Maximise utilisation of grazed grass in beef production to meet market demands of the future

A report for Nuffield Ireland

By Eddie Kehoe

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Title	Maximise utilisation of grazed grass in beef production to meet market demands of the future.
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Summary Objectives of the Study tour	• To maximise quantity and quality of grass growing • Management techniques to best utilise grass • Identify suitable animals for future market demands.
Countries Visited & Studied	United Kingdom (UK), New Zealand, Brazil and Ireland.
Key Findings	• Fertile, well-drained and non-compact soil is essential for quality grass growth and will facilitate the implementation of effective management practices • Forward planning and paddock rotational grazing ensures maximum grass growth and efficient utilisation of grass • Consistency and quality is imperative to meet market demands.

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Executive Summary

Beef farming has always been a low margin enterprise with an emphasis on extensive production in many parts of the world and often poorer quality land is used for this enterprise. Part of this paper explores how beef farming operates at an extensive level in countries such as Brazil and New Zealand. However, the possibility of intensive production of beef also exists in countries with a temperate climate and which are located near high price markets. The combination of proximity to these markets and the ability to produce beef from low cost grass based systems in countries such as Ireland were the stimulus to determine the factors involved in devising a blueprint for such a system.

Research conducted in New Zealand highlighted key process elements required to achieve optimum soil condition in order to maximise the quantity and quality of grazed grass being produced from the soil. In New Zealand the best land is devoted to dairying and the production of grass forms the backbone of this system. There are a number of key components in a successful grassland production system.

The first step must be to carry out soil fertility tests to identify those nutrients which are in existence and above all to highlight the deficiencies which need to be addressed before proceeding with the process of establishing productive grassland including the re-seeding process. Once the desired soil conditions are achieved the research highlights the importance of selecting the correct varieties of grass seeds to achieve a high output of quality grass growth which will enable a high level of beef stocking to be carried. Once the crop is established and available for consumption it is critical to ensure appropriate grass management practices are implemented to guarantee the maximum utilisation of the grass grown on Irish farms. Such practices include regular grass measurement, budgeting and the employment of grazing methods in particular paddock rotational grazing.

A visit to the UK was motivated by a keen interest in the research work by IBERS in the UK into the breeding of grass varieties (perennial ryegrass) e.g. Aberwolf. This new grass has

been developed from decades of plant breeding and as well as high yield and good persistency has the characteristic of high sugar levels which means good animal intake and better animal performance. In the future it is the development of this type of grass variety which will improve the output of beef at farm level.

Identification of future beef market demands

Research findings from the UK indicate that at present of the 90% of the beef being exported from Ireland, 53% of these exports go to the UK market (Appendix 1.2). Due to changes in consumer demand and the potential increase in the dairy sector Irish farmers need to be fully aware of and be in a position to fulfil market demands.

Research findings from this study identified consistent carcass weight, age and fat cover as being the key considerations in beef production in order to meet customer demands. Heavy beef carcasses are no longer a market demand. This significant change will influence what the Irish beef farmer produces and the requirements of processors. The specific carcass weight requirement is to accommodate fixed size packaging which will regulate the price for the consumer and increase the quality and shelf life of the meat.

Meeting market demands combined with the ability to produce a high output of beef from grass based systems are the ingredients needed in establishing a successful beef sector in the future. This paper with its combination of established research from different countries and first-hand experience of farming practice in various parts of the world attempts to point the way forward for the industry and producers alike.

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Contents

Vita

The author grew up on a beef farm in Co Wexford, in the South East of Ireland. He attended Gorey Community School until 1997 and in 1998 attended Gurteen Agricultural College where he was awarded a Certificate in Agriculture. On completion of this course he returned home and took over the management of the family farm. His family farm consists of 132 acres and the enterprises on the farm are suckler cows, beef and sheep. He is currently Chairman of the North Wexford Suckler Cow Discussion Group and has held this position for the past 3 years. He is also a member of the Irish Farmers Association (IFA) and is an active member in his local community.

Chapter 1 Introduction

The purpose of the study was to research areas on a local and international level where beef is produced from grass-based systems in order to identify the key practices that are essential to efficient grassland production. The marketing of this grass-fed beef is the second part of the study with the aim being to identify the key issues affecting the demand for this product from the producer and the factors affecting the marketing of grass-fed beef to the consumer.

Objectives:

- Increase the quantity and quality of grass grown and combine this with good grass management techniques in order to increase the carrying capacity and output of beef on farms.
- Reduce the input costs of beef production through more efficient utilisation and increased performance off grass.
- Identify animals and finishing systems most suitable to producing a product that meets the market specification.

The study will be relevant to those involved in the production of beef cattle, the processors of cattle and those marketing the product as it will enable all concerned to take a global view of the issues and to focus on the way forward for the industry. The Irish beef industry is undergoing change at present due to an increase in the dairy herd and a decline in the suckler beef herd (Moran, C., April 2014) Those involved in cattle rearing will have to re-assess the type of animal they are producing and the purchasers of these animals will have to indicate how they can market these animals.

Research methods:

Literature

The literature used in this report comes from a variety of sources and comprises of the following:

1) Moorepark Animal & Grassland Research and Innovation Centre
2) Grange Agriculture and Food Development Authority
3) Teagasc Agriculture and Food Development Authority

Countries researched and travelled

The author travelled to the UK, New Zealand and Brazil. The UK was chosen because of its proximity and the Irish dependence on the UK market for Irish beef. In terms of production the fact that the UK has a similar climate means that their beef production systems are relevant to Ireland including research carried out there on grassland production.

New Zealand has a temperate climate broadly similar in many areas to that of Ireland and is acknowledged as being to the fore in growing grass. New Zealand was visited in order to study the various grazing systems in use in that part of the Southern hemisphere.

Brazil is acknowledged as a major producer of beef although their systems of production differ considerably with an emphasis on making use of low cost production systems but on poor quality grassland. While in Brazil, the author analysed the cost of finishing animals in a particular feedlot system in Brazil

Private interviews

The author interviewed a Senior Research Officer in Moorepark (Ireland) and a Professor in Lincoln University (New Zealand) as part of the research process into soil and grassland management.

Many on site interviews were conducted with farm owners and managers in New Zealand on grassland management techniques to best utilise grass. On a local level, consultations and

trials were conducted with the developers of the latest technology developed in Ireland to measure grass. (Appendix 1.1)

Agricultural Managers of key retail outlets (Tesco, Sainsburys and Asda) were interview with a view to identifying future beef market demands. Contact was also made with the Chief Executive Officer of Bord Bia with regard to the marketing of Irish beef.

The author interviewed the Managing Directors of a number of processing plants in Ireland, the UK and Brazil. Companies visited included (Dawn Meats (UK & Ireland), Slaney Foods International (Ireland), Dunbia (UK) and JBS Slaughtering Plant (Brazil). Representatives of these companies were interviewed in order to establish the key characteristics required in an animal that would be most suitable for processing and meeting the quality standards required.

Conferences attended

The author attended the Teagasc National Beef Conference 2011, ASA (Agricultural Science Association) annual conference in 2013, and the Teagasc Beef Conference 2014, all of which were held in Ireland.

Chapter 2 Findings

Soil

2.1 Compaction

Soil compaction is an increase in the soil density which in turn solidifies the soil and reduces the pore space. Soil compaction is a common occurrence in soil with a natural higher water content and can also be seen in dry grounds due to periods of heavy rainfall. The compaction of this wet soil occurs with the use of heavy machinery and the trafficking of livestock. Research work conducted by Moorepark demonstrates that compaction reduces the capacity for air and water movement and infiltration within the soil. These conditions result in increased water runoff, poor root growth and a reduction in the microbial life due to a lack of oxygen. Surface runoff increases the likelihood of artificial fertiliser been washed into streams and rivers instead of feeding our plant. A reduction of root growth will limit root function such as crop anchoring and water and nutrient uptake. The important contribution of microbial life to healthy plant growth is restricted and perhaps in more severe cases prevented.

In a study with ryegrass, the application rate of the nitrogen (N) has to be more than double on the compacted soil to achieve comparable dry-matter (DM) yields (Duiker, 2004).

From contact made in the course of this study, the author observed that a simple inexpensive way to identify compaction is dig some cubes from the ground and carry out a visual assessment of the cubes. Indicators of soil compaction include difficulty in digging the cube, shallow thread like root formation and where the cube breaks or cracks in horizontal layers rather than vertical layers when broken down. The two most common methods to resolve soil compaction difficulties are the use of a soil buster or by subsoiling. Soil compaction will greatly reduce the yields of DM of the crop.

2.2 Drainage

Before considering growing good quality and quantities of grass it is advisable to ensure soil conditions are suitable in order to achieve the desired outcome.

The first step is to assess, the soil drainage capacity. Soil drainage is a necessary step to remove excess water from soil. Excess water in soils will inhibit grass growth and

consequently restrict good grass land management practice. This will lead to extra production costs on the farm and will limit the length of the grazing season. The end result may lead to a later turn-out date in spring and an earlier-than-planned re-housing in the autumn. Poaching (pugging) of soil is a common occurrence when there is excess water in the soil leading to poor utilisation of the grass. Poaching is the term used when animals walk the grass into the ground and damage the surface of the soil. This also contributes to root damage of the grass. Root damage results in a poor regrowth of grass leaving the surface of the soil exposed. When the soil is exposed this will lead to weed growth in the pasture and will increase the likelihood of the regrowth of poor quality grasses and could lead to the increased costs associated with reseeding. Weeds and poor quality grasses offer little nutritional value to animal feed and will compete with grass for the nutrients and fertiliser in the soil. Research work in Moorepark demonstrates the importance of identifying the type and structure of the soil before deciding on a particular drainage system. It is important also to analyse the soil characteristics on a field by field basis as soil types and associated features can very within a farm (Moorepark Dairy Levy Research Update, Series 22, p.14, 2014).

The most effective approach to establish soil characteristics is by conducting a site and soil test pit investigation. For drainage to be effective, a permeable layer at a workable depth is required. A permeable layer allows the flow of water, and the positioning of a piped drain within this layer creates a very effective drainage system. If this permeable layer does not exist, the other effective methods to increase water filtration include gravel moiling or sub soiling. Both of these methods increase the movement of water through soil to the piped drain. These piped drains lead to open drains around the perimeter of the field or farm.

The author observed in Waikato in New Zealand, the most common drainage methods used are conventional open ditch or box drains. These often form the boundaries between paddocks and are usually domed or humped towards the centre of the paddock to increase the runoff of surface water. Another drainage method used in New Zealand is ‘humps’ and ‘hallow’ formations. These humps and hollows remove surface and ground water to the main drain through the use of shallow spinner drains.

All of the above drainage systems may be used to lower the water table on the farm. The lowering of the water table will result in increased trafficability for stock and machinery, an

increase in root growth and consequently an increase in the availability of N in the soil leading to more productive land (Tuohy et al, p.140, 2014).

2.3 Soil testing

Carrying out soil analysis on a farm is generally advised as it determines the inputs required for efficient, economic and quality production. When carrying out soil tests it is good practice to carry out an efficient analysis of the soil testing results to grow grass for livestock. The preferred time of year to conduct a soil sample is in the middle of winter when the crop has finished growing or has been harvested and any application of fertiliser or soil nutrients are fully utilised for that year. When soil sampling, the person taking the samples should walk in a zigzag pattern to ensure uniform sampling distribution throughout the entire area. Using the information captured, an appropriate application of a suitable fertiliser product may be used to meet the requirements of the crop. Soil sampling will allow an informed decision to be made on which crop is the most suitable to take advantage of the nutrients already present in the soil.

A significant benefit of soil sampling is the ability to determine the pH levels in the soil. It is crucial to ensure the soil is at the correct pH level for maximum absorption of nutrients from the soil.

Following the detailed information obtained from soil analysis, it is possible to maximise the output of the area under assessment. It is recommended to soil sample every two to five years depending on the crop requirements.

2.4 Fertility

Correct soil fertility will maximise grass growth and crop production. The author found that to maximise grass growth a soil nutrient management plan needs to be implemented on the farm to address nutrient deficiencies. The management plan can be devised from soil test results. Index 3 is the optimum level for phosphorus (P) and potassium (K) to maximise grass growth. Research conducted by Moorepark Research Centre have found the ideal pH level for grass to be 6.3 in order to ensure maximum grass growth, N release and P and K availability (Lalor et al, p.53, 2013).

The application of lime increases the soil pH and stimulates the release of N from soil organic matter while increasing nutrient uptake and DM yields. Research carried out at Moorepark found that by applying 5t/Ha of lime to soils with a low pH (5.3) grass production would increase by approximately 1.5t DM/Ha over a two year period (O'Donovan et al, p.27, 2013).

Soils with a P index 3 would grow approximately 1.5t DM/HA per year more grass than those soils with a P index 1 (O'Donovan et al, p.27, 2013)

Fertiliser containing sulphur will add to the nutritional value of the soil especially on light free draining soils. A deficiency of sulphur in soil will reduce DM yields by up to 14% and reduce the response of N fertiliser (O'Donovan et al, p.27, 2013).

The correct minerals in the soil will contribute to plant growth and any mineral imbalance will have a negative effect on growth. (Appendix 1.3)

Grass

2.5 Reseeding

Research work in Moorepark demonstrates that reseeding is one of the most valuable processes to be performed by grassland farmers. Through the use of a continuous grass measurement programme practiced on the farm, farmers can easily identify poor performing paddocks. Where grass measurement programmes are not implemented poor performing paddocks can be identified by examining:

1. growth yields
2. sward content
3. responsiveness to fertiliser application.

Growth yields and sward content are best examined in early spring and late autumn when conditions are not at their optimum due to weather and soil conditions specifically associated with this time of year. These specific time periods are when old grasses are put to the test in terms of growth rates and quality and so poor performing paddocks are quickly identified ensuring sufficient time is available to reseed if/when necessary. Poor performing paddocks have a tendency to contain less than 50% ryegrass however in order to produce good quality and quantities of grass 70% ryegrass is necessary (O'Donovan & Creigton, p.32, 2012).

Lack of response to fertiliser application is another method of identifying an old unproductive grass sward.

In order to ensure that the desired outcome is achieved from the reseeding process the pH levels must be 6.3, P and K levels are index 3 and compaction and drainage are in the appropriate state to maximise output quantities and quality (Lalor et al, p.53, 2013).

Benefits of reseeding: (Moorepark Dairy Levy Research Update, Series 22, p.5, 2014)

These are:

- production of higher annual grass yields per Ha
- more efficient use of and response to the application of nitrogen

- achieve higher feeding quality resulting in increased live weight gain
- faster regrowth
- support and facilitate higher stocking levels and increased utilisation of grass grown.

Grass growth on the farm will increase substantially by carrying out the reseeding process correctly in poor performing paddocks along with the implementation of good grassland management practices. Research work conducted by Moorepark highlighted that pastures with a low proportion of perennial ryegrass are costing farmers up to €300/Ha/year due to a loss of DM production and reduced nitrogen use efficiency during the growing season (O'Donovan & Creigton, p.132, 2014).

Research conducted in Moorepark found that new grass reseeds produce 3-5t DM/Ha more than old permanent pasture (O'Donovan & Creigton, p.35, 2012).

There are two methods of reseeding most commonly used: namely, conventional ploughing and minimum cultivation. Both these methods when completed correctly are equally effective. Minimum cultivation techniques are predominantly used in stony light soil types that are less suitable to conventional ploughing.

2.6 Grass varieties

The author found when choosing a grass mixture it is important to have the right cultivars in the mix to maximise output from the sward. In a grass based production system high spring and autumn production are sought, and high mid-season quality and good ground cover are basic requirements. By considering the recommended list of varieties in a country, an informed and timely decision may be made on which most suitable grass mixture will suit the farm requirements (www.agriculture.gov.ie, www.eservices.afbini.gov.uk).

In Ireland perennial ryegrass is most commonly used due to its high digestibility and it's strong persistency as a species. In fields that are predominantly used for grazing, the grass mix should consist of late heading diploids with a proportion of tetraploids varieties. Tetraploids have less potential for tiller density but have a higher dry matter yield with a large leaf area. In addition, tetraploids produce 1t DM/Ha yield more than diploids but with less tiller potential and ground cover and therefore are less suitable on wet ground. On dry

grounds, a 40% tetraploids inclusion is sufficient when mixed with highly digestible diploids. In heavier wet soils however there must be increased use of diploids (Moorepark Dairy Levy Research Update, Series 22, p.22, 2014). Dense ground cover diploids will increase the shoulder grazing periods and reduce soil damage and poaching. When choosing grass varieties for grazing it is also important to use late heading varieties with less than a seven-days range among cultivars to keep quality grass ahead of stock. Small and medium leaf clover varieties with high yield and good grazing persistence at high and low nitrogen levels should be included in the grazing mix to maximise the use of natural nutrients available, while at the same time ensuring the desired quantity and quality of grass is achieved.

The author experienced at Aberystwyth University interesting research conducted there that highlighted the benefits of a new high sugar grass called Aberwolf which has been added to the UK national list in 2013. Aberwolf utilises nitrogen more efficiently, results in increased production efficiency, and improves farm economics and lower carbon footprint from livestock (Hayes, R., Lovatt, J. A. & Thomas, G. L. 12-Feb-2013 0). Further research into this grass variety may be of benefit to grass farmers in Ireland.

2.7 White clover

Research in Moorepark demonstrates the many benefits of white clover in a grass seed mix. Clover is a highly digestible high protein feed and thrives under low nitrogen fertiliser inputs. White clover fixes atmospheric N in excess of 100-200 Kg's of nitrogen per Ha per year and makes it available for grass growth (Phelan et al, p.136, 2014). This process is called Biological Nitrogen Fixation and is achieved by the activity of bacteria in the clover nodules. For the bacteria to perform this process sufficient quantities of molybdenum and iron are needed. To gain maximum benefits from clover, the fertiliser application rate should be less than 60 Kgs of N/Ha and applied during February to April (Hennessy et al, p.50, 2013).

Hennessy et al. 2013 reported that herbage production was on average 2t of DM/Ha greater when based on the grass-clover plots compared to the grass-only plots regardless of N application rate (Hennessy et al, p.50, 2013).

During the author's research visit to Moorepark it was interesting to observe the variation in milk and herbage production levels from a grass-only and a grass-clover sward. The grass-clover sward yielded on average an extra 1.1t DM/Ha/year, an extra 1.6 Kgs of milk per cow

per day and 0.12 Kgs per cow per day more milk solids. Both pastures received the same management and fertiliser rate (Hennessy et al, p.51, 2013).

To maximise clover growth good fertile soils with the required pH levels (discussed earlier) are required but there must be sufficient capacity in the soil to withhold moisture due to shallow rooting of clover plants.

In Ireland there are a variety of preferred white clovers used. For a small leaf, Crusader is most commonly used and for a medium leaf Chieftain is the preferred choice.

2.8 Red clover

Red clover is a tall clover used mainly to provide protein rich feed for silage. It has the ability to produce much higher yields than white clover. Red clover has deep tap roots which are beneficial when reaching for water and nutrients in soil while at the same time the roots assist in loosening the soil which improves soil fertility. Red Clover has a nitrogen fixation capacity of double the capacity of white clover as measured in N/Ha and it is of major benefit in organic farming systems.

However, when grazing animals on red clover swards caution needs to be exercised as there is the increased risk of animal bloat, along with increased levels of body oestrogen. To avoid bloat, livestock should not be introduced to pasture when hungry and animals should not be grazed six weeks prior to mating or six weeks post mating due to the high levels of oestrogen content. Results from trials conducted by EBLEX in the UK have found that lambs grazed on red clover swards finish faster, heavier and with increase kill out percentage when compared to a similar group of lambs grazed on a grass only sward (www.eblex.org.uk/clover).

Red clover provides high protein silage feed for beef animals. Amos and milvus are the most commonly used variety of red clover but like all red clovers they only have a life of three to four years in a sward.

Grass land management

2.9 Understand the plant

An understanding of how grass grows is fundamental to carrying out effective grassland management. Ryegrass only ever has three live leaves and as soon as a fourth leaf starts to appear the first leaf begins to die. When this outcome occurs there is a waste of good grass, a waste of nutrients in the soil and a lowering of the quality of the grass (McCarthy, p.30, 2009). Therefore the appropriate timing of placing stock on the pasture is vital. When grass is grazed at the optimum three leaf stage, grass growth is maximised, cattle performance is at its optimum and full benefit may be obtained from soil nutrients.

After grazing down to the target residual level (discussed later) it is best practice to remove the livestock from the paddock to allow the regrowth process of the plant to begin. The regrowth process commences with the appearance of the first leaf from the residual plant which uses the sugar stored in the plant roots. This process is visible within forty eight hours of reaching the desired residual level. If livestock are not removed from the paddock once the residual level is reached, the eating of the first leaf will naturally occur. This will cause a severe slow-down in the growth of the new plant as sugar levels will have already been consumed in growing that first leaf and the plant will struggle to repeat the process. The first leaf is vital to the regrowth process as it acts as a solar panel for photosynthesis to grow the second and third leaf as well as replenishing the sugar levels for the next cycle. The second and third leaf provides 75-80% of the total DM of this three leaf plant to feed animals.

2.10 Measuring and budgeting

Striking the balance between grass quality and quantity is a top priority of grassland farming (Grazing Guide, 2011). Ensuring top quality grass and optimum quantities of grass is kept ahead of livestock offers the greatest potential to increase profitability on beef farms.

Budgeting grass realistically starts in early October in order to set up the farm up for early turnout the following spring. The first paddocks for early spring grazing must be the first paddocks to be closed down in October. The 10th of October should be the target date to start closing down these paddocks as each day from this date to the 11th December reduces spring herbage mass by 15kg DM/Ha/day (O'Donovan & Hennessy 2011). The aim is to have sixty per cent of the farm closed by the end of the first week of November and the

remainder of the farm by the 1st of December. All paddocks should be grazed to a post grazing height of 4 cm during the last rotation to encourage winter tillering (O'Donovan & Hennessy 2011).

To maximise grass utilisation the grazing season must be broken into the three main grazing periods – spring, summer and autumn.

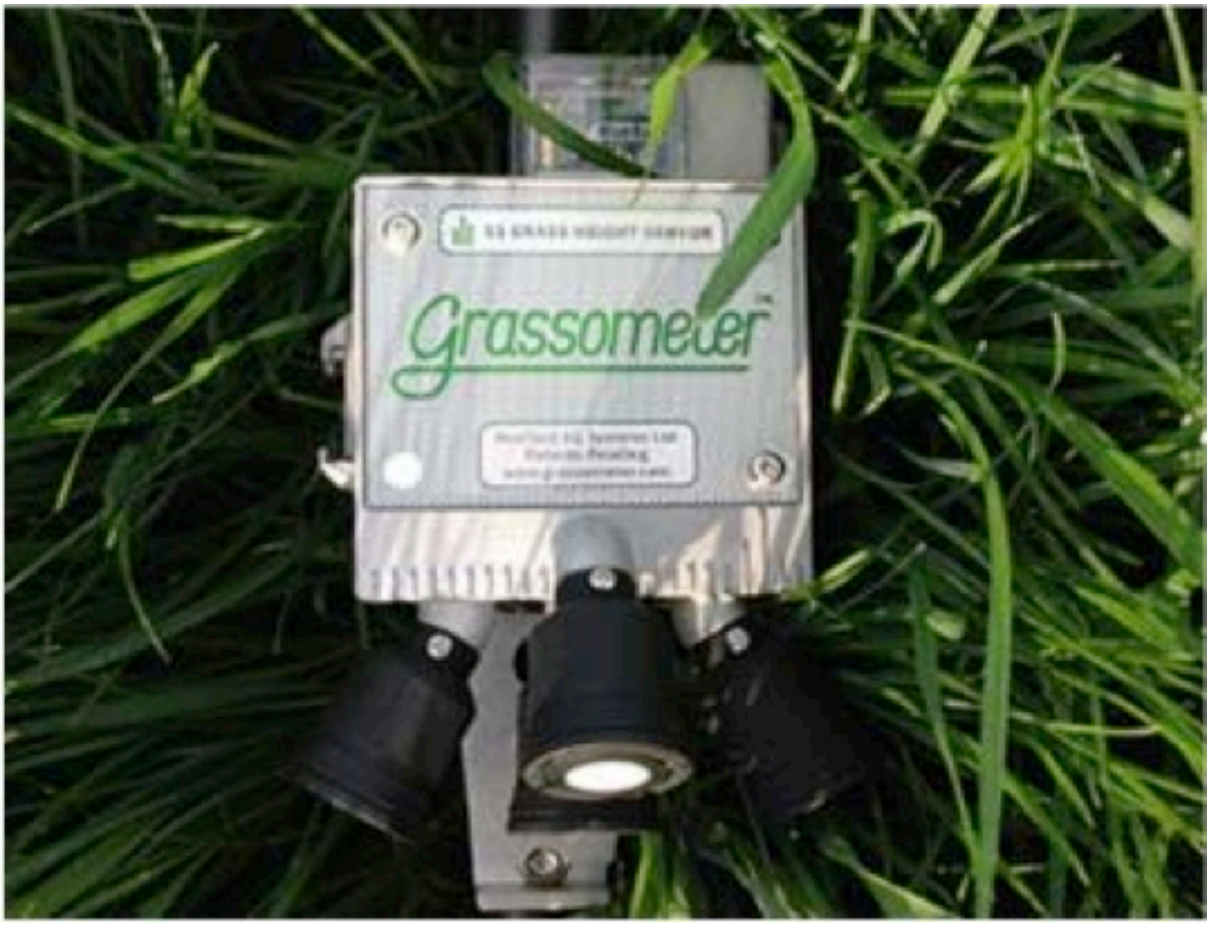

Figure 1: GrassOmeter, utilising latest technology available to measure grass (Appendix 1.1)

The author interviewed one of the developers of this new technology, the GrassOmeter. This new grass measuring device utilised the latest sensor and computer technologies to enable fast, simple and accurate measuring and recording and is due to be launched in Ireland in early 2015.

Spring grass utilisation

Early spring grazing will have a significant beneficial effect on animal and sward performance as well as reducing the overall concentrate and grass silage requirements.

In spring before grass budgeting may take place, it is necessary to measure the grass sward. There are various grass measurement devices including the use of a plate meter or a grass box. The most recently developed device was the GrassOmeter (Appendix 1.1, www.grassometer.com). With the use of any of these devices the Kgs of grass available per Ha can be established. The recommended target pre-grazing height for good animal performance based on research conducted in Moorepark is 8-10 cm for an output of 1300Kg – 1,600 Kg DM/Ha (8-10 cm) (O'Donovan & Hennessy 2011). During the early grazing season (February – April) a balance must be found between feeding animals adequately to sustain high animal performance and conditioning the sward for the late spring/summer grazing season.

The Spring Rotation Planner is an effective mechanism for rationing grass to animals (www.agresearch.teagasc.ie). It is based on a system that allocates an increasing proportion of the farm each day to the herd from turnout to grass in spring up to what is known as "magic day" i.e. where growth rate of grass equals demand for grass by the animals.

Another simple way of budgeting grass is through the use of PastureBaseIreland where the grass measurement data from each paddock are inputted into the system along with animal numbers planned for early spring turnout. The following websites provide further information on this system, www.agrinet.ie and www.pasturebase.teagasc.ie . This system of measuring will calculate the number of days grazing ahead of livestock when growth rates and animal demand are input into the system. When continuous measuring is carried out it enables the farmer to identify surpluses and deficits and allow for adjustment in management, for example, in times of surplus one can remove surplus grass as baled silage or increase stocking rates. When there is a deficit, reduce stocking rates or increase fertiliser application.

In early spring beef farms are recommended to keep 12-16 days of growth ahead of grazing livestock increasing as the season progresses (A Beef Teagasc Advisory Newsletter, February 2013). Post grazing height in early spring is 3 – 3.5 cm as this will ensure good tillering and the regrowth of good quality leafy grass.

Based on research conducted in Moorepark, for spring grazing rotation it is recommended that thirty per cent of the farm is grazed by 27 February, 60% by 17 March, 95% by 1 April and 100% by 5 April (A Beef Teagasc Advisory Newsletter, February 2013).

At the Grange Research Centre in Co. Meath in 2010, a study was conducted that compared the effect on performance of early turnout of spring calved suckler cows and their calves compared to the performance of similar animals retained indoors. The results showed that each extra day on grass resulted in a cost saving of €1.54 per day per unit (Dukelow & O'Donovan, p.29-30, 2014).

Mid-season summer grazing management

The main objective in managing the mid-season grazing programme is to keep good quality leafy grass ahead of grazing livestock to ensure average daily gain per animal is at least 1 kg/day. From April onwards the grass changes from a vegetative (leafy) structure to reproductive (stemy) stage. Therefore continuous measuring and budgeting of grass is necessary during the mid-season. The optimum pre grazing height in mid-season is 1,400 kg DM/Ha (10 cm) increasing the rotation length to 17-21 days (Dukelow & O'Donovan, p.30, 2014). If the recommended height or number of days ahead of stock is exceeded, animal numbers need to be increased or surplus grass should be removed as baled silage to avoid wastage. Post grazing height must not exceed 4 cm mid season as it will have a significant adverse effect on future regrowth and quality of grass produced. Green leaf content is directly related to grass digestibility.

A 5.5% change in green leaf content is equal to a 1% unit change in digestability (Dukelow & O'Donovan, p.30, 2014).

Autumn grazing management

In autumn, the objective of grazing management is to increase the number of days animals are kept at grass. This postpones the winter housing dates to the recommended paddock closing dates discussed above, while at the same time maintaining the level of animal performance. In order to maximise the number of days on grass, it is recommended to increase grazing herbage mass to 2,000 Kg – 2,300 Kg DM/Ha (12-13 cm) in mid September

while at the same time increasing rotation length to 35 days (Dukelow & O'Donovan, p.31,2014). October 10th is the scheduled start date for the gradual closing of paddocks in preparation for the following spring.

2.11 Paddock grazing

Paddock grazing is a more intensive management system where fields or areas of ground are divided up through the use of suitable fencing equipment with individual access points and each paddock has its own water supply. This grazing system is usually carried out on a twenty to thirty day cycle depending on the time of year and typically animals move paddock on a daily basis. Paddock size may be determined by the numbers of stock in each batch. These paddocks may be square in shape to reduce waste of grass due to trampling in wet conditions. This system of grazing allows a more accurate match the nutritional demand of the livestock with the availability of forage. This method of grazing can greatly reduce worm burden as animals are continuously moving to fresh paddocks each day reducing the risk of the consumption of worm contaminated grass from excreted animal waste. Paddock grazing allows for small areas of ground to be taken out of the rotation system where growth exceeds demand (i.e. hay or silage). The use of strip grazing may be adopted in a paddock grazing system to reduce access where there is high grass coverage. This is a system where livestock are given a restricted narrow strip throughout the paddock through the use of an electrified single wire to reduce the risk of waste through trampling or spoilage by waste matter.

2.12 Rotational grazing

Rotational grazing is where animals rotate around the farm giving each area of ground a rest or regrowth period. In rotational grazing the area is grazed down to the residual level and livestock are removed to allow the regrowth process to commence before the area is suitable for grazing again. This is a cyclical process and essential to maximising the growth of grass and the utilisation of that grass.

Rotational grazing has a positive benefit in terms of soil fertility. Grass growth above the ground facilitates root development below the ground. Once the grass above the ground is grazed a similar proportion of the roots die below the surface. This dead material provides food for soil inhabitants and a proportion of it is also turned into soil carbon. Soil carbon

improves the physical properties of the soil, water holding capacity and nutrient and trace elements leading to improved grass growth (www.unep.org/yearbook/2012).

When rotational grazing is compared to a set stocking system where livestock are left on areas of ground for longer periods of time significant damage is done. Once a sward is eaten, regrowth will start to appear after 48 hours (establishment of the first leaf) and if eaten by livestock it will take 7-10 days for the first leaf to re-emerge resulting in significant damage to both the regrowth process and livestock performance. To achieve maximum performance from a sward it is important to avoid eating that first leaf.

2.13 Techno grazing

Techno grazing is a grazing system used in New Zealand. This system of grazing is particularly applicable for bull beef finishing. An area of ground is sub divided into small areas called cells through the use of temporary electrified wire and flexible posts. A quad bike is fitted with an alkathene pipe to lower the electrified wire so as to allow the farmer to drive over this wire and move into the next cell without dismounting from the quad. When moving the animals to a new cell the wire is lowered to allow the animals to move into the next cell. The bulls are grazed for only twenty four hours in small numbers of approximately twenty animals. Within each cell there are temporary water troughs which are moved as the animals moved around the grazing areas.

In May of each year in New Zealand (autumn) when there is only minimum grass available but enough to maintain the animals liveweight, the cattle enter the cell system at twenty months of age. In spring, with good grass growth, the animals compensate for this lack of thrive and have weight gains in excess of two kilos per day. With a new pasture each day, the bulls were content and very little fighting or poaching takes place resulting in animals finishing for slaughter mid-summer on grass alone averaging one kilo per day while on grass. (Cosgrove, G.P.; Clark, D.A.; Lambert, M.G. 2003)

2.14 Residuals

Residual is the term used to describe the amount of grass left in a paddock after grazing. The residual will determine the quality of the grass in the paddock for the next grazing and subsequently each grazing for the rest of the season. When the height of residual grass exceeds the recommended height for the time of year, it reduces the quality and digestibility

of the grass for the next grazing reducing animal performance. Animals will be reluctant to eat this poor quality feed at their next grazing and so over time there will be a build-up of poor quality grass and a reduction of animal growth from grazing these paddocks. The target post grazing height (i.e. residual) in spring (early February to mid April) is 3.5 cm and from mid-April onwards post grazing height should be increased to 4 cm (Glanche et al, p.64, 2014). Reaching these target heights at the specified times of the year guarantees excellent quality grass for top animal performance, quality pasture and maximum growth for subsequent grazing rotations.

"The difference between a good farmer and a bad farmer is a week"

Beef

2.15 Grass fed suckler and dairy beef

The findings from the research completed in this study seem to show grass-fed beef is a more economical and therefore sustainable system of production for the producer i.e. the beef farmer. The ability of the farmer to meet the needs of the final customer not only leads to a more sustainable business for the farmer but also for the processor and the wholesaler who are part of the supply chain. In order for beef farming to be sustainable, costs must be minimised in order to maximise the profits generated from the beef industry. Grass is a key input and given that it is a natural resource this also makes it one of the cheapest inputs. By maximising the utilisation of this natural resource, the beef farmer has the opportunity to minimise costs and not only benefit directly but also to pass the benefits down the supply chain resulting in a more competitively priced product for the consumer.

The agricultural manager of Sainsbury's supermarket informed the author of the health benefits of grass fed beef. Beef produced from grass contains high levels of vitamin E which increases the shelf life making this beef more attractive for the wholesaler. From a consumer point of view grass-fed beef has many benefits. It promotes the development of a yellow fat cover on the meat which enhances the flavour. It also increases the nutritional value of the meat as it contains high levels of vitamin E, omega 3, iron and B12 (naturallyirishbeef.com).

From an environmental perspective, grass based beef has the benefit of reduced CO_2 emissions from the animals when compared to other systems and inputs of production. In papers presented at the ASA (Agricultural Science Association) annual conference in 2013, it was highlighted that the beef industry in Ireland has one of the lowest levels of CO_2 emissions within the EU. When Irish and Brazilian CO_2 emissions are compared, they stand at 19 kg CO_2 per Kg of beef produced for the former and at 28 Kg CO_2 per Kg of beef for the latter (www.asaireland.ie).

2.16 Praid Do Sol feedlot

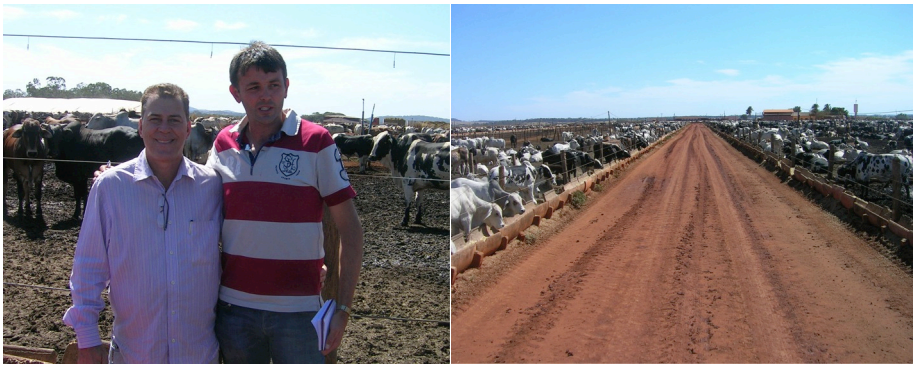

Figure 2: Praid Do Sol Feedlot 13,000 Cattle, Brazil July 2014

The main beef breed in Brazil is the Zebu. The information captured in this research case visit showed that animals were taken off grass and entered the feedlot system at a minimum weight of 300 Kgs. The animals had a 90 day finishing period fed ad-lib on maize, urea and soya. This 90 day finishing period incurred a cost of €2.08 (R$6.25) per head per day and resulted in an average weight gain of 1.7 Kgs per head per day. When the 90 day finishing period was completed the animals were slaughtered and yielded an average carcass weight of 240 Kgs under 30 months of age. The farmer was paid €2.10 (R$6.30) per Kg of beef.

Two interesting points may be noted from this system. Firstly, Brazilian farmers selected one breed, the Zebu, as their choice of animal for this system. The reason for this selection was that the Zebu was found to be the most suitable breed due to its potential ability to survive and to thrive on the type of grass growing in Brazil (Bahiagrass) prior to entering the feedlot.

The second point is the high costs associated with operating a feedlot system highlighted the importance of maximising weight gain while on grass. Grass is a cheaper form of feed than grain and therefore a significant fraction of the profit is made as a result of the use of the grass-based portion of the system.

The use of the Zebu breed with a grass-based system insured that the finished animals produced a consistent weight of carcass suitable for meeting market demands.

2.17 Beef breeds

A finding from this research study showed that breed type is a key difference in any comparison of production between Ireland and the UK with the breeds of beef found in New Zealand and Brazil. In New Zealand and Brazil, it appears that there is a significant

concentration on the specific breeds which have been selected carefully so as to meet market demands while at the same time utilising natural grass resources to minimise their cost base thereby leading to the maximisation of profits.

The majority of beef farms in these countries had suckler herds producing Aberdeen Angus and Hereford with the exception of Brazil who mainly focused on the Zebu breed.

The Aberdeen Angus, Hereford and Zebu animals are "easy-care" at calving, requiring a low labour input and are hardy and docile animals. These three breeds of animals were easy to finish off grass, allowed for a high carrying capacity per Ha on the farm and were consistently meeting market demands.

Research conducted in this study seems to show that Ireland could replicate this grass based finishing system with the use of Aberdeen Angus and Hereford beef breeds. Livestock from the suckler and dairy herd may be deemed suitable for this low cost input finishing system. The Aberdeen Angus and Hereford appear to show increased carrying capacity on a farm, suitable for a grass based environmentally friendly finishing system and above all meet market demands (Private Interview Senior Management at Dawn Meats, Tesco and Sainsbury's, 25th July 2013).

The Aberdeen Angus and Hereford are suitable breeds as they are easily finished off grass with sufficient fat cover, delivering a suitable carcass weight and requiring a low level of concentrate input. This is a sustainable system of production with a low cost base and low levels of CO_2 emissions. The focus on these two particular breeds should be facilitated by the abolition of the dairy quota here in Ireland coupled with the increased use of sex semen in the dairy herd.

The increased demand for dairy cows post quota will support the use of sexed semen to produce female stock for replacements early in the season. The use of Aberdeen Angus and Hereford bulls with dairy cows later in the season would provide suitable stock for finishing animals for the beef market.

The Livestock Improvement Corporation (LIC) in New Zealand have results in the use of sex semen in the dairy herd which appear to show the benefit. Their results showed good conception rates and 90% of the sex semen resulted in female calves (www.licnz.com).

Figure 3: Hereford & Aberdeen Angus heifers grazing irrigated perennial ryegrass in New Zealand

The author took this picture of Hereford and Aberdeen Angus cattle while on a farm in New Zealand. These cattle were produced from the dairy herd and will be finished for slaughter on a perennial ryegrass diet. Research seems to show that similar animals may be produced from the dairy herd in Ireland post quota and finished on a grass-based system and suitable for market demands.

2.18 Composite breed

The Genus Breeding Station in the UK identified composite breeds of cattle as a range of new breeds or new lines of cattle breed specifically to improve hybrid vigour termed 'Stabiliser cattle'. This consists of a four way cross. One four way cross breed combination that currently exists, mainly in UK farms, is the Aberdeen Angus, Hereford, Simmental and Gelbvieh. The addition of the Aberdeen Angus breed contributes towards the quality and taste factor of the meat. The Hereford is included due to its ability to convert feed into live

weight gain. The Simmental contributes milk and conformation while the Gelbvieh contributes an early fertility characteristic to the breed mix (www.bigbeef.co.uk).

The average continental cow weighs approximately 650 Kgs while the Stabiliser cow on average weighs 625 Kgs resulting in lower maintenance costs (www.bigbeef.co.uk).

The Stabiliser animal has approximately a 20-25% better food conversion ratio than continentals resulting in the potential to increase carrying capacity of a farm by 30% per Ha resulting in a stocking density of 7-7.5 Stabilisers/Ha compared to just 6 Continental cows per Ha (www.bigbeef.co.uk).

The average conception figures for Continental cows are 80 calves out of 100 put with the bull compared to Stabilisers which are 96 out of every 100. Stabiliser calves have an average daily live weight gain of 1.3 Kg's/day at weaning and has the potential to weight 50% of its mothers weight (approximately 650 kgs) at 200 days old (www.bigbeef.co.uk).

Stabiliser bull calves have the potential to be ready for slaughter at 13 months rather than the average 16 month finishing period required for continentals. These 13 month stabiliser cattle can achieved a carcass weight of 350 Kg after eating one tonne of meal over its lifetime and with a kill-out percentage of 55%. Overall, these stabiliser animals have the ability to generate 22.5% extra profit as a result of their composition (www.bigbeef.co.uk).

2.19 Conformation, age and weight

Ireland exports 90% of its beef produce, 53% of which goes directly to the UK market (www.bordbia.ie, Appendix 1.2). It is for this very reason that the UK appears important to the beef farmer in Ireland. The main UK purchaser of these exports in the beef retail market is Tesco; however Sainsbury's and Asda are also significant buyers of our exports.

Separate meetings between the author on 25 July 2013 and senior management of Tesco, Sainsbury's and Asda highlighted current and future UK market demands and may be summarized as follows:

- Consistent size of animal ranging from 260-380 Kg for heifers and steers respectively suitable for fixed size packaging
- Age of animal up to 30 months
- Animal grade R3 and R4.

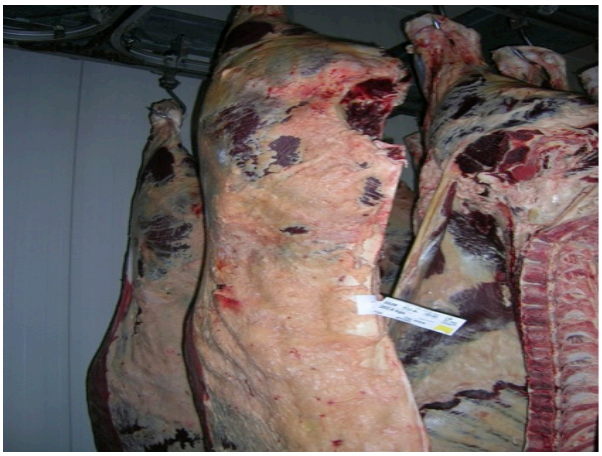

Figure 4: Ideal carcass U grade, Fat score 3+, January 2014

Research appears to show that animals both from the suckler and dairy herd are suitable for the UK market with a preference for carcasses from Aberdeen Angus and Hereford beef breeds (Private Interview Senior Management at Tesco and Sainsbury's, 25 July 2013). The preferred animals, for the UK market are steers and heifers. However, due to an insufficient supply of steers and heifers under 16 month of age, bull beef is acceptable once it is within the predetermined weight and fat limits. These restrictions comprise of a weight limit of 380kg's and a minimum fat cover of 2+ (Appendix 1.4). Bull beef is less attractive to the UK market as it can have a reduced white-fat cover, inhibiting taste and flavour of beef. Bulls are also more easily stressed resulting in dark cutters of beef with a shorter shelf life.

2.20 JBS slaughtering plant

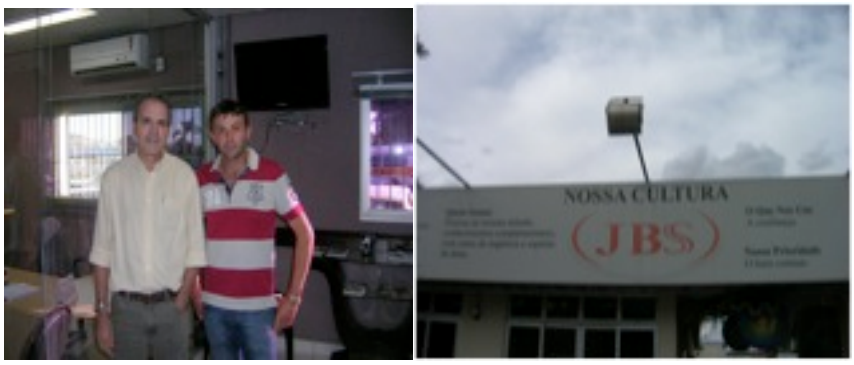

Figure 5: Gilberto Silva – JBS Procurement Manager, Goiânia (Brazil) July 2014

JBS is at present the world's largest multi-protein company carrying out the slaughtering of 89,790 beef animals per day. Cattle enter the JBS plant lairage the evening prior to slaughter where they are washed with water containing lactic acid to clean contamination from the animal body. At the company plant in Goiânia, the slaughtering standards appeared to be very similar to the standards prevailing in Ireland. However in contrast to Ireland, no metrics were available relating to the origin, traceability and quality assurance for the animals being processed.

The research data captured on this visit showed that JBS were paying €2.10 per Kg (R$6.30) of beef to the farmer and selling to the retailer for €2.55 (R$7.65) resulting in a profit margin for JBS. A large portion of the profit margin for the Brazilian factories was from the offal (heart, liver, tail, feet).

Also, from visiting this example of a multi-national slaughtering facility in Brazil, this researcher formed the view that standards in Irish beef slaughtering plants appear to be better and at a higher standard to what was observed on a research visit to a Brazilian plant.

Figure 6: Retail price of steak per Kg (€3.99/kg)

Marketing

2.21 Packaging

The author met with the senior marketing and consumer insight manager at Dawn Meats Group UK on 26 July 2013. The researcher was made aware of the importance of packaging and presentation to improve the sales potential of beef products. When packaging beef it is important that the beef can be clearly seen by the customer with the provision of as much information as possible about the product i.e. price, weight, quality assurance and sell by date. In more recent times customers are seeking more information on the origin of the product.

The packaging of beef can have a significant effect on sales as was clearly seen with the introduction of fixed size packaging which, when introduced, was said to have increased sales by 50-60% (26 July 2013 Private interview).

Fixed size packaging was introduced to keep the size and weight of the meat cuts regular for the customer. The introduction of this packaging allowed the customer to budget the cost of meat each week and kept the cooking properties of the meat consistent. The research visit seemed to demonstrate the importance of the farmer to produce animals of a suitable size for this packaging. The most suitable animal for this packaging appears to be an animal 260-380 kg and grading R3 and R4 (Appendix 1.4). Animals that do not fit this fixed sized packaging results in increased work for the processor trimming the cuts of beef to suit the packaging. This has an adverse effect on the value of the cut resulting in reduced margins for the processor and producer i.e. the farmer.

Another point brought to the attention of the researcher was the different types of packaging of beef and the effects it can have on the produce. Skin packed beef is where beef is vacuum packed excluding all air from the meat and the packaging itself. This packaging will increase shelf life and allows the meat to mature. Another method of packaging is oxygen packed beef. This type of packaging has air trapped in the pack and while it is effective the big disadvantage is that it results in a reduced shelf life when compared with skin packed.

Chapter 3 Conclusions

3.1 Grass

- Optimum soil fertility levels consist of a pH level of 6.3 and a P and K index of 3 in order to maximise potential grass growth
- Paddock-rotational grazing benefits animal performance, grass growth and soil condition
- Forward planning and good grass land management skills are the key elements to maximise grass utilisation. These practices reduce the cost of production of beef and supports the sustainability of the beef farmer
- Reseeding is a very cost effective investment made on beef farms.

3.2 Beef

- Producing consistent weight and quality of animals is essential to meet consumer demands
- Grass-fed beef is the most environmental friendly and sustainable finishing system.

Chapter 4 Recommendations

- Irish beef farmers need to be made more aware of the benefits that can be obtained from grass through the introduction of paddock rotational grazing and improved grazing management, budgeting and measuring skills as part of the farm advisory system.
- Gaining a good understanding of the benefits to be obtained by analysing soil fertility is also a process that would prove fruitful.
- The beef industry and beef breeding programs in Ireland may benefit by examining the value of specific breeds to produce more consistent quality animals finished on a grass-based system.
- Further research into and increased awareness of the benefits to be obtained through the use of composite breeds.

Appendix

1.1 GrassOmeter (www.grassometer.com)

This grass measuring device utilised the latest sensor and computer technologies to enable fast simple and accurate grass measuring and recording. This easy-to-use device can be attached to a pole or can be worn mounted on the farmers boot. Many measurements are taken with every step ensuring thousands of samples per paddock. These samples contribute to refined-accurate decision making. This device is linked to the phone via Bluetooth, and measurements are recorded and displayed instantly so management decisions can be made whilst in the paddock. The GrassOmeter is operated via an App on the farmer's smart phone. The GPS system on the phone tracks the farmer's movement as the farm is measured.

Measuring and recording grass growth allows you to:

- Maximise grass growth
- Optimise fertiliser use
- Plan when to reseed
- Extend your grazing period
- Improve pasture quality
- Manage seasonal variation.

All of the above lead to reduced input cost and improved animal performance and carrying capacity on the farm.

1.2 Total beef exports from Ireland in 2013 was 466,000 tonnes

United Kingdom	247,000 tonnes
France	52,000 tonnes
Scandinavia	40,000 tonnes
Holland	39,000 tonnes
Italy	37,000 tonnes
Germany	17,000 tonnes
Spain	13,000 tonnes
Other EU countries	10,000 tonnes
Non EU countries	8,000 tonnes
Portugal	3,000 tonnes

(www.bordbia.ie)

1.3 Elements and their role in grass production for livestock (Teagasc, Major & Micro Nutrient Advice for Productive Agricultural Crops, 2008).

Element	Role
PH	Regulates the availability of nutrients to the plant, has major impact on bacterial and fungal activity. 6.2-6.8 is ideal
Boron	Seed development, production of sugar and carbohydrates, nutrient usage and regulates other nutrients
Calcium	Essential for cell formation, cell strength, regulates PH, helps transport nutrients in the cells, and stimulates microbial activity
Copper	Reproductive growth, aids root metabolism, helps utilise proteins
Iron	Needed chlorophyll and photosynthesis, required for respiration and by N fixing bacteria
Magnesium	Essential for photosynthesis, sugar, protein production and energy release
Manganese	Involved in breakdown of carbohydrates and the metabolism of N
Molybdenum	Needed for the effective use of N especially with legumes as they cannot fix N without it
Nitrogen	Vital for growth, part of all living cells, helps form protein, key ingredient for photosynthesis. Very leachable
Phosphorus	Vital for photosynthesis, rapid root and shoot growth, transfers solar energy into chemical energy
Potassium	Second only to N in quantity absorbed by plants helps build protein and sugar. Strong stalks, hardiness and resistance
Sodium	This has a role in the production of sugars in the plant, and palatability
Sulphur	Production of quality protein, root growth and seed formation, needed for N fixing root nodule bacteria
Zinc	Transformation of carbohydrates, helps regulate the consumption of sugar, parts of enzymes system that regulates plant growth
Cobalt	Source of vitamin B12 for ruminant animals
Iodine	Source of mineral for animal

1.4 The Quality-Based Euro Pricing Grid

(www.slaneyfarmers.com/qps-grid)

	U+	U=	U-	R+	R=	R-	O+	O=	O-	P+
2+	24	18	12	6	Base	Base	-18	-24	-30	-36
3	24	18	12	6	Base	Base	-12	-18	-24	-30
4-	24	18	12	6	Base	Base	-12	-18	-24	-30
4=	24	18	12	6	Base	Base	-12	-24	-30	-36
4+	18	12	6	0	-6	-6	-18	-24	-30	-36
5	0	-6	-12	-18	-24	-24	-36	-42	-48	-54

- Conformation is classed on the scale U to P, U being excellent and P poor.
- Fat covering is graded on a scale 1 to 5; 1 is ultra lean and 5 is excessively fatty.
- Cattle prices are based on R4- grades and specific weights.
- Steer and heifers grading within the shaded area are paid an extra 12c/kg if they come from a quality-assured farm and are under 30 months old at slaughter.

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