Agriculture and Food Development Authority

BEEF 2024

ACKNOWLEDGEMENTS

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To minimise disease risks and accidents, visitors entering and leaving Grange Research Centre are asked to:

Use Footbaths

Not Handle Cattle

Not Enter Pens or Paddocks containing Cattle

Thank You

Beef 2024

Foreword

I am delighted to welcome you to BEEF2024, our biennial beef open day, at Teagasc Grange. The theme of BEEF2024 is 'Securing your future' reflecting the multiple challenges, and also opportunities, facing the beef sector at present.

The beef sector is one of the most important contributors to the national economy in Ireland, supporting in excess of 70,000 beef farmers with an export value of approximately €2.7 billion. In addition to supporting farm families and intermediate suppliers and services within the sector, the beef industry makes a critical contribution to employment in the processing, distribution and transport sectors in predominantly rural areas. Therefore, it plays a crucial role in securing a vibrant rural economy. Moreover, beef farming is a core element of rural societies with an associated tradition and culture that can be seen on family farms throughout the country.

The strength of the sector lies in its pasture-based production systems, the exploitation of which not only helps to drive profitability but also underpins its strong sustainability credentials. The important management practices pertaining to efficient grassland management, excellent beef genetics and high herd health status continue to be key to increase the competitiveness and sustainability of the Irish beef sector. It is these principles that will maximise profitability and ensure the sector is best-placed to meet the increased global demand for sustainable, high-quality food protein in the form of grass-fed beef. At BEEF2024 we will showcase the latest research in these respective areas and highlight recent advances that further improve the efficiency and profitability of beef cattle farming. The event is organised so that the predominant form of engagement will be by means of demonstrations, live displays and interactive exhibits within our 'technology villages'.

Like all other enterprises, there is an urgent need for the beef sector to address consumer and policy demands for food with low environmental impacts. There is clear evidence that beef produced in grass-based systems of the type that predominate in Ireland has amongst the lowest environmental impact of beef systems globally. We are working from a position of strength; however, there are still opportunities for improvement. Fortunately, most of the management practices and technologies that have been identified to reduce the environmental impact of beef systems, also improve profitability. For example, reducing finishing age can lead to sharp reductions in lifetime methane emissions, our most significant greenhouse gas, while concurrently improving profitability by reducing feed costs. Importantly, beef carcass output can be almost entirely maintained as evidenced by the progress made nationally in the past decade. Likewise, efficient nutrient management, for example, by optimum timing of manure use and using low emissions slurry spreading

technologies, reduces the requirement to purchase much more expensive inorganic forms of fertiliser, again positively benefitting both environmental and financial performance. So, while there are challenges posed by the increased environmental demands being placed on the sector, these demands can also lead to opportunities and, ultimately, a more secure and profitable future for the beef farming sector.

Securing the future of the beef sector is very tightly intertwined with developing clear pathways to farm succession. Teagasc recently updated its guide to transferring the family farm and later this year there will be a series of 'Transferring the family farm clinics' throughout the country. The age profile of the beef sector indicates that succession and inheritance will be particularly important topics for the sector in the coming years. Given the challenging farm income situation within the sector, it is likely that many potential successors will operate beef farms of the future in parallel with off-farm employment. For that reason, labour efficiency within the sector is crucial. These issues will be explored at BEEF2024 both in our technology villages and on our panel forums.

Today's event is being held at our national research centre at Grange. Additional investment in beef research is planned for our research site at Johnstown Castle, Co. Wexford where, in addition to a sizable dairy calf-to-beef research herd, we are developing an organic beef research programme. The enclosed farm unit at Kildavin in Johnstown Castle is currently undergoing organic conversion and the research programme there will commence in late 2024 with complementary finishing studies at Grange. We continue to develop our wider beef programme across the advisory and education programmes. Our beef demonstration programmes - the Future Beef Programme focused on suckler beef and the DairyBeef 500 Campaign – will have a prominent role in BEEF2024. Both programmes sit within the wider Signpost programme highlighting our commitment to developing and deploying management practices that benefit the environment and farm economics, along with our valued partners in those programmes.

I would like to thank our sponsors FBD Insurance for their generous support for this open day. I would also like to thank industry partners who will join us today, highlighting the collaborative nature of the beef sector. So all in all, there are many important and interesting topics for beef farmers that will be discussed at the Open Day, and I hope that you find the day enjoyable, informative and fulfilling.

Professor Frank O'Mara
Director Teagasc

Beef 2024

Welcome to Grange

Paul Crosson and Pearse Kelly

Teagasc, Grange Animal & Grassland Research and Innovation Centre, Dunsany, Co. Meath

On behalf of the staff at the Teagasc, Animal & Grassland Research and Innovation Centre, Grange and other staff involved with today's event, it is a pleasure to welcome you to BEEF2024. The theme today is 'Securing Your Future" where we will be focusing on the challenges in relation to farm succession, profitability, market disturbances, reducing the environmental footprint and high costs of beef production. The focus of BEEF2024 will be on the application of technologies that will help beef farmers increase the profitability and environmental sustainability of their family farm businesses. The roadmap to environmentally sustainable beef production as outlined in the Signpost Programme will feature throughout the event. Technologies in relation to grazing management, animal nutrition, beef genetics, reproductive management, animal health and welfare, and farm planning will be essential to increase the competitiveness and sustainability of the Irish beef sector and will form the focus of the day. BEEF2024 is your opportunity to see first-hand the results of Teagasc's comprehensive research and innovation programme and to meet Teagasc research, advisory and education staff. Today's event is comprised of two main 'speaking' stands followed by a series of 'villages' where the key technologies to improve beef farming sustainability will be shown throughout the day. We have a number of live-demonstrations throughout these villages that will be both informative and interactive. You will also have the opportunity to meet with beef farmers from around the country who are Teagasc 'Signpost' demonstration farmers in our 'Future Beef' and 'DairyBeef 500' programmes. These farmers are implementing many of the technologies on show today on their farms. Visitors today will have the opportunity to visit our new pilot scale anaerobic digester and to hear what research is being planned on this topic. BEEF2024 will include two small forums at 12.30pm and 1.30pm, and finish with our Main Forum starting at 2.30pm. The first two forums will focus how our demonstration farmers are using the latest technologies to improve their incomes and to future proof their farms. Dairy calf-to-beef farmers will address the first forum and suckler beef farmers will share their experiences in the second forum. Our Main Forum will conclude the event where the main opportunities and challenges facing the sector and beef farm families, including succession and inheritance, will be discussed. Keynote speakers will outline the strengths of the beef sector and the potential to enhance profitability, sustainability and lifestyle through the deployment of the latest technologies. In preparation for today's event, particular attention has been paid to health and safety, and biosecurity arrangements. Please use the footbaths provided, pay attention to the signs erected throughout the circuit and follow the direction of our staff. Visitors are asked not to enter paddocks with cattle in them, which are 'double-fenced', or pens with cattle in them for both bio-security and safety reasons. Your help and co-operation with these safety measures is greatly appreciated. A major Open Day at our National Beef Research Centre in Grange is an opportunity for you, the visitor, to see directly the latest research and advice on a wide range of topics that will make beef farming more sustainable, both profitably and environmentally, into the future. Again, on behalf of Teagasc and Grange staff we hope you have an enjoyable and worthwhile visit, and can take some of what you see here today back to your own farm.

SECURING YOUR FUTURE

Securing your future in beef farming

Paul Crosson[1], Pearse Kelly[1], Aidan Murray[2] and Mark McGee[1]
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Summary

- The source of beef calves coming into the beef sector has changed substantially in the past decade with a sharp increase in dairy-beef coinciding with a reduction in suckler cows.
- The key principles underpinning profitable farm systems are largely the same for suckler and dairy-beef systems – producing high levels of beef output from a predominantly grazed grass diet while maximising the contribution to ecosystems services.
- Recent research has found that Monitor and Research farms had 4.9 and 2.2 times greater profitability, respectively, when compared to National average profitability.
- The environmental impact of beef systems encompasses greenhouse gas emissions, biodiversity and water quality.
- A recent online survey of beef farmers highlighted the prevalence of part-time farming and the desire for greater labour efficiency to improve work-life balance.

Introduction

The beef sector has undergone profound change in the past decade particularly in relation to the source of beef calves. The expansion of the dairy herd has resulted in a substantial increase in the number of dairy-beef cattle. This has coincided with a reduction in the number of suckler cows (Figure 1). The consequence of this is that the proportion of beef sourced from the suckler herd has declined between 2013 and 2023. The drivers behind dairy herd expansion are well-understood; abolition of the EU milk quota system in 2015 coupled with relatively high family farm incomes for dairy systems compared to other enterprises. The decline in suckler cows is less clear. Certainly low family farm incomes has been a key factor, in addition to a reduction in direct supports, particularly when expressed in real terms. Furthermore, off-farm employment opportunities have created an alternative income source for beef farmers. However, these factors largely existed prior to this period and therefore, further analysis is required to elucidate the drivers of the reduction in suckler cow numbers in Ireland.

At farm level, the key principles underpinning profitable farm systems are largely the same for suckler and dairy-beef systems. In essence, the objective is to generate high levels of beef output from a predominantly grazed grass diet while maximising the contribution to ecosystems services such as high levels of biodiversity, 'good status' for water bodies and low greenhouse gas emissions. Delivering ecosystems services from beef cattle production is necessary to support the sustainable environment necessary for future generations of farmers. Furthermore, farm support payments are increasingly linked to delivery of such ecosystems services, particularly measures to reduce greenhouse gas emissions. Given the high proportion of beef farmers with off-farm employment, an additional critical factor influencing farm level decision making on beef farms is the impact on the labour requirement.

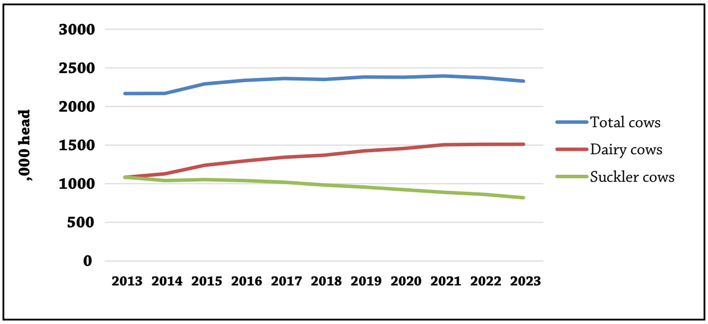

Figure 1. Number of cows in Ireland

Source: CSO

Financial performance of beef cattle systems

Beef production systems are characterised by low levels of farm profitability with farm income for suckler farms and other beef farms (i.e. non-suckling farms) averaging €9,300 and €16,100, respectively, for the period 2017 to 2022 (Figure 2).

Furthermore, direct and support payments make a critical contribution to income; for example, in 2022 direct payments were 182% of farm income (€15,100) for suckler beef farms and 92% of farm income (€17,100) for other beef farms. These payments are a combination of Basic Income Support for Sustainability (BISS; formerly the Basic Payment Scheme) payments, which is the decoupled EU support scheme for farmers funded by the Common Agricultural Policy, and various other schemes such as the Agri-Climate Rural Environment Scheme (ACRES), the Suckler Carbon Efficiency Programme (SCEP) and the National Beef Welfare Scheme. Clearly, these payments are a key income support for the beef farming sector. It is also apparent that there is clear focus on incentivising measures at farm level, which help to reduce the environmental footprint, chiefly greenhouse gas emissions, from beef cattle production.

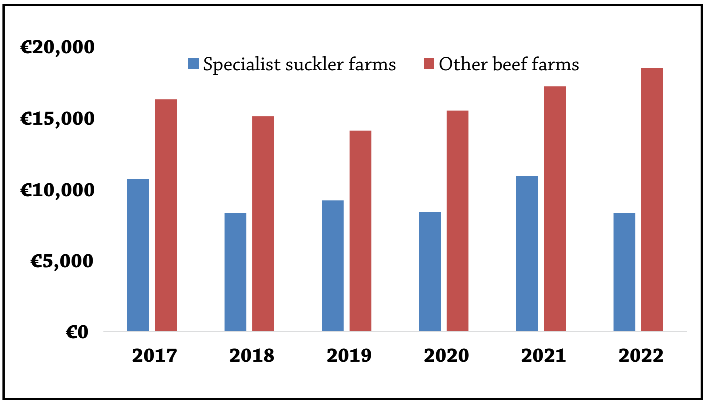

Figure 2. Family farm income on Irish beef farms

Source: Teagasc National Farm Survey

Recent research at Teagasc Grange has investigated the relative performance of beef farms in Ireland by comparing national average performance (based on data obtained from the Teagasc National Farm Survey and the Irish Cattle Breeding Federation, ICBF) with monitor farms participating in demonstration farm programmes (such as the Teagasc/ Farmers' Journal BETTER Farm Programme) and high performance targets (i.e. the highest performing demonstration farms and research farm systems). The Monitor and Research farms had 4.9 and 2.2 times greater profitability, respectively, (expressed as gross margin) when compared to the National average (Figure 3). This greater performance was largely due to higher stocking rates and greater animal performance (expressed as carcass weight per day of age) resulting in much higher levels of beef output. Importantly, this output was generated from a predominantly forage diet with 60 to 70 percent of the total diet in the form of grazed pasture.

