be considered.

Diet Feeders

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The diet feeder, like any other input, has advantages and disadvantages associated with it. As with any other investment or input decision, costs and benefits should determine whether its use is viable on a particular farm. This calculation is often complex for two main reasons:

- Machine costs are always difficult to calculate.
- Benefits, such as less manual labour, improved feeding management, the ability to use mixed forage diets etc., are difficult to value.

The concept of 'complete-diet-feeding' (also known as 'total-mixed-ration' feeding) has been around for some time. Complete diet feeding (or TMR) requires a mixer wagon to mix and distribute the feed components immediately prior to feeding.

The first mixer wagons used on the Irish market were multi-auger-type machines that were not well suited to our wet forage. The introduction of the open-paddle mixer wagon by Keenans in 1983 (and adopted by many others since) brought mechanical reliability to a product that needs to work unfailingly through the feeding period.

Mixer Wagon Attributes

The mixer wagon brings more than just the ability to mix a concentrate ration with a forage feed. The following attributes are common to most diet feeders:

- Concentrate and forage ration constituents can be mixed.
- Complementary forages (e.g. grass silage and maize silage) can be mixed.
- Mixed rations can be dispensed evenly, directly in front of the animal.
- Feeding can be accurately controlled and monitored.
- Concentrate diet component can be mixed from straights.
- Roots can be cleaned, chopped and mixed into a ration.
- Straw can be chopped.
- Whole grain can be treated with alkali products to improve digestibility and storage characteristics.
- The wagon can provide the ability to transport feed efficiently from feed storage area to feeding shed.

It is unlikely that all of these benefits/uses will be utilised on any one farm. Different farms will use mixer wagons in different ways. This must be considered when evaluating the cost/benefit ratio.

Using Diet Feeders

Home Blending

For many, the ability to formulate cost effective home rations by mixing keenly purchased straights in the diet feeder is the principal reason for owning a diet feeder. Normal procedure is to pre-mix a wagon-load of blended straights to ensure accurate proportioning and proper mixing of the constituents added in small quantities. This pre-mix is then dumped out and the required quantity is added to each load of total mixed ration, when feeding.

If farm blending is being practised, adequate feed storage space is needed for straights and the blended ration. Many smaller farms with diet feeders are now purchasing ready-made blends from compounders/merchants. While this is convenient, it leaves less scope for cost saving.

Incorporation of Other Feeds

The diet feeder offers a practical way of transporting, mixing and blending a variety of feed types:

1. Where complementary forages, such as maize or whole crop wheat, are being fed grass silage, the use of a diet feeder to mix the forages is a practical way of presenting them to the animal.

2. Roots (fodder beet, sugar beet etc.) can be mixed and fed with a diet feeder. Some models can wash and chop the roots also.

3. The diet feeder is a practical way of feeding moist or wet feeds, such as brewers grains, pressed pulp or liquid feeds, such as molasses.

Treatment of Grain

Diet feeders facilitate the treating of grain with caustic soda (NaOH). This treatment breaks down the seed coat eliminating the need for further processing, such as rolling or grinding. The 'soda-grain' process also allows moist grain to be stored without the need for drying or aeration, although careful monitoring of the stored product is necessary to avoid spoilage. Proponents of the system make much of the balancing nature of the alkali soda-grain, particularly when it is fed with low pH silage. There is some research with dairy animals to support this, but other work questions the digestibility of the caustic-treated grain. The level of feeding of soda grain must be carefully controlled to avoid excessive sodium uptake.

Workrates/labour

It is occasionally claimed that diet feeders can have a marked influence on the workrate of the entire feeding operation. This depends on many factors including:

- The feeding system that the wagon is being compared with.
- The feed mix being used.

- The size of the wagon
- The distance between feed storage and feeding area.

In a survey of feeding system workrates, carried out in 1992, the performance of the mixer wagon system was assessed. On average, it took 19 minutes to complete a feeding cycle (one load) with a $10m^3$ wagon, resulting in a feed rate of 11.4 t/hr. This figure was substantially less than feed rates recorded with high-output direct silage feeding systems (14-25 t/hr), but the typical mixer wagon load includes concentrates and often alternative forages also.

When a comparison between mixer-wagon feeding of a complete diet and separate mechanical feeding of the individual components of the same diet was made, the workrates were quite similar.

If the livestock building is some distance from the feed storage areas, then the diet feeder can speed up the feeding operation.

There is little doubt that the diet feeding operation generally eliminates ancillary manual work such as handling of meal bags, forking silage into a barrier, etc. It is a streamlined mechanisation system.

Tractor and Loader Requirements

- A tractor is needed to power the wagon: usually 50 kW+ category.
- A tractor loader with a good lift height (3.4 m) is needed to safely load a wagon.
- An implement quick-hitch device is needed on a tractor loader to allow a quick interchange of bucket/grab during the wagon fill cycle. Tractor loader quick attach units are not that easy to operate due to restricted visibility.
- An industrial loader is typically easier to use with a diet feeder as it is faster, more stable and has good visibility.
- Mixer wagons require good access to buildings and straight through passageways to avoid the need for reversing.

Diet Feeder Costs

A move to diet feeding on individual farms usually involves additional machinery costs - the cost of the feeder itself and the cost of any additional equipment needed to load it. The cost of feed storage space may also need to be considered. The cost of the diet feeder is the principal cost involved in a change to complete diet feeding. The price of a mixer wagon depends on its size, specification and make. The most common wagon is a $10m^3$ unit with weigh gear, with a list price of approximately £16,000 incl. VAT. Weigh gear is essential if feeding is to be accurately controlled and monitored. Options, such as elevator feeders, chopping knives (for bales etc.) can add considerably to this cost.

As with all machines: depreciation, interest and repairs are the principal cost components. These are influenced by machine cost, use level and replacement age. Unfortunately, we have not got a reliable source of cost data for diet feeders, but the Oak Park cost program allows cost estimates to be made based on use level, age at replacement and initial cost.

Annual Machine Costs

Estimates of the annual costs of owning a diet feeder are given in Table 1. Six scenarios are costed, all based on a standard specification $10m^3$ wagon. Three different sized feeding systems are envisaged: 65, 125 and 250 livestock units (LU). Different replacement ages are selected, either 8, 12 or 15 years as indicated in the table. The resulting total machine costs and cost per LU fed are given. These figures are estimates, but they probably are quite reasonable.

The replacement age may be quite conservative, but a residual value, depending on age and use level, is factored in to the depreciation calculations. If a combination of maintenance and good machine construction could extend the replacement age, then machine costs may be reduced. It is clear that economies-of-scale apply, with the largest unit capable of achieving much lower costs per animal (£10.02). Replacement age is also important, particularly on smaller units.

Table 1: Estimated diet feeder costs on three different farms: 63, 125 and 250 LU

Mixer wagon: 10 m^3 ***List price: £16, 000*** **incl. VA T** **Discount: 17%**

Livestock Units	Replacement Age	Annual Machinery Cost (£)	Annual Cost/Livestock Unit (£)
63	8	1,546	24.53
63	12	1,227	19.46
63	15	1,095	17.37
125	8	1,807	14.46
125	12	1,490	11.92
250	8	2,506	10.02

Ancillary Costs

The mixer wagon is not the only cost associated with diet feeding. On larger farms, the ancillary equipment, such as a suitable loader and tractor to operate the wagon, will often be available.

The only extra cost over an existing feeding situation would be the marginal running costs of the tractor operating the wagon, which would be an extra £3.00 per LU fed on a 125 LU farm.

On smaller farms a front loader upgrade is often required. On some farms a diet feeder may be used to justify the purchase of a second tractor or second-hand industrial loader. The extra annual costs that these impose on a 125 LU farm, are outlined in Table 2.

Table 2: Ancillary equipment costs if required on 125 livestock unit farm

	Annual (£)	Cost/Livestock unit (£)
Tractor running costs	350	3.00
Loader upgrade[1]	275	2.20
Cheap tractor purchase	1,200	9.60
S/H Industrial Loader[2]	1,100-3,300	8.80-26.40

[1] difference in cost between low-spec and high-spec loader
[2]dependent on purchase price and use level

The costs to be added depend on the farm situation. Smaller farms usually require more ancillary equipment to be purchased. Other costs, such as storage facilities for ration components, must also be considered. On a 125 livestock-unit farm, this could add from 0 up to £7 per livestock unit in costs.

The cost of adopting diet feeding can be considerable. On large farms, it may be just £10/animal/year, which could easily be offset by savings on concentrates etc. On smaller farms where ancillary equipment is required, £20/animal may be more typical, and much higher figures could be appropriate in certain cases. The decision to change to diet feeding needs to be taken carefully. Costs and benefits must be assessed.

Multi-Farm Use

While larger units benefit from strong economies-of-scale, both in machinery and ancillary costs, does this preclude smaller units from benefiting from diet feeding? Although rarely practised, feeding equipment is quite suitable for shared operation, or a contractor-type operation, where the costs can effectively be spread over a number of farms. At its simplest form, two farms could join: one supplying loading equipment, the other supplying the diet feeder, and each charging an appropriate fee for their service. More extensive contracting could also be possible. These alternatives to single-farm ownership should be considered as they can solve labour problems, in addition to facilitating the use of improved mechanisation at lower cost.