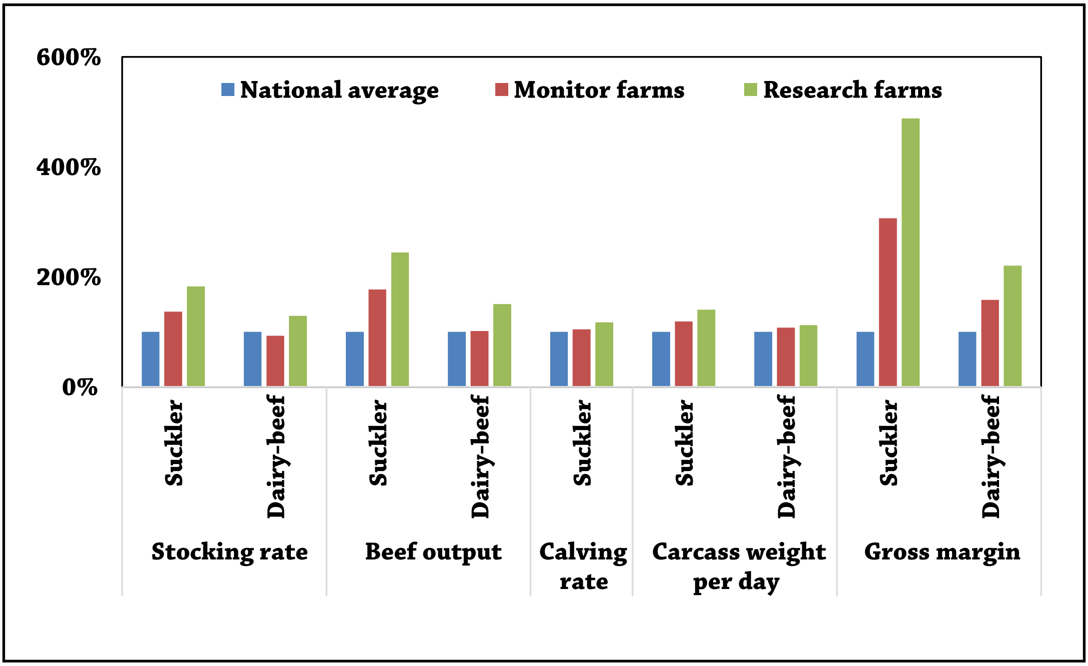

Figure 3. Relative performance of beef farms in Ireland for key profit indicators and gross margin. National average performance are set at 100% with Monitor and Research farms benchmarked against this. **Source:** Taylor et al. (2018); Kearney et al. (2024).

Thus, the 'technology' components that influence the generation of high levels of beef output from grazed grass are: high stocking rates, long grazing seasons, high quality forage during grazing and winter feeding periods, judicious use of concentrate supplementation, excellent animal genetics and high herd health status. For suckling systems, cow fertility is also critical so that heifers calve for the first time at around two years of age and cows subsequently produce a weaned calf every year for six to eight years. The key principles to achieve each of these objectives are dealt with in detail throughout these proceedings.

Current profitability targets for high-performing beef systems are presented in Table 1. The specifics of these production systems are described in detail on page 72 (suckler systems) and page 114 (dairy-beef systems).

Table 1. Financial targets for high performance beef production systems[1]

Suckler calf-to-beef					
Male finishing season/age	Under 16 month bull	Under 19 month bull	Second grazing (20 months)	Second winter (23 months)	Third grazing (27 months)
Female finishing season/age	Second grazing	Second grazing	Second grazing (19 months)	Second winter (22 months)	Second grazing (18 months)
Net margin (€/ha)	780	608	595	581	612
Net margin (€/LU)	318	261	264	257	272
Suckler weanling-to-steer beef systems					
Finishing system/age		Under 19 month bull	Second grazing (20 months)	Second winter (23 months)	Third grazing (27 months)
Net margin (€/ha)		1,423	1,030	882	851
Net margin (€/LU)		518	494	414	394
Dairy calf-to-steer beef systems					
Finishing system/age			Second grazing (20 months)	Second winter (21 months)	
Net margin (€/ha)			1,337	1,349	
Net margin (€/LU)			525	568	
Dairy calf-to-heifer beef systems					
Finishing system /age			Second grazing (19 months)	Second winter (21 months)	
Net margin (€/ha)			1,119	963	
Net margin (€/LU)			486	339	

[1]Beef price, €5.00/kg. N fertiliser ('protected' urea), €550/t. Concentrate price, 350/t.

Environmental footprint of beef cattle systems

The environmental impact of human activity in all sectors of society is under much greater scrutiny than heretofore. In terms of agriculture, the main issues of concern are greenhouse gas emissions, biodiversity and water quality.

Recent UN FAO analysis found that livestock agri-food systems are responsible for approximately 12 percent of anthropogenic greenhouse gas emissions. The carbon footprint of beef (i.e. the quantity of greenhouse gas emissions generated to produce 1 kg of beef meat) is also amongst the highest of all food products. However, it is important to consider that there is great variation in the carbon footprint of beef depending among different regions reflecting differences in production efficiencies, cattle breeds and management practices. For example, average emissions for beef production in western Europe is approximately 18 kg CO_2e/kg beef carcass compared to the global average of approximately 47 kg CO2e/kg carcass. Analysis presented elsewhere in these proceedings indicate that emissions for high-performing suckler and dairy-beef systems range from 15.5 to 18.8 kg CO2e/kg carcass and 10.5 to 12.4 kg CO2e/kg carcass, respectively. This is largely consistent with the Teagasc Sustainability Report, which reported an average emissions intensity for Irish beef of approximately 17.7 kg CO2e/kg carcass (average of suckler and dairy-beef systems). With the global demand for beef continuing to grow (OECD expect beef demand to increase by 10 percent by 2032 relative to the average of 2020-22) and the consumer focus on 'sustainable food choices', Irish beef is in a strong position to remain attractive in key export markets.

Clearly, there is also a requirement to develop and deploy technologies and management practices that further reduce greenhouse gas emission from beef cattle production systems. Research in Teagasc and elsewhere is seeking to develop these technologies with current efforts focussing on the following areas: reducing finishing age; breeding more efficient (and low emitting) cattle; assessing the efficacy of additives to reduce methane emissions from enteric and manure sources; using less fertiliser by improving soil fertility and increasing legume incorporation in grasslands; using a higher proportion of 'protected' forms of nitrogen; and valorising methane in manure systems via anaerobic digestion to reduce emissions and provide an additional income source for livestock farms. These technologies are dealt with in detail elsewhere in these proceedings.

A factor contributing to the relatively high greenhouse gas emissions intensity of beef meat is the relatively low conversion efficiency of animal feed into human-edible food. However, beef cattle play an important role in converting pasture into high quality human-food protein. This is particularly important in Ireland given the preponderance of beef cattle farms located on land types that are unsuitable for direct production of human food (i.e. tillage). Given the capacity of ruminants to utilize these grasslands, beef production makes an important contribution to food production and economic activity in these areas.

Livestock systems not only emit greenhouse emissions but also have the potential to remove carbon dioxide from the atmosphere and sequestering this carbon in above and below ground biomass. The most obvious form of sequestration is planting of hedges and trees and this is being strongly promoted in Ireland through various agri-environmental and forestry schemes. The impact of grazing on soil carbon is more difficult to quantify and has very large associated uncertainty. Nonetheless, there are a number of studies where the effect of grazing beef cattle on soil carbon has been investigated with results indicating that between 15 percent to greater than 100 percent of greenhouse gas emissions can be offset. In other words, in certain circumstances, depending on initial carbon stocks and grazing management practices, beef grazing systems can be net sinks for greenhouse gas emissions. Substantial investment has been made, for example through the National Agricultural Soils Carbon Observatory and VistaMilk SFI Centre, to quantify the sequestration potential of Irish soils particularly in relation to the impact of grassland management practices. These data will permit the holistic impact of beef grazing systems on greenhouse gas emissions to be assessed. Regardless, the maintenance of grazing land and associated carbon stocks is an important role for beef systems.

A further consideration is the role of beef cattle farming in the preservation of biodiversity in rural landscapes. Biodiversity refers to the diversity of genes, species and habitats, and encompasses the variety of life on earth. Despite the richness of biodiversity in Ireland, some of the key metrics in this area are disimproving. For example, eighty-five percent of our EU-protected habitats are in 'unfavourable status' and almost a third of our semi-natural grasslands have been lost in the last decade. Ireland's Fourth National Biodiversity Action Plan was launched in 2023 and has a number of objectives to reduce biodiversity loss including incentivising farming practices that help to restore and protect the biodiversity on our farmlands. These measures are promoted in schemes such as ACRES, which is a results-based payment scheme offering farmers a range of targeted and general biodiversity-positive initiatives such as low-input grassland, extensively grazed pastures and planting hedgerows. The Irish model of beef farming, with relatively extensive grazing and low inputs of concentrate feed and fertiliser application on a wide range of land types, is innately compatible with these measures and gives some indication of the positive impact of cattle farming on the preservation of biodiversity in rural areas. Indeed, there is evidence that undergrazing can be harmful for biodiversity leading to less stimulation and loss of grazing-dependent grasses. The National Biodiversity Action Plan also set out to promote greater uptake of organic farming. This ambition has been further developed in the Climate Action Plan (2024) which set a target of 450,000 ha (10%) farmed organically by 2030 – roughly double the current area. Further details in relation to the opportunity for beef farmers to convert to organic farming are dealt with elsewhere in these proceedings.

Current water quality legislation in Ireland is underpinned by the Nitrates Directive (Directive 91/676/EEC), now under the umbrella of the Water Framework Directive (Directive 2000/60/EC), which aims to minimise surplus nitrogen application on farms and to reduce the associated nitrogen losses from agriculture to water bodies. More recently, at EU level, the Farm to Fork Strategy has outlined a pathway to sustainable agriculture including a target to reduce fertiliser use by 20% and nutrient losses by at least 50% by 2030. Teagasc have recently launched the 'Better Farming for Water' campaign, which will build on existing water quality programmes such as the Agricultural Catchments Programme (ACP) and the Agricultural Sustainability Support and Advisory Programme (ASSAP). The multi-actor (farmers, agri-food industry, government) approach to support farmers will ensure that challenges and solutions to address local water quality are delivered at farm, catchment and regional scale.

Labour on beef farms

One of the key drivers on beef farms that influences many of the decisions that are being made when it comes to the choice of beef system, stocking rate, type of animals purchased, age at finish and overall future direction for the farm is the amount of labour that is available to carry out the work involved. The majority of beef farmers now have off-farm employment, which limits the amount of hours per week that they can devote to working on the farm. In a recent online survey completed by Teagasc beef farmer clients, over 70% of both part-time and full-time beef farmers said they would like to reduce the number of hours they work per week on the farm. This is not surprising as a high proportion of the 266 respondents to the survey recorded working long hours each week throughout the year. For example, of the 163 farmers (63%) who worked off the farm, over 70% of them replied that they worked at least 30 hours per week off the farm in spring, summer, autumn and winter (Table 2). When asked how many hours they worked per week on the farm across each season, 44% of these part-time beef farmers reported working at least 30 hours per week in the spring.

Table 2. Hours worked each season off the farm by part-time beef farmers

	Spring	Summer	Autumn	Winter
0 hr	0%	2%	1%	2%
1 – 10 hr	4%	6%	6%	6%
10 – 20 hr	11%	10%	9%	11%
20 – 30 hr	12%	10%	11%	10%
30 – 40 hr	41%	40%	42%	42%
> 40 hr	32%	32%	31%	29%

Source: Teagasc online labour survey (N=163)

The respondents to the recent Teagasc online labour survey were asked for additional feedback in relation to the labour issues on their beef farms and this returned some very insightful comments. One mentioned, "Getting casual labour even on Saturdays is difficult for jobs like fencing, cleaning out sheds, dosing cattle, also hard to get items on farm fixed such as machinery, sheds, gates etc." A related comment stated, "There is not sufficient profit being made to employ and pay additional workers" with another having a similar response, "I could do with employing someone but cost and availability is an issue". These statements show the difference between labour issues on beef farms when compared to the labour problems more intensive and larger dairy farms have. On dairy farms with large cow numbers and much higher profitability levels per hectare, hiring full-time labour that can be retained for 12 months of the year is often the biggest issue. In contrast, on beef farms if extra labour is going to be employed it is only for a small number of days each year but that is proving difficult due to low profitability levels and low availability of casual labour.

Weather conditions are also having an influence on the number of hours worked on beef farms. The early-winters and late-springs experienced recently have an impact on the pattern of hours worked on beef farms and this is borne out in some of the comments. "We don't get enough good weather, so when the sun shines a lot of work has to get done. As a farmer with an off farm job to make a living I find myself rushing home to do a lot of work when the weather allows". It is well documented that our farmer population is getting, on average, older every year. This is especially the case in drystock farming where the profitability levels are insufficient to support the next generation to take over the running of the farm, which means that they have no choice but to seek employment off the farm. One of the survey respondents commented, "I'm a one man show so, there's no one to take over, if it's not done this week it will have to be done next week", another said "I work on my own, I am also a pensioner". The low level of profitability on many beef farms also influences the long-term choices many farmers make, with many choosing not to invest in housing and facilities that could help to improve their labour efficiency. One farmer summed up their thoughts on this, "Big investment will reduce the hours worked but is it worth it?" Another theme throughout the comments in the survey were the choices farmers were making when it comes to the choice of beef system they are operating on their farms. A number stated that calving and breeding cows was too time-consuming when trying to hold down an off-farm job. This is probably one of the reasons that we are seeing a drop in recent years in the number of calves born to suckler cows. In 2023, there were over 60,000 fewer suckler calves born compared to 2022, and in 2024 the number born to the end of May (ICBF statistics) is down by over 32,000 compared to the same date in 2023.

The number of hours worked per day on beef farms varies throughout the year. In our recent online survey, 61% of the farmers who responded said their main beef enterprise was suckling. This was reflected in the number of hours worked throughout the different seasons with springtime being the busiest period (Table 3). This is not surprising as the majority of suckler herds calve in the spring. The workload associated with calving combined with feeding cattle indoors was illustrated in the increased proportion of farmers working over 40 hours per week on the farm in spring. In contrast, the proportion of beef farmers who reported that they work over 40 hours per week on the farm was lowest for the winter period.

Table 3. Number of hours worked per day on the farm by season

Farm hours per day	Spring	Summer	Autumn	Winter
0 – 10	9%	9%	13%	12%
10 – 20	18%	18%	20%	17%
20 – 30	15%	18%	23%	25%
30 – 40	14%	17%	15%	18%
> 40	45%	36%	29%	28%

Source: Teagasc online labour survey (N=259)

When asked what was the most labour intensive activity carried out on the farm, respondents to the survey ranked feeding fodder during the winter at the top, with calving and machinery work ranking after this (Table 4). In a follow up question, they were asked what area of their farm system they would like to make more labour efficient. Again, feeding fodder over the winter came out on top, followed by grassland management and machinery work.

Table 4. Tasks on beef farms ranked by how labour intensive they are (highest to lowest)

Task	Rank
Feeding fodder during the winter	1
Calving	2
Machinery work	3
Grassland management	4
Calf feeding	5
Travelling between farms	6
Breeding	7
Transporting cattle	8
Other	9

Source: Teagasc online labour survey (N=259)

One of the key measures of sustainability when it comes to any farming system is the long-term sustainability of the hours required to maintain that system so that it is profitable and environmentally acceptable. For beef farms to meet this requirement into the future, it cannot mean working full-time off the farm and long hours on the farm, even if the farm work is seasonal in its intensity. With each new generation of beef farmer taking up the management of farms there is an increased demand for beef systems and technologies that reduce the time required to run a sustainable and profitable beef system. Investment in infrastructure that includes having enough animal housing, slurry storage, feed storage, animal handling facilities, roadways for moving stock, fencing and water troughs, while costly to begin with, will likely be money well spent in the long-term. The increased use of contractors will also need to be considered by many beef farmers who work long hours off the farm each week. Sustainable beef systems into the future will be the production systems that return a worthwhile income for the number of hours devoted to them, that can be managed in the amount of time available to the beef farmer who has good facilities and who makes efficient use of contracted in labour and services.

Key factors underpinning viable and sustainable beef farming

***Mark McGee*[1], *Aidan Murray*[2], *Pearse Kelly*[1] *and Paul Crosson*[1]**
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Summary

- Failure to meet animal performance targets is a major source of inefficiency in beef cattle production systems.
- If animals are to be finished younger, achieving high growth performance is critical.
- Animal growth rate is largely a function of feed 'quality' and quantity, animal genetics and herd health.
- Where key performance targets are not met, this has large negative ramifications for the profitability and environmental footprint of beef production systems.
- Reducing greenhouse emissions is generally associated with greater profitability of grass-based beef production systems.

Introduction

Calves for Irish beef production come from the national suckler herd, mainly late-maturing crossbred genotypes, and from the national dairy herd, mainly early-maturing beef × Holstein-Friesian and Holstein-Friesian genotypes. As calf births in Ireland are very seasonal, most Irish beef production systems entail a spring-born animal, which has implications for principal finishing periods. Nationally, most male cattle are produced as steers, with a mean finishing age in 2023 of 27.3 months, with heifers finished just over one month younger. These finishing ages are much older than obtained in research production systems and on many high-performing commercial farms. As part of the Irish Climate Action Plan, a 25% reduction target in agricultural greenhouse gas (GHG) emissions, by 2030 was established. With increased GHG emissions associated with older cattle, reducing the average finishing age of the national prime beef cattle population (i.e. steers, heifers, and young bulls), can make a significant contribution to this reduction target. This paper will explore the key factors influencing the productivity, profitability and environmental footprint of beef cattle production systems.

Grass-forage based systems

Due to the considerably lower comparative cost of grazed grass as a feedstuff (see page 34), suckler and dairy-bred beef production systems in Ireland are predominantly grass-based, and 'designed' to optimize the seasonal supply of pasture. Pasture-based beef production systems have evolved to optimise the contribution of grazed herbage and to providing grass silage and (purchased) concentrate as efficiently and at as low a cost as feasible.

A key objective is to increase the contribution of high-digestibility, grazed grass to the lifetime intake of feed while simultaneously achieving high individual-animal performance. The foundation underpinning low-cost grass production and utilisation is having optimal soil pH and fertility, unimpeded drainage, targeted application of nutrients, including using low emission slurry spreading (LESS) and 'protected' urea fertiliser (see page 42), reseeding of 'old' non-productive pastures with high Pasture Profit Index grass varieties (see page 50), the use of legumes (clover) and good grazing infrastructure, coupled with appropriate grazing management practices (see page 34). Efficient pasture utilisation hinges around measuring grass supply, knowing animal nutritional requirements, and then matching seasonal grass supply with the changing herd demand. This entails having a planned grassland management system, which is flexible and adaptable to fluctuating grass supply, grazing conditions and herd demand. Appropriate grazing management practices include, turning cattle out to grass as early as grass supply and grazing conditions permit in spring, and ensuring an adequate supply and intake of high DMD leafy grass, by avoiding excessively high pre-grazing herbage masses and excessively low post-grazing sward heights (see page 34). Research at Teagasc Grange has shown the benefits of including clover in grass swards in terms of superior animal growth and reduced nitrogen fertiliser requirements (see pages 34 and 72). Of note is that lifetime animal growth performance was similar for grass-clover and multi-species swards.

The seasonality of grass growth and inclement grazing conditions means that an indoor 'winter' period, of varying duration, occurs on practically all Irish farms and the main feed costs on beef farms relate to this period, especially when feeding finishing cattle. Therefore, providing sufficient grass silage of appropriate digestibility for the indoor winter period – high dry matter digestibility (>72% DMD) grass silage for all growing-finishing beef cattle, and moderate-digestibility grass silage (~67% DMD) for 'dry' suckler cows in good body condition – is a crucial component of grassland management and feed self-sufficiency in beef production systems (see page 58).

Because of their relatively greater cost, concentrate feedstuffs should only be used 'strategically', to rectify deficits in forage nutrient supply at key points in the lifecycle in order to achieve target growth and carcass fatness levels. The level of concentrate supplementation (see page 104) depends on the nutritive value of forage offered (higher digestibility forage requires less concentrate to achieve the same live weight performance), the target growth required (e.g. 'store' or 'finishing' period) and the animal 'type' (e.g. breed, gender, genetic merit).

Consequently, the grass-forage component of the feed budget on a dry matter basis for contrasting grass-based suckler- and dairy-beef steer research systems is high, ranging from 82 to 96% for suckler-beef and 77 to 88% for dairy-beef systems.

Animal performance targets

Many types of beef production systems are operated commercially, depending on factors such as the animal origin (i.e. suckler- vs. dairy-bred), progeny gender (i.e. steers, heifers and bulls), on whether it is a 'component' - selling/buying live cattle at different ages (e.g. 'weanling', 'yearling' or 'store' cattle) or a partially (e.g. weanling-to-beef, store-to-beef) or fully (e.g. calf-to-beef) 'integrated' system, and ultimately the finishing/ target market.

Animal growth rate is a significant driver of beef farm profitability and is largely a function of feed 'quality' and quantity, animal genetics and herd health. Animal performance targets for integrated suckler and beef × dairy calf-to-beef systems are illustrated in Figure 1; the same principles apply to other 'component' systems. The actual values will differ according to factors such as animal genotype and production system modifications.

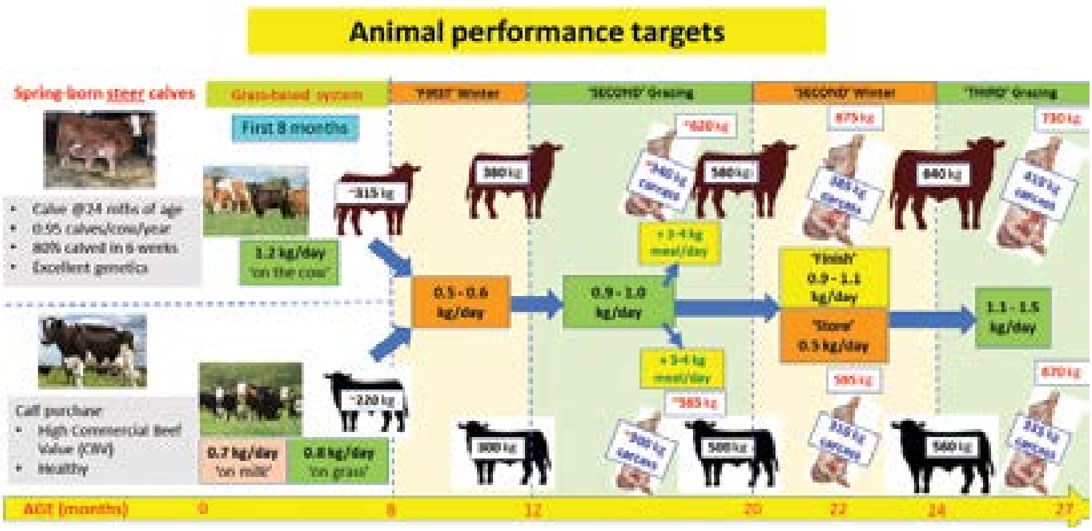

Figure 1. Animal performance targets for spring-born grass-based suckler and beef × dairy steer calf-to-beef production systems

1. Suckler cow productivity targets

The lifetime productivity of suckler cows begins with the onset of puberty and thereafter is determined by critical events comprising age at conception, age at first calving, duration of the postpartum interval for each consecutive calving, and conception and pregnancy rate, which is ultimately manifested as calving interval and number of calves weaned over her lifetime (see page 84). Reproductive targets for a suckler cow herd include an average age at first calving of 24-months, calf mortality of less than 5%, a calving rate of greater than 0.95, an empty rate of less than 5%, a calving-to-calving interval of 365 days, compact calving, with 80% calving in 6 weeks (Figure 1) and a 'long' productive life. A target age at first-calving of 24-months is important as it provides the foundation for maximum potential lifetime productivity – 'unproductive' older replacement heifers are inefficient. Attaining a calving-to-calving interval of 365 days, through operating a compact calving season, and good animal husbandry in terms of meeting cow nutritional requirements and body condition score levels after-calving to ensure resumption of oestrous, is essential. As the calf is the primary output of a suckler cow, the number of calves born is fundamental to productivity; thus, attaining a calving rate as close to one as possible (i.e. each cow in the herd produces a calf every year) is essential. Additionally, the suckler cow must produce sufficient colostrum (see page 88) and milk and ultimately rear a healthy, vibrant and heavy weanling that achieves lifetime growth targets with desirable carcass characteristics. The beef Eurostar Terminal and Replacement Indexes (while also taking cognisance of the individual component traits making up the overall indexes) can be used to select suitable bulls and cows to produce cattle for finishing or to produce replacement heifers (see page 80).

Central to seasonal spring-calving suckler systems is the alignment of calving date with onset of the grazing season in spring, which means that the relatively higher nutritional requirements of lactating spring-calving cows can be met with lower-cost, high-nutritive value grazed grass. This 'date' will differ from region-to-region and is a function of prevailing grass growth commencement date plus soil type, climate and thus grazing 'conditions'. Nutrition of spring-calving suckler cows in good body condition at housing in autumn generally involves feed energy restriction and mobilisation of body fat reserves during the indoor winter period when feed costs are high and subsequent deposition of body reserves on cheaper-produced pasture. This feeding regime results in feed cost savings. However, these annual changes in body reserves need to be within the boundaries of target body condition scores at key stages of the production cycle – late pregnancy, calving and breeding – in order to maintain good reproductive performance, as well as avoiding nutritionally induced calving difficulty (see page 84).

2. Growth targets for spring-born suckler-bred and dairy-bred calves

- Birth to the end of the 'first' grazing season

Grass-based suckler systems entail spring-calving cows (~March) rearing their own calves until weaning at the end of the grazing season at about 8 months of age, following which the 'weanlings' are housed; concentrate supplementation (~1 kg/day) is usually introduced shortly before weaning to support the weaning process and continues through to the end of the first winter period. In grass-based dairy-beef steer production systems, spring-born calves are artificially-reared on milk replacer and concentrates over an indoor rearing period of approximately 8 weeks, turned out to pasture in summer (~May) at 85-90 kg, and housed at the end of the grazing season (~October/November); concentrate supplementation (~1.0 kg/day) is usually provided at the start and end of the grazing season. When purchasing dairy-bred calves, the Commercial Beef Value (CBV) (see page 122) can be used to identify calves with superior genetic merit for beef production. Research at Teagasc Grange has shown that high CBV steers generate more profit and produce beef with a lower carbon footprint than low-CBV steers (see page 114).

Adequate calf passive immunity, derived through timely ingestion of sufficient quantities of quality colostrum, optimised early-life nutritional management coupled with appropriate parasite and animal health strategies during this time period (and subsequently), are critical to ensure that suckler and dairy-bred calves can meet their production potential (see pages 88, 92, 96, 126, 130). Target pre-weaning live weight gains of dairy calves are 0.7 kg /day, and subsequently at pasture 0.8 kg/day (Figure 1). Target live weight gains of spring-born single-suckling un-supplemented calves on well-managed rotationally grazed systems typically exceeds 1.2 kg daily over the grazing season, although this is heavily influenced by cow milk yield.

At the end of the ‘first’ grazing season, spring-born dairy weanlings are about 90 to 100 kg lighter than their suckler-bred counterparts (Figure 1). Despite the fact that these contrasting breed types differ markedly in their intake relative to weight (dairy-bred consume more than suckler-bred), feed efficiency (dairy-bred poorer than suckler-bred) and carcass traits (dairy-bred have inferior kill-out proportion, and carcass weight and conformation score compared to suckler-bred), animal management and live weight gain targets from housing at the ‘first’ winter until ‘finished’ are broadly similar for both suckler-bred and dairy-bred production systems.

- ‘First’ winter growth targets

During the ‘first’ winter indoor (‘store’) feeding period, animals consume a ‘restricted-energy’ diet based on grass silage ad libitum and supplementary concentrates (e.g. 1.0 kg fresh weight/day). A target live weight gain of 0.5 to 0.6 kg/day through the first winter is acceptable for steers, heifers and bulls destined to return to pasture in spring (Figure 1).

Due to *compensatory growth*, there is no benefit to over-feeding weanlings in winter as, during the subsequent grazing season, cattle that gained less over the winter had the highest live weight gain at pasture, resulting in most of the winter weight advantage ‘disappearing’ by the end of the grazing season. This feeding regime is designed to minimise winter feed costs and subsequently exploit compensatory growth on cheaper-produced pasture, which further avails of the economic efficiency of grazed grass over conserved forages and concentrates. Conversely, cattle growing too slowly during winter (<0.5 kg/day) will not be able to compensate sufficiently at pasture, and consequently, will not reach target weights later in life.

- ‘Second’ grazing season growth targets

During the ‘second’ grazing season (~March-October/November) a target live weight gain of ~0.9-1.0 kg/day should be attainable without meal supplementation (Figure 1).

Finishing spring-born steers at about two years-of-age involves an ‘expensive’ final indoor winter feeding period. As grazed grass is considerably cheaper than grass silage or concentrates, early finishing of cattle from pasture in autumn before housing (~20-months of age), reduces total costs per animal. Because a commercially-acceptable carcass fat score (minimum target of 2+, 6 on a scale 1-15) is currently a primary market requirement, the propensity of cattle to deposit subcutaneous fat is important to ensure they have an adequate carcass fat cover. One strategy is to provide concentrate supplementation (e.g. 3-4 kg/day) to animals during a finishing phase at pasture.

- 'Second' winter and 'third' (short) grazing season growth targets

Alternatively, at the end of the 'second' grazing season steers are re-housed and offered high DMD grass silage supplemented with concentrates. Animals destined for finishing at ~22 to 24 months of age receive a moderate allowance of concentrate (e.g. 4-5 kg daily, depending on silage DMD) with a target live weight gain of 1.0 kg /day (Figure 1). Providing high DMD grass silage for all growing-finishing cattle is essential. For example, research has shown that each one-unit decline in DMD of grass silage offered to finishing cattle requires an additional 0.3 to 0.4 kg concentrate daily to sustain growth performance. The housing environment that animals are accommodated in is also important. For example, research from Teagasc Grange clearly shows that over-stocking cattle in pens reduces animal growth rate. In terms of floor types, there is evidence that overlaying concrete slats with some rubber mat products can enhance the growth rate and feed efficiency of finishing cattle (see page 100) – a cost-benefit analysis should be undertaken.

With finishing cattle, it is important to avoid overly long finishing periods as feed efficiency declines with duration of feeding, and especially at high carcass fat scores. For example, research at Teagasc Grange has shown that the daily live weight gain of finishing steers offered grass silage and supplementary concentrates declined from 1.13 kg in the first 62 days of a 132-day finishing period to 0.77 kg for the remaining 70 days. At the same time, animal total dry matter intake increased from 9.9 to 10.3 kg/day resulting in an increase in feed conversion ratio of 8.8 kg to 13.4 kg feed DM/ kg live weight gain. In other words, 52% more feed was required to gain 1.0 kg live weight in the second half compared to the first half of the finishing period. In this regard, live weight gain and fatness level of cattle should be monitored regularly to permit timely *drafting* of finished animals. Nationally, a relatively high proportion of cattle are finished at excessively high fat scores, implying surplus days on feed and associated financial and environmental costs.

In contrast, steers destined to be turned out to pasture for part of (2 to 4 months) a 'third' grazing season and finished at pasture at about 27-months of age receive a much lower (e.g. 1 kg/day), if any, concentrate allowance. Similar to the 'first' winter, their target live weight gain is also only 0.5 kg/day in order to further exploit compensatory growth during the subsequent short grazing period (Figure 1).

Importance of achieving performance targets

Where animal-related and production system-related key performance targets are not met, this has large negative ramifications for the profitability and environmental footprint of beef production systems.

For example, the impact of age at first-calving, calves/cow/year, calving interval, grazing season length and progeny daily live weight gain in a spring-calving suckler calf-to-beef system on profitability and GHG emissions is summarised in Figure 2. Reducing biological efficiency resulted in reductions in profitability on a per livestock unit (LU) basis, and concurrent increases in GHG emissions 'intensity' (per kg 'product' produced). Overall, this inverse relationship implies that reducing GHG emissions to meet national climate targets is generally associated with greater profitability of grass-based suckler beef production systems.

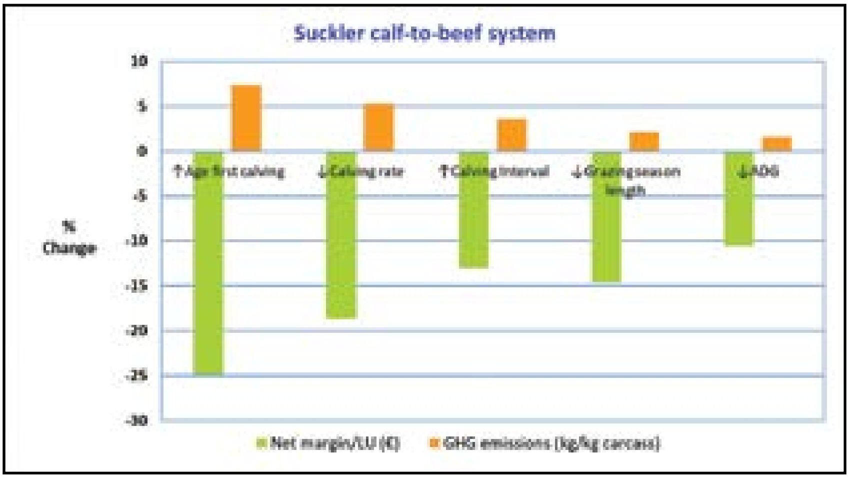

Figure 2. Effect of increasing age at first-calving (24 vs. 36 months), reducing calves/cow/year (0.85 vs. 0.95), increasing calving interval (400 vs. 365 days), reducing grazing season length (25 days) and reducing progeny live weight gain (50 g/day) in a spring-calving suckler calf-to-beef system, on the percentage change in net margin/livestock unit (LU) and GHG emissions per kg carcass.

Effect of increasing finishing age on profitability and GHG emissions

The effect of increasing finishing age in a spring-born suckler weanling-to-beef system and dairy calf-to-beef system where steers are finished during the second winter or during the third grazing season, on profitability and GHG emissions is summarised in Figures 3 and 4.

Increasing finishing age during the second winter and during the third grazing season in the suckler steer weanling-to-beef system resulted in reductions in net margin on a per LU basis, and concurrent increases in GHG emissions per animal finished (Figure 3). In terms of GHG emission 'intensity' (per kg 'product' produced), there was also an increase associated with older age at finishing during the indoor winter period during the indoor winter period but not during the third grazing season. In the case of the latter situation, the additional live weight gained during this additional month at pasture, created a sufficient 'dilution effect' to offset the additional GHG emissions generated.

Similarly, for the dairy calf-to-beef steer system, increasing finishing age during the second winter and during the third grazing season resulted in reductions in net margin per hectare, and concurrently increases in GHG emissions per kg carcass gain and per animal finished (Figure 4). This highlights the potential role of reducing finishing age as a GHG mitigation strategy for beef producers.

Overall, this inverse relationship implies that reducing GHG emissions to meet national climate targets is generally associated with greater profitability of grass-based beef production systems.

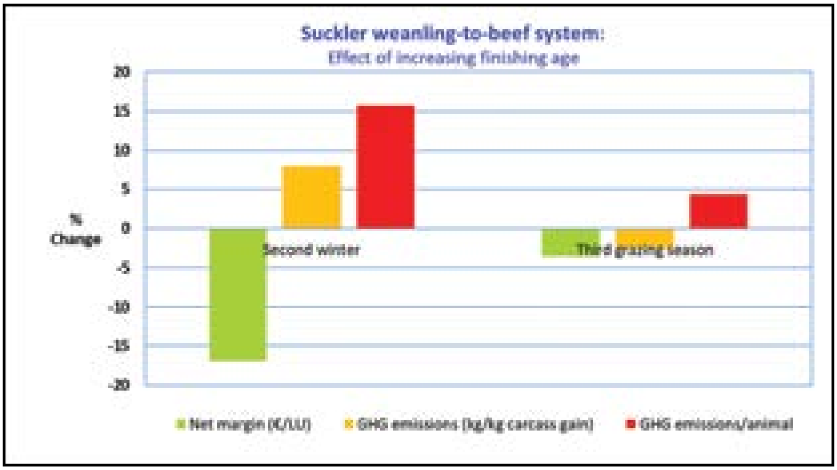

Figure 3. Effect of increasing finishing age by one month in a suckler weanling-to-beef system where steers are finished during the second winter or during the third grazing season, on the percentage change in net margin/livestock unit (LU) and GHG emissions per kg carcass gain and per animal.

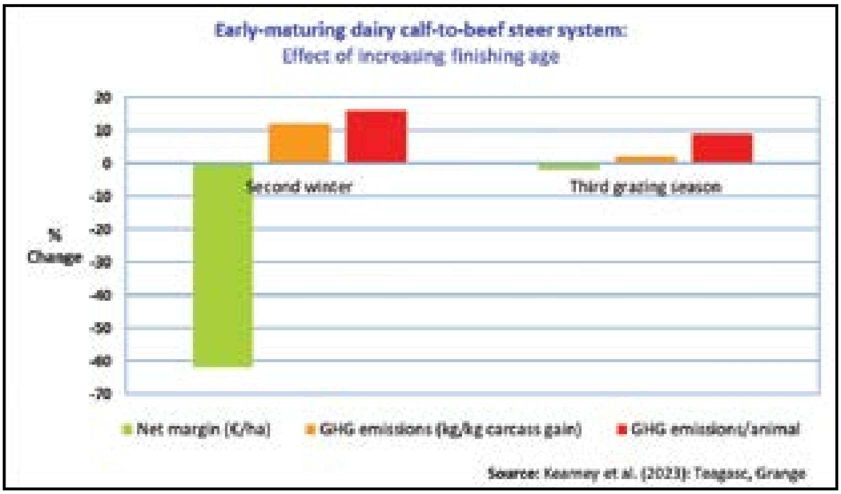

Figure 4. Effect of increasing finishing age where steers are finished during the second winter (i.e. 23.8 vs. 26 months of age) or finished during the third grazing season (i.e. 28.4 vs. 30 months of age) in an early-maturing × Holstein-Friesian dairy calf-to-beef steer system, on the percentage change in net margin/hectare (ha) and GHG emissions per kg carcass gain and per animal.

TECHNOLOGY VILLAGE

Grassland & Forage

Beef production from grass forage-based systems

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Summary

- Grazed grass is the cheapest feed, with white clover inclusion further reducing its cost.
- Optimising individual animal performance and achieving weight-for-age targets from grazed pasture are critical in beef systems.
- Aim to maximise the length of the grazing season.
- Ensure pre-grazing herbage mass and post-grazing sward height are managed to maximise individual animal live weight gain at pasture.
- Both grass-clover and multi-species swards (MSS) increased live weight gain of beef cattle compared to grass-only swards. Live weight gain for MSS and grass-clover swards was similar.
- Proper grazing infrastructure underpins good grassland management, high pasture utilisation and, ultimately, cattle attaining their growth targets.

Introduction

Irish beef production is largely pasture-based where collectively, grazed and conserved pasture account for 80-90% of the lifetime feed consumption. As grazed pasture is invariably the cheapest cattle feed resource in Ireland, increasing the duration of the grazing season and maximising animal growth performance during grazing is critical for sustainable beef production. As grass silage is an inherent part of grassland management, and the primary forage during the winter period on beef farms, optimising animal performance from grass silage is equally important (see page 58). In beef systems, especially on farms with relatively low stocking rates, performance of the individual animal is essential in terms of efficient production, reducing concentrate input and in achieving a younger age at finishing. As the majority of steer beef production systems have two indoor winters and at least two grazing seasons, optimising individual animal performance at each stage in the production cycle is essential. Indeed, due to compensatory growth, animal live weight gain during a particular production stage can influence performance subsequently. Clearly, any factor retarding overall animal growth performance needs to be addressed.

Nationally, mean finishing age for steers is nearly 28 months, and with increased greenhouse gas (GHG) emissions associated with older cattle, beef systems need to reduce finishing age. Therefore, understanding how to increase animal performance from grazed pasture is essential from an environmental and economic point of view.

Table 1. Assumptions and estimated costs (€) to produce feedstuffs in spring 2024

	Grazed Grass	Grass + white clover	Zero-grazing grass all year[1]	First + second cut pit silage[2]	First + second cut bale silage[2]	Three-cut red clover silage[3]	Maize silage (open)[4]	Fodder beet[4]	Purchased rolled barley @ €270/t	Beef finishing ration @ €350/t
Assumptions used										
Dry matter (DM) yield (tonnes/hectare, t/ha)	13	13	13	6 + 4	6 + 4	5.6 + 4.0 + 3.5	13	15	-	-
Dry matter utilised (t/ha)	10.4	10.4	10.4	7.7	8.5	10	11.1	12		
Dry matter (%)	17.4	17.4	17.4	21.7	32.4	30	30	19	-	-
UFL (net energy units) / kg DM	1.03	1.02	1.03	0.82	0.82	0.82	0.80	1.12	-	-
DM digestibility (%)	82	81	82	73	73	73	70	86	-	-
Inorganic nitrogen fertiliser (kg/ha)[5]	225	100	225	87 + 69	87 + 69	-	112	114	-	-
Total nitrogen fertiliser (kg/ha)	250	125	250	115 + 82	115 + 82	0	145	145	-	-
Feed costs (April 2024)										
Total cost/ha (incl. land charge) (€)[6]	1221	1079	2572	2133	2522	2720	3044	3723	-	-
Total cost/ha (excl. land charge) (€)	*603*	*462*	*1955*	*1716*	*2105*	*2183*	*2427*	*3105*	-	-
Total cost/t DM grown (incl. land charge) (€)[6]	94	83	198	213	252	208	238	248	-	-
Total cost/t DM grown (excl. land charge) (€)	*46*	*36*	*150*	*172*	*211*	*167*	*189*	*207*	-	-
Total cost/t DM utilised (incl. land charge) (€)[6]	117	104	247	276	296	274	273	308	-	-
Total cost/t DM utilised (exc. land charge) (€)	*58*	*44*	*188*	*222*	*247*	*220*	*218*	*257*	-	-
Relative cost to grazed grass per energy utilised (UFL) including land charge[6]	1.0	0.9	2.1	2.9	3.2	2.9	3.0	2.4	2.5	3.5
Relative cost to grazed grass per energy utilised (UFL) excluding land charge	*1.0*	*0.8*	*3.2*	*4.8*	*5.4*	*4.8*	*4.8*	*4.1*	*5.0*	*7.1*

[1] Zero-grazing as carried out by contractor does not include the cost of handling extra slurry vs. grazing.
[2] First-cut and second-cut silage were assumed to be harvested on 29 May and 17 July, respectively.
[3] Slurry + 0-7-30 fertiliser for the remainder of P and K requirements; does not include autumn grazing. Six-year persistence assumed.
[4] The extra cost of feed protein supplementation required for maize and fodder beet is not included. Beet washing and chopping is included.
[5] Remainder of nitrogen requirement was met with slurry (organic N) application.
[6] Land charge of €618/ha (€250/acre).

Cost of feedstuffs

The "Grange Feed Costings Model" was used to determine the cost of commonly grown feed crops in March-April 2024. Assumptions applied for each feedstuff are outlined in Table 1. Slurry was applied to all crops, which lowered the requirements for inorganic (chemical) fertiliser. Based on market prices in April 2024, 'protected' urea (the inorganic nitrogen fertiliser source used) and 0-7-30 cost €520/tonne each, and rolled barley and beef finishing ration cost €270 and €350/tonne fresh weight, respectively. Contracting costs (including VAT) were based on Farm Contractors Ireland reference figures; pit silage = €180/acre, mowing = €29/acre, tedding = €17/acre, baling = €9/bale, maize harvesting = €207/acre, beet harvesting = €175/acre. It is acknowledged that these prices may change throughout 2024. Land charge was assumed to be €250/acre (€618/hectare), which is similar to that outlined in the SCSI/Teagasc Agricultural Land Market Review And Outlook Report. All figures include the cost of feeding out and processing.

Grazed grass costs €94/tonne dry matter (t DM) grown (including land charge), which is the equivalent to 9.4c/kg DM grown or 11.7c/kg DM utilised, making it the cheapest feed resource, with white clover inclusion adding further reductions in cost (Table1). The cost of zero-grazed grass is greater than grazed grass but cheaper than grass silage. Although three-cut red clover silage has a lower nitrogen fertiliser cost than two-cut grass silage, the addition of the third-cut and the lower lifespan of the red clover, results in it having a similar cost to grass silage. Baled silage remains more expensive than pit silage. A more detailed breakdown of the estimated cost of baled silage is outlined in Table 2.

Table 2. Calculated cost to produce a round bale of grass silage in 2024

	Cost per bale (€)	Cost per tonne dry matter grown (€)	Contribution to total cost (excl. land charge)
Fertiliser (including spreading)[1]	9.60	48	23%
Harvesting	26.77	134	64%
Other (feeding, herbicides etc.)	3.25	13	7%
Fixed costs (reseeding/facilities)	2.51	13	6%
Total excluding land charge	42.12	211	-
Total including land charge	50.46	252	-

[1] *2500 and 2000 gallons/acre of slurry was applied for first-cut and second-cut silage, respectively, and the remainder of nutrient requirements was supplied via inorganic nitrogen fertiliser.*

Maize silage remains more expensive than fodder beet and slightly more expensive than grass silage (pit). This analysis assumed maize was 'open'. Covering maize with plastic (with a corresponding increase in yield of 2.0 t DM/ha) results in the cost increasing by 4% from €238/t DM grown to €248/t DM grown. Fodder beet has somewhat lower production costs compared to grass silage when expressed per unit net energy utilised basis. It should be noted that compared to grass crops, maize silage and fodder beet have a greater requirement for supplementary protein and minerals, which were not included in this analysis. Purchased concentrates such as rolled barley and beef finishing ration remain an expensive feed source, and especially compared to grazed grass. The competiveness of concentrate feeds against grass silage per unit of net energy utilised will primarily depend on ration price and whether a land charge is considered or not. Feed costings are provided with and without ('cash cost') a land charge. In theory, a land charge should be included to account for the opportunity cost of land.

The figures in Table 1 can be used to calculate the costs of feeding an animal. For example if a steer is consuming 8.5 kg DM/day whilst grazing, it costs €0.99/day to feed him, including land charge (i.e. 8.5 kg DM × 11.7 c/kg DM utilised).

Grassland management in beef systems

As the provision of winter feed is a major cost in Irish beef production systems, research has focused on evaluating the effects of early-turnout to pasture in spring, as a means of increasing animal growth performance and reducing costs associated with the indoor period. Similarly, research has focused on the pasture management factors that are likely to increase grass utilisation and enhance individual animal performance. Following turnout of cattle to pasture in spring, the main grassland management 'tools' available to a farmer primarily relate to the supply (and indirectly the 'quality') of grass when animals enter and leave a paddock. In this regard, a number of studies at Teagasc Grange, using dairy-beef and suckler-bred animals, have examined the effects of, turnout date to pasture in spring, pre-grazing herbage mass and post-grazing sward height (PGSH) on growth performance of cattle.

Effect of spring turnout date and post-grazing sward height (PGSH) on cattle performance

One study compared dairy-bred yearling steers with a mean initial live weight of 280 kg were assigned to treatments with either an early (23 March) or late (12 April) turnout date to pasture. The animals grazed to a post-grazing height of either 3.5 or 5.0 cm in a rotational grazing system. From late-May onwards, steers grazed as followers in a leader-follower rotational grazing system (i.e. calves grazed ahead of the yearlings). The grazing area was stocked at approximately 2.7 LU/ha (equivalent to ~220 kg organic N/ha). Compared with late-turnout steers, early-turnout animals were significantly heavier in early-May, but the weight advantage was not retained, such that by the end of the grazing season live weight was similar for both turnout dates, showing that compensatory growth took place. The main advantage from early-turnout to pasture was cost savings, associated with reduced silage consumption and slurry handling, due to the shorter indoor period. Similar results pertaining to spring turnout date (i.e. compensatory growth exhibited in the animals turned out late) were also found in three experiments using suckler-bred yearling cattle.

Dairy-bred steers grazing to a post-grazing height of 3.5 cm had a significantly lower daily live weight gain, such that by the end of the grazing season in late October they were 30 kg lighter than those grazing to 5.0 cm. The adverse effects of excessively tight (3.5 cm PGSH) compared to more lax (5.5 cm PGSH) grazing on animal growth rate at pasture was confirmed in another follow-up experiment with dairy-beef yearlings.

Effect of PGSH and pre-grazing herbage mass on performance of suckler-bred cattle

A study evaluated the effects of sward PGSH (4 or 6 cm) on DM intake, grazing behaviour and growth of suckler steers. The 'carryover effects' of the two pasture treatments were then monitored during a subsequent indoor finishing period on a diet of either grass silage-only or grass silage + 4 kg concentrate/head daily. Animals rotationally grazed pasture for 196 days, followed by indoor finishing for 119 days. Grazing to 4 cm reduced animal grass intake compared to grazing to 6 cm. At pasture, daily live weight gain was 0.10 kg greater for steers grazing to 6 rather than 4 cm, resulting in a 21 kg heavier live weight at the end of the grazing season, and a tendency for carcass weight to be 11 kg heavier after the indoor finishing period. Concentrate supplementation during indoor finishing increased carcass weight (37 kg) and fat score (1.75 units, scale 1-15), but the majority of steers (80 %) still achieved a commercially acceptable carcass fat score (2+ or greater) in the grass-forage-only system.

In another study, Charolais crossbred suckler steers were used to investigate the effects of sward pre-grazing herbage mass (1500 or 2500 kg DM/ha) and PGSH (4 or 6 cm) on herbage production and animal growth during a 222 day grazing season (Figure 1). The 'carryover effects' from the grazing treatments were monitored during a subsequent 146 day indoor finishing period, during which a diet of grass silage-only or grass silage + 4.75 kg concentrate/head daily was offered. Grazing to 4 cm reduced animal grass intake compared to grazing to 6 cm. At the end of the grazing season, live weight was 16 kg heavier for the lower pre-grazing herbage mass (1500 kg DM/ha) and 34 kg heavier for the lax (6 cm) PGSH. After indoor finishing, there was no difference in carcass weight between pre-grazing herbage mass treatments, but steers grazing to 6 cm had a 19 kg heavier carcass than those that grazed to 4 cm. Annual herbage production was ~900 kg greater on the 2500 kg pre-grazing herbage mass sward and ~500 kg DM/ha greater for the 4 cm PGSH. Grazing lax (to 6 cm) resulted in using more grazing ground per grazing rotation (lower stock carrying capacity) due to a higher animal intake and slightly lower herbage growth than grazing tight (to 4 cm).

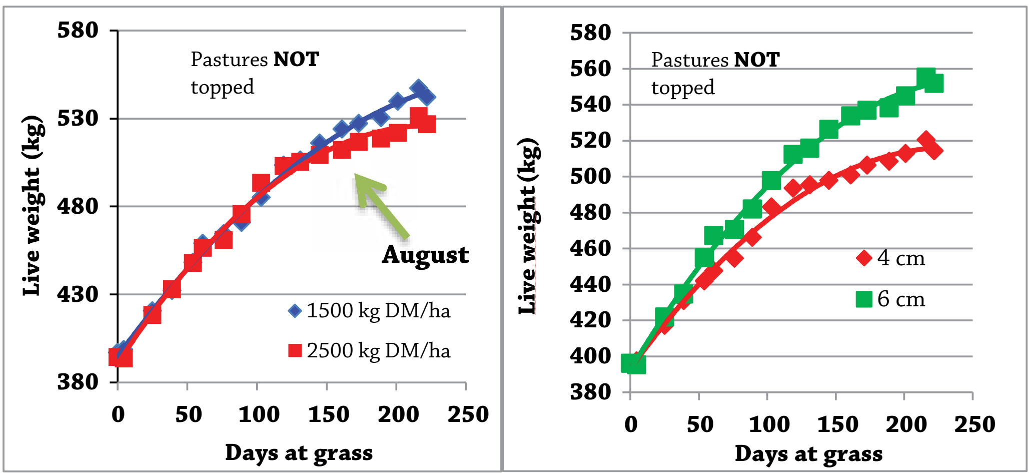

Figure 1. Effect of pre-grazing herbage mass (1500 vs. 2500 kg DM/ha) and post-grazing sward height (PGSH, 4 vs. 6 cm) on steer live weight gain over the grazing season.

It was concluded from this experiment that grazing to 6 cm rather than to 4 cm, increased individual carcass weight but not carcass weight gain/ha. Grazing the lower pre-grazing herbage mass of 1500 kg DM/ha rather than 2500 kg DM/ha, increased animal live weight gain at pasture but did not affect carcass weight on an individual steer or per ha basis following indoor finishing.

Grass-clover and multi-species swards

The inclusion of clover in grazed pasture swards is desirable from the point of view of maintaining similar levels of herbage production with less nitrogen fertiliser, and improving animal performance. There are two main methods to establish white clover in the grass swards; 1) over-sowing clover into existing grass swards, and 2) a conventional full reseed (see page 50).

Effect of nitrogen fertiliser application rate on clover content and herbage yield of grass-clover swards

The effect of inorganic chemical fertiliser N application rate on white clover content and herbage production of grass-clover swards was examined over five consecutive years (2019-2023) on cutting plots in Teagasc Grange. Clover content of swards receiving zero N was similar in year five as in year one whereas, for the treatments receiving higher rates of inorganic fertiliser N the clover content was decreased, substantially (Figure 2). Sward clover content and its yield declined as nitrogen fertiliser application rates increased. Averaged over the five years, swards receiving zero, 100 or 200 kg nitrogen/ha yielded 88, 94 and 98% relative to a sward receiving 300 kg nitrogen/ha (Figure 3).

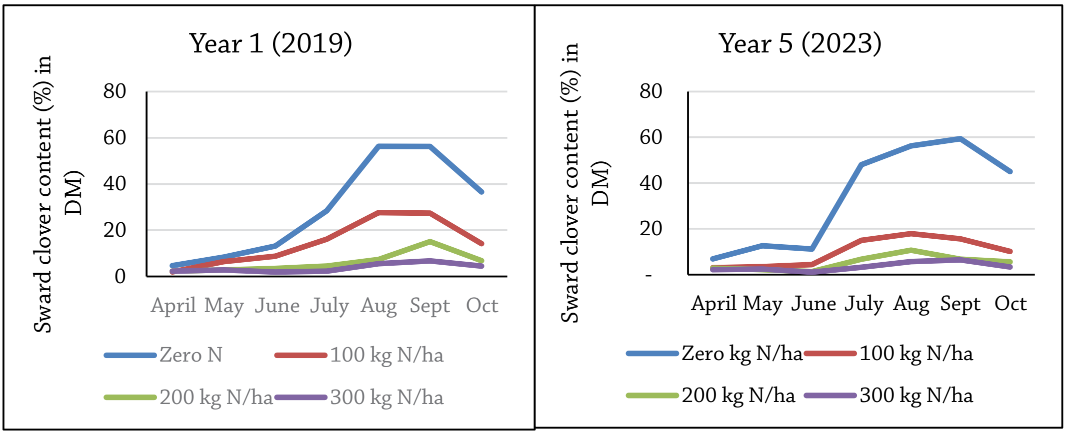

Figure 2. Effect of inorganic nitrogen fertiliser application rate on sward clover content in year 1 (2019) and year 5 (2023)

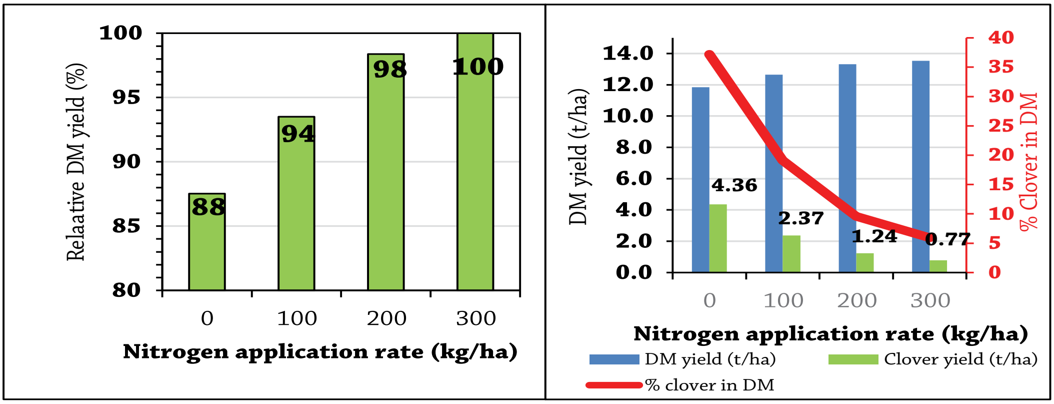

Figure 3. The effect of inorganic nitrogen fertiliser application rate (kg/ha) on relative herbage dry matter yield in grass-clover swards (left chart) and on total herbage and clover yield and clover content (right chart)

Effect of pasture type on growth performance of beef cattle

Grass-only vs. Grass-clover swards

In spring 2023, suckler-bred yearling steers and heifers in the Derrypatrick herd were assigned to either a perennial ryegrass-only or perennial ryegrass-white clover sward to quantify carcass gain from the two pasture types over a single grazing season (see p72). Animals grazing grass-white clover swards had greater daily live weight gain (+ 0.1 kg), and were 23 kg heavier at the end of the grazing season, resulting in a 14 kg heavier carcass, than those grazing grass-only swards. This finding is consistent with previous research at Teagasc Grange.

Grass-clover vs. Multi-species swards

Suckler-bred steers were assigned to either perennial ryegrass-white clover or multi-species swards (MSS - perennial ryegrass, timothy, white clover, red clover, chicory and plantain) as part of a weanling-to-beef systems experiment encompassing two production cycles, at Teagasc Grange (see p54). Overall, results indicated that live weight gain and carcass weight was similar for both pasture types, implying that the addition of 'herbs' (chicory and plantain) to the grass + legume sward had no benefit in terms of animal growth rate.

Grass-only vs. Grass-clover vs. Multi-species swards

Early-maturing dairy-beef heifer calves purchased at 20 weeks of age were assigned to one of three pasture treatments: 1) perennial ryegrass-only or, 2) perennial ryegrass-white clover or 3) MSS (perennial ryegrass, white clover, red clover, chicory and plantain), in a dairy calf-to-beef systems experiment at Teagasc Johnstown Castle (see p114). The animals remained on their respective treatments (i.e. pasture + corresponding silage) for the first grazing season, first winter and second grazing season and 'finished' animals were drafted at the end of the second grazing season. Any heifers not finished at pasture were housed in October, and offered a finishing diet of silage *ad libitum* supplemented with 4 kg concentrate/head daily. Overall, results indicated that animal lifetime average daily live weight gain and carcass weight was lowest for the grass-only treatment, and similar for the grass-clover and MSS treatments.

Therefore, from the above three separate studies it can be concluded that both MSS and grass-clover swards increase animal live weight gain compared to grass-only swards. Animal lifetime live weight gain was similar for MSS and grass-clover swards.

Grazing infrastructure

Improving grazing infrastructure (paddock system, roadways and water provision) on beef farms allows better control of grass, increased grass growth, improved grazing utilisation, a longer grazing season and may help to increase clover content. This is very obvious during poor weather conditions and in both the spring- and autumn-growing seasons. Additionally, with good grazing infrastructure cattle are easier to manage, which is particularly important in a one-person operation. With better grazing infrastructure, grass utilised on farms can be increased by either growing more grass and/or improving the utilisation rate. On many drystock farms, there are too few paddocks per grazing group. As a result, cattle are grazing paddocks for too long, grass regrowth is not 'protected' and consequently, growth rate is hindered. On the other hand, cattle end up grazing excessively high grass covers resulting in poor utilisation and animal performance, and necessitating mechanical topping to remove the heavy residual. Dividing fields into paddocks need not be an elaborate or high-cost project. In the majority of cases, reels and polywire can be used to temporarily split existing fields for grazing. Having adequate drinkers in fields is very important to allow subdivision.

Key steps when setting up a paddock system

1. Create a farm map with precise areas

The first step is create a map of the farm. Ungrazeable areas, walls, ditches and hedgerows will influence where paddocks and farm roadways will go. Talk to your advisor about developing a farm map or use your own paper map. There are also a number of free maps online and apps that can help to map the farm.

2. Paddock size

The aim on beef and sheep farms is to grow grass in three weeks and graze it in three days. Three-day paddocks are the goal. A common question is: how large should paddocks be? As a rule of thumb, a group of 40 suckler cows and 40 weanlings grazing on free-draining, productive ground should be allocated a 2 ha paddock. The plan is to have seven to eight paddocks per grazing group. Avoid creating long narrow paddocks to minimise poaching. Aim for a ratio of 2:1 so that paddocks are twice as long as they are wide.

3. Plan the location of drinking points when dividing fields

Water trough location in the paddock is very important. Avoid locating troughs near gateways. Ensure to position water troughs in a central location in the field, which means each trough can serve a minimum of two paddocks. Ensure the drinker is positioned on level ground and balanced with some hard core where necessary. In some cases, you could divide larger, square fields, into four, with one drinker serving many paddocks.

4. Farm roadways

Roadways allow more efficient access to paddocks. They enable easier movement and management of livestock around the farm. Roadways also allow for easier management of grass during difficult grazing conditions. Ultimately, farm budgets will determine which roadway type is chosen. Narrow ‘spur’ roadways can be efficient to use in some areas of the farm, simply created with a reel, polywire and pigtails.

Conclusion

Increasing the length of the grazing season through early-turnout to pasture in spring will reduce feed costs on farms, but may not always increase overall animal performance. Grazing to a PGSH of 6 cm (rather than ~4 cm) and including clover (legumes) in grass swards improves individual animal live weight gain, which helps to reduce finishing age and improve profitability, while contributing to meeting our climate change targets. It is fundamental to put an appropriate grazing infrastructure in place to help achieve the above targets.

Strategies to reduce reliance on chemical nitrogen fertiliser on cattle farms

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Summary

- Use soil analysis results to identify fields that need pH correction or improvements in phosphorus (P) and potassium (K).
- Get slurry analysed for nutrient content.
- Apply slurry using low emission slurry spreading (LESS) systems in the springtime to get maximum benefit from nitrogen (N), P and K, and target silage ground.
- Reduce fertiliser waste by calibrating fertiliser and slurry spreaders, adhere to buffer zones, and consider the use of precision technology including global positioning systems (GPS) for more targeted application.

Introduction

Agriculture has a requirement to reduce greenhouse gas emissions by 25% by 2030, relative to 2018. A 25% reduction is a very demanding target. The Marginal Abatement Cost Curve (MACC) developed by Teagasc sets out a menu of actions that farmers can take to reduce emissions on their farms. Most of the actions in the MACC are 'win-wins' i.e. they are good for the environment and good for farmers' pockets. These include, reducing our reliance on chemical nitrogen (N) fertiliser, making better use of slurry, reducing finishing age at finishing for beef cattle, increased grazing days at pasture, better breeding, including using the Replacement and Terminal indices, as well as use of the commercial beef value (CBV) when buying calves, reduced age at first-calving, and improved animal health.

The Signpost Programme, led by Teagasc, is tasked with supporting and enabling farmers to reduce greenhouse gas emissions. There are 37 Signpost beef demonstration farms (Dairy Beef500 and the Future Beef Programmes) in the country and these farmers are the early-adopters of the key technologies to reduce emissions. The Signpost Advisory Programme is a free programme designed to support all farmers, Teagasc clients and non-clients. All farmers are encouraged to get to know their local Signpost farmer and sign up for the Signpost Advisory Programme to develop a plan for their own farm to help meet the targets.

Where should cattle farmers start to reduce greenhouse gas emissions?

Step one on any farm should be to reduce the reliance on chemical N in grassland and cropping systems. Chemical N releases nitrous oxide (N_2O), a potent greenhouse gas, into the atmosphere when applied to land. Nitrous oxide is one of the three main greenhouse gases (the others being carbon dioxide (CO_2), and methane (CH_4)). Therefore, if a farmer reduces the amount of chemical N used on the farm the amount of N_2O emitted is reduced. According to the Teagasc MACC 2023, reducing chemical N by 25% has the potential to reduce total emissions by 0.5 million tonnes (Mt) or 11% of the total emissions reduction needed.

What are the main fertiliser reduction strategies?

There are a range of proven technologies today to reduce our reliance on chemical N fertiliser:

Use a nutrient management plan

Improving farm N use efficiency is the first step to reducing farm N requirement and reducing total farm carbon emissions. The starting point is maintaining and following a farm fertiliser plan on a regular basis to manage soil fertility and identify farm nutrient requirements annually.

Soil sampling

Soil analysis is a small cost and provides the basis to planning nutrient applications. Take soil samples to the correct sampling depth of 10 cm, every two to four hectares (ha) and take fresh soil samples every three to four years.

Soil pH

Aim to maintain soils in the agronomic range pH 6.3 to 6.5 for productive ryegrass swards, and pH 6.5 to 6.8 for clover-dominated swards. For successful clover establishment aim to build soil pH in advance of sowing. Optimum soil pH has the largest impact on improving nutrient availability, efficiency of applied organic or inorganic fertilisers and productivity of a clover sward. For example, at optimum pH soils can release up to 70 kg N/ha/year and reduce soil N_2O emissions annually.

Considerable progress was made improving soil pH through liming from 2012 to 2018. However, across beef enterprises there has been a significant increase in the proportion of our soils that have low pH. Currently, 65% of soil samples from cattle farms indicate a lime requirement or the fields from which they were obtained. According to the Teagasc MACC 2023, the target is to use 1.75 m tonnes of lime per annum up to 2025, and 2.5 m tonnes per annum to 2030. In 2022 we used 1.4 m tonnes of lime, this reduced to 1.0 m tonnes in 2023 due to poor weather conditions, which limited opportunities to apply lime.

Soil phosphorus (P)

Aim to maintain soil P at Index 3 (5.1 to 8.0 mg/l) for optimum productivity on moderate to intensively managed farms. Increasing soil P from Index to Index 3 will increase grass production capacity by ~1.5 t/ha DM/year and reduces soil N_2O emissions. Sufficient P supply is important throughout the growing season. For example, early applications of P are required to promote grass growth at the beginning of the grass-growing season (March/April).

Soil potassium (K)

Aim to maintain soil K at Index 3 (101 to 150 mg/l) for optimum productivity. Increasing soil K from Index 1 to Index 3 will increase grass production capacity by ~2.0 t DM/ha/year. Apply maintenance (Index 3) levels of K in springtime based on stocking rate to reduce risk of grass tetany. Aim to apply 'build-up' rates of K in the autumn to reduce the risk of luxury uptake of K during the main growing season. Recent research from Johnstown Castle indicates that autumn applications of K improve N efficiency compared to either spring or mid-season applications. Maintaining optimum levels of soil K increases the percentage of clover in both ryegrass- and clover-based swards.

Use clover or multi-species swards

Clover can fix between approximately 80 and 120 kg N/ha/year depending on the underlying soil fertility and sward management. Multi-species swards may also offer extra benefits in terms of drought resistance.

Make best use of slurry

Slurry is a valuable fertiliser for growing grass on beef farms. Purchased inorganic fertiliser is one of the highest variable costs on beef farms; however, correct use of slurry can help reduce costs associated with growing grass. Slurry provides a balance of nutrients for grass growth in terms of N, P and K along with other trace elements. Good quality cattle slurry applied through low emission slurry spreading (LESS) in the springtime can have approximately 9 units N (1.0 kg N), 5 units P (0.5 kg P) and 32 units K (3.5 kg K) available per 1,000 gallons applied. However, the N:P:K nutrient content within slurry can vary across beef farms. The 'quality' of cattle slurry is primarily influenced by its dry matter (DM) content and the diet of the animal producing the slurry. Slurry DM content can be estimated using a slurry hydrometer. The N:P:K content (and DM) can be analysed by testing slurry in a laboratory. Slurry can be analysed at a relatively low-cost and the resulting information means more appropriate and targeted application rates can be applied to the grass crop being produced.

Compared to splash plate application, slurry spread using LESS substantially reduces grass contamination meaning it can be applied to grass covers of up to 1,000 kg/DM/ha. A grass cover of 1000 kg DM/ha is equivalent to a grass height of seven to eight centimetres. Low P and K index soils benefit immensely from slurry. Soil fertility maps in the Teagasc Nutrient Management Plan should be reviewed to identify paddocks that are shaded pink or blue as these paddocks are index one or two, respectively, for P and K.

The EU nitrates directive rule states that, "*from 1 January 2024 farms with a grassland stocking rate of >130 kg organic N/ha need to apply organic manure through LESS. Furthermore, from 1 January 2025 LESS application is mandatory on farms stocked >100 kg organic N/ha*".

What type of chemical fertiliser should cattle farmers use?

If inorganic fertiliser must be applied, then switching from calcium ammonium nitrate (CAN) and urea to NBPT Urea (i.e. protected urea) will directly reduce both greenhouse gas and ammonia emissions, while also being cheaper. Calcium ammonium nitrate-based fertilisers release N_2O, which is one of the main greenhouse gases of concern. Compared to CAN, NBPT Urea has 71% less N_2O emissions. By switching from urea to NBPT urea, ammonia emissions reduce from 15.5 to 3.3%, thus reducing fertiliser requirements by ~12%. Of the tools assessed by Teagasc, using NBPT Urea nitrogen fertiliser offers the single largest emission reduction potential to Irish farmers. On a drystock farm, switching to NPBT Urea has the potential to reduce total emissions by up 6%, depending on chemical N usage. In terms of cost, NBPT Urea is substantially cheaper than CAN, and has the potential to reduce fertiliser costs by 15-20%.

Recent research on low-N compound fertilisers has found that N_2O emissions could be reduced by around 40% with compounds such as 18:6:12 compared to high-N compounds (e.g. nitrate-based 24's and 27's). Use low-nitrate compounds such as 18:6:12 and 10:10:20 to further reduce farm carbon emissions.

How can the accuracy of fertiliser application be improved?

- Setup and calibration of fertiliser spreaders is very important to ensure even distribution of fertilisers when spreading. This involves adjusting the spreader settings to achieve accurate application rates and uniform coverage. Proper calibration not only maximizes the benefits of fertilisation but also minimizes the risks of over- or under-application, which can lead to yield losses, environmental pollution, and increased production costs.
- Keeping the machine in good condition. Regular maintenance, including cleaning, lubrication, and inspection of components, is essential to ensure proper functionality. Worn vanes, in particular, can significantly impact the spread pattern and distribution uniformity. As vanes wear out over time, this will result in uneven spreading, resulting in areas of over- or under-fertilisation. By replacing worn vanes promptly, farmers can maintain consistent application rates and optimize fertiliser efficiency.
- Different fertilisers exhibit varying flow characteristics and spread patterns. Different fertiliser types have different particle sizes and densities, leading to variations in spreading behaviour. Consequently, adjustments to spreader settings are needed to maintain an accurate spread width and flow rate, and achieve uniform coverage across the field. Failure to adjust spreader settings to suit the product can result in uneven distribution and suboptimal fertiliser utilization.
- To mitigate the risk of over-application and to reduce environmental impact, farmers can utilize headland control mechanisms. These systems allow operators to adjust the spread pattern when spreading at the field's edges, preventing excess application in headland areas. By minimizing overlap and reducing wastage, headland control mechanisms not only conserve resources but also help protect nearby hedgerows and watercourses from pollution. This proactive approach to precision farming promotes sustainable agricultural practices while enhancing crop productivity and environmental stewardship.

In conclusion, the calibration of fertiliser spreaders is a critical aspect of modern agricultural management. By maintaining equipment in good condition, replacing worn vanes, adjusting settings for different fertilisers, and employing headland control mechanisms, farmers can optimize fertiliser application, minimize waste, and protect the environment. Investing time and effort in proper calibration practices ultimately contributes to improved crop yields, reduced production costs, and sustainable agricultural development.

Agricultural Sustainability Support and Advisory Programme (ASSAP)

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Summary

- Ireland has been set a target by the E.U. Water Framework Directive of achieving 'Good Status' for all waters by 2027.
- The River Basin Management Plan for Ireland sets out Ireland's plan to achieve 'good status'.
- As part of this plan, priority areas for action (PAAs) have been identified across the country where water quality improvements need to be made.
- The ASSAP is a free and confidential advisory service, which is available to farmers in PAAs, and is a key part of helping achieve 'good status'.
- The Farming for Water European Innovation Partnership (EIP) provides funding for farmers to implement actions that prevent the loss of nutrients and sediment to waters.

Introduction

In Ireland all water policy and management is led by the Water Framework Directive. Under this directive, Ireland has been set a target of achieving at least 'good status' for all Irish waters by 2027. However, despite a lot of good work over the last 20 to 30 years we are falling short in achieving this target; in fact, water quality has declined in recent years.

Ireland's response to challenges around water quality is set out under the National River Basin Management Plan. As part of this plan, priority areas for action (PAAs) have been identified across the country where water quality improvements need to be made. The recently launched Farming for Water European Innovation Partnership (EIP) is available in PAAs and provides financial support to farmers to put in place specific measures that are beneficial to water quality.

Implementation of the ASSAP

The Local Authority Waters Programme (LAWPRO) have deployed a catchment assessment team of 60 scientists across the country to evaluate streams and rivers in PAAs in detail and identify the significant pressures impacting water in each PAA. Where an agricultural pressure is identified the farmers in the area will receive the offer of a free farm visit from an advisor under the ASSAP programme.

The ASSAP programme comprises of a group of 46 advisors (20 working under Teagasc, jointly funded by Department of Housing, Local Government and Heritage (DHLGH) and Department of Agriculture, Food and the Marine (DAFM), and 26 advisors from the dairy processing co-ops. These advisors are available to provide farmers with a free and confidential advisory service that farmers in a PAA can avail of on a voluntary basis.

The advisors will meet the farmer to assess the farm for any potential issues that are having an effect on the water quality in the local stream or river. At the end of a visit the advisor and farmer will agree on where the farmer should focus improvements or actions, if any are required, on their farm. The practical advice will focus on reducing the diffuse loss of nutrients to water by carefully managing the source of nutrients and by implementing 'break the pathway' measures on farms. These measures, supported by the EIP, will help farmers to put the right measures in the right places on farm to target the loss of phosphorus, sediment, nitrates and pesticides from farming activities.

Farming for Water EIP

The Farming for Water EIP was launched in 2024, and will continue until the end of 2027. The project is a collaboration between Teagasc, LAWPRO and Dairy Industry Ireland (DII) together with DAFM and DHLGH. A fund of €50 million is available to farmers in PAAs with the aim of delivering targeted actions to reduce losses of nutrients, sediment and pesticides from agricultural lands. The ASSAP advisors will engage with up to 15,000 farmers across the country to participate in the EIP where water quality needs to be improved. It will assist farmers in implementing voluntary measures on farm above regulatory requirements and ensure the "right measure is put in the right place".

Figure 1. Heavy rainfall leads to overland flow of water, phosphorus and soil particles

Factors influencing losses to water

The loss of contaminants such as nutrients, sediment and pesticides to water from agricultural sources is increasingly under the spotlight. Recent Environmental Protection Agency (EPA) reports have highlighted the role farming plays as a source of contaminants affecting water quality. Soil type, weather conditions and land management all influence the type of contaminant lost and the pathway through which it enters the nearby stream or groundwater (Figures 1 and 2). When assessing

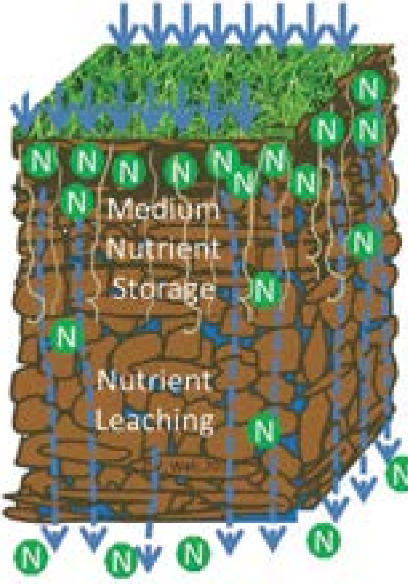

Figure 2. Nitrogen that is not used up by grass/plant is available to leached to groundwater/streams during heavy rainfall

farms under ASSAP, Teagasc and dairy co-op advisors discuss the diffuse loss of nutrients (phosphorus and nitrate), sediment and pesticides to water with farmers to help improve awareness and understanding of how contaminants leave a field and enter the drainage network.

Risk areas on farms for diffuse losses and mitigation actions to reduce impacts

1. Critical Source Areas (CSA) and the benefits of clay bunds and tree planting

A CSA is typically a low-lying area in a field with high connectivity to the drainage network. During periods of high rainfall, water will flow over the surface of the ground and enter drains or watercourses, bringing with it sediment and nutrients. By putting a clay bund around this low-lying area you will slow down the rate at which the water enters the watercourse and gives the sediment time to settle on the ground before it enters the watercourse. Tree planting in this area can help mop up the nutrients deposited by the sediment and improve soakage.

2. Field drains and bank stabilisation

Field drains can contribute to sediment load in watercourses. This typically happens during maintenance where soil is disturbed by a digger and gets washed away. However, where field drains are over-deepened and have very steep banks then these can become unstable and collapse into the drain.

3. Soil profile

Soil plays an important role in the movement of water through the landscape and it is important to know the soil type on farms as this will inform the measures a farmer should implement. Freely draining soil is risky for nitrate loss, whereas poorly draining soils can lead to phosphorus and sediment loss.

4. Soil type and water infiltration

Soil type influences the rate of infiltration of water into the soil profile. The ASSAP team have developed a rainfall simulator comprising five soil trays filled with different soil types, which provides a visual representation of real time losses of phosphorus, sediment and nitrate (Figure 3). The five soils are:

A. Poorly-draining grassland soil
B. Freely-draining tillage soil
C. Poorly-draining tillage soil
D. Freely-draining grassland soil
E. High organic matter peat soil

Soils A and C become saturated quickly and water then moves via the overland flow pathway bringing with it phosphorus and sediment. There is a greater potential for sediment loss on tillage fields.

Soils B and D allow water to move downwards through the soil profile with nitrate lost via the sub surface pathway to groundwater. There is a greater potential for nitrate losses from tillage fields in autumn where no cover/catch crop is present.

In Soil E, water moves through the soil and is dependent on the level of the water table in the field.

Figure 3. The rainfall simulator shows how different soil types lead to different pathways for loss of nutrient and sediment

Interactive water quality maps

A range of mapping tools have been developed by the EPA to help farmers identify high-risk areas of their farms for diffuse nutrient loss, and also provide information on the water quality in their local river or stream. These can be viewed on **https://gis.epa.ie/EPAMaps/agriculture**

Conclusion

The ASSAP programme is collaborative and the funding and support received from DAFM, DHLGH and the dairy industry has been critical to allow a new approach to enabling local landowners to engage positively in seeking solutions to local problems with the support of a confidential advisory service. The recently launched Farming for Water EIP will provide financial support to farmers to put in place measures to prevent the diffuse loss of nutrients in specific catchments that have a water quality issue throughout the country.

Reseeding and over-sowing clover on drystock farms

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Summary

- Reseeding is one of the most cost-effective on-farm investments.
- Grazing management after reseeding and over-sowing is important to ensure good sward establishment.
- The most appropriate time for reseeding or over-sowing is late spring/early summer.
- When reseeding, farmers should use varieties with high Pasture Profit Index (PPI) values associated with the key traits required for the farm enterprise.

Introduction

Reseeding and over-sowing swards with white clover has grown in importance in the last number of years. The increased price of chemical nitrogen (N) fertiliser has been one of the main drivers for farmers to incorporate more clover into their swards. Reseeding is an expensive investment costing >€1100/hectare (ha) but is worthwhile and cost-effective since new swards typically return greater annual dry matter (DM) production. There are two main avenues for developing grass/clover swards, direct reseeding or over-sowing, both of which need to be combined for a farm to become clover-dominant over a 4-to-5 year period.

Establishing grass/white clover swards

Incorporating white clover in a full reseed is the most reliable method of clover establishment; however, it will take too long to establish clover throughout the whole farm if this is the sole method used. Over-sowing is a simple and low-cost method of introducing white clover into swards and is very applicable for drystock farms. Success is very much dependent on soil fertility, weather conditions at the time of over-sowing, and post-sowing grazing management. For both processes, it is better to reseed/over-sow in spring/early summer.

White Clover Establishment Blueprint

A targeted multi-year approach should be used in establishing a white clover system-combination of reseeding and over-sowing

- Reseed approximately 3 to 5% per year
- Over-sow approximately 10 to 15% per year
  - Year 1: reseed 5% & over-sow 15% = 20%
  - Year 2: reseed 5% & over-sow 15% = 20% (40%)

- Year 3: reseed 5% & over-sow 15% = 20% (60%)
- Year 4: reseed 5% & over-sow 15% = 20% (80%)
- Year 5: reseed 5% & over-sow 15% = 20% (100%)
- Year 6+: on-going process/maintain clover

While reseeding may not take place every year on a drystock farm, over-sowing is an important aspect to develop clover swards.

Reseeding

- Spring reseed provides best results - April, May.
- Spray-off the old pasture with glyphosate.
- Prepare a fine, firm seedbed (with the most appropriate cultivar method for that paddock).
- Soil sample and apply required lime, phosphorus (P) and potassium (K).
- Use the Irish Recommended List for grass and clover cultivar selection.
- Sowing rates:

	Grass	**White Clover**
Cattle	28-30 kg/ha	4-5 kg/ha
Sheep	25-28 kg/ha	5-6 kg/ha

- Ensure good seed-soil contact by rolling after sowing

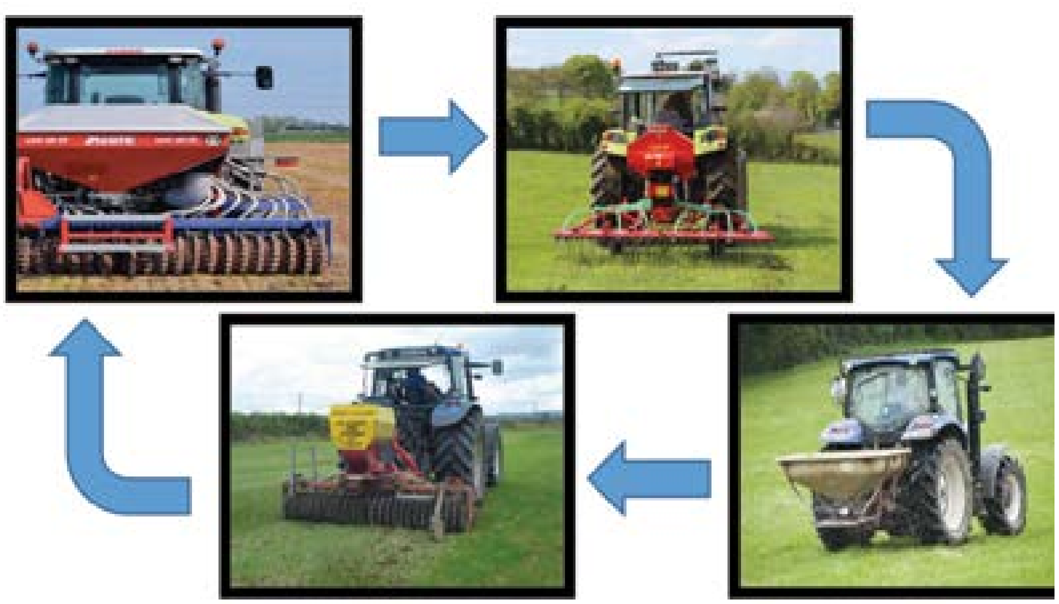

Figure 1. Methods of over-sowing white clover into existing swards

Over-sowing

- Control weeds in the year prior to over-sowing white clover.
- April/early-May is the best month for over-sowing.
- Over-sow directly after a tight grazing.
- White clover can be over-sown using a number of methods (Figure 1).
- Ensuring soil contact after over-sowing is one of the most crucial factors.
- Over-sowing methods - all methods outlined in Figure 1 below are equally successful as long as the right conditions and post-sowing management are correct.
- *Broadcasting*: gives more varied results:
  - Mix clover seed with a compound fertiliser in the field – max of 1.0 ha at a time
- *Stitching*: can ensure a better soil-seed contact:
  - In sheep swards, stitching should be used.
- Sow at a rate of 5 to 6 kg/ha.

Post-sowing management: full reseed or over-sowing

- Ensuring that sunlight gets to the base of the sward is a crucial factor in post-sowing management, as it encourages stolon development.
- The first grazing should be at a pre-grazing herbage mass of 600-to-1000 kg DM/ha.
- The subsequent three grazings should be at a pre-grazing herbage mass <1,100 kg DM and swards should be grazed to ≤4 cm (graze tight) – this means that grazing duration will be much reduced in these paddocks.
- No silage should be harvested from these swards in the first 12 months after sowing.
- Swards should be grazed later in the autumn to avoid carrying 'heavy' grass covers over the winter.

Weed control

Weed control in reseeded and over-sown grass/white clover swards is vital to sward persistence. All pesticide users should comply with the regulations as outlined in the Sustainable Use Directive (SUD).

- Reseeds
  - Weeds are best controlled when the grass plant is at the three-leaf stage and when the trifoliate leaf has appeared in the clover. White clover safe herbicide should be used.
- Over-sown
  - Established weeds should be controlled the year before over-sowing.
    - Consider the residue time of non-clover safe sprays, as his may effect clover establishment.

Grass variety choice

When reseeding, only varieties from the Pasture Profit Index (PPI) should be used. The PPI for 2024 is displayed in Table 1. Farmers should select varieties using the PPI to ensure the best return on investment when reseeding. Selecting varieties based on the sub-indices (i.e. spring, summer and autumn yields, Quality, Silage, Persistence and Grazing Utilisation) is recommended. Farmers are generally finding the new trait 'Grazing utilisation' useful to ensure the mixtures chosen have good 'graze-out' capacity.

Table 1. Pasture Profit Index (values, €/ha/year) for 2024

Variety	Ploidy	Heading date	PPI	Spring yield	Summer yield	Autumn yield	Quality	Silage	Persistence	Grazing utilisation
Galgorm	D	Inter	266	60	66	67	25	47	0	*
AberSpey	T	Inter	240	26	56	59	65	34	0	****
AberClyde	T	Inter	229	38	61	41	44	45	0	****
Barwave	D	Inter	227	84	54	55	-19	52	0	*****
Gracehill	D	Late	225	37	53	54	11	70	0	**
Tollymore	T	Inter	225	54	49	44	21	70	-13	*****
AberGain	T	Late	217	24	53	46	48	45	0	****
AberMagic	T	Inter	198	22	57	74	18	27	0	***
Nashota	T	Late	194	45	48	33	28	39	0	*****
AberPlentiful	T	Late	193	50	56	46	11	29	0	***
Glenfield	D	Late	191	50	56	36	4	44	0	*****
AberWolf	T	Inter	186	43	49	46	11	37	0	**
Ballintoy	D	Late	183	34	51	42	24	33	0	****
Moira	T	Inter	183	95	31	52	-32	36	0	***
AstonConqueror	T	Inter	182	63	46	41	-10	42	0	****
Anurad	T	Late	180	45	45	37	32	21	0	****
Meiduno	T	Late	180	39	48	42	28	22	0	****
AberChoice	T	Late	174	7	58	54	22	32	0	**
Fintona	D	Inter	174	40	45	45	-4	47	0	*****
AberGreen	T	Inter	173	28	62	66	5	12	0	*
Dunluce	D	Inter	172	14	50	48	24	35	0	****
AberBann	T	Late	171	-5	74	71	-25	56	0	***
Ballyvoy	D	Late	170	57	38	43	19	13	0	*
Bowie	D	Late	163	13	45	50	29	26	0	*
Gusto	D	Inter	156	40	43	60	2	10	0	****
AberBite	T	Late	148	-11	49	49	33	40	-13	*****
AstonEnergy	T	Late	145	1	40	40	50	13	0	*****
Briant	D	Late	140	2	51	42	13	32	0	***
Oakpark	T	Late	135	24	45	48	-11	29	0	*
Solas	T	Late	131	7	40	50	1	32	0	***
Drumbo	D	Late	130	14	36	37	25	16	0	*
Xenon	T	Late	127	4	41	31	30	21	0	*****
AstonKing	D	Late	126	52	43	33	-25	22	0	***
Triwarwic	T	Late	125	11	46	26	7	35	0	.
Aspect	T	Late	125	3	43	26	28	25	0	*****
Callan	D	Late	109	61	32	29	-35	21	0	****

Grass-clover and multi-species swards for beef production

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Summary

- Herbage and beef production from grass-clover and multi-species swards were compared within suckler steer weanling-to-beef systems, finishing animals at either 19-, 23- or 26-months of age.
- No chemical nitrogen (N) fertiliser or slurry was applied to the grazing areas, while the remainder received 30 m^3 (~3000 gallons/acre) of cattle slurry plus 80 and 70 kg N/hectare for first-cut and second-cut silage, respectively.
- Growth performance of cattle grazing grass-clover and multi-species swards, or offered silages conserved from these pastures, was similar.
- Herbage production and digestibility was similar for both sward types.
- No difference in animal methane production, or in anthelmintic properties, was found between the two sward types.
- Vigilance regarding animal bloat is required.

Introduction

European Union and national legislation has been introduced to reduce greenhouse gas (GHG) emissions and losses of nitrogen (N) and other nutrients to the environment. Irish agriculture, including livestock farming, is required to take some of this burden. For many decades, perennial ryegrass has been the dominant, and sometimes the only, constituent included in grass seed mixtures sown for grassland renewal. However, to achieve its production potential, these pastures require fertile soil and higher rates of inorganic fertiliser N. Ever-increasing fertiliser and farm input prices and environmental legislation have led to a greater emphasis on more sustainable, low-cost, efficient grass-based beef production systems. Thus, the sustainability of relatively high input, intensively managed single-species pasture is questionable. More recently, there is renewed interest in white clover inclusion in grassland reseeding mixtures. It is generally accepted that well-established clover-based grassland swards can have annual savings of chemical fertiliser equivalent to 100-150 kg N/ha, and as many beef farms use less than this amount of chemical N, the attractiveness of legumes in a sward is obvious. Currently, interest is focused on more botanically diverse swards, with subsidies offered to farmers to encourage their greater use. Such diverse or multi-species mixtures include grasses (perennial ryegrass and other grasses), legumes (white and red clover) and herbs/forbs (e.g., chicory and plantain) which together aim to exploit complementarity between the different herbage species sown. Although multi-species pasture are known to enhance biodiversity above and below the soil and provide essential 'ecosystem services', there is, however, relatively little published research evaluating the performance of suckler beef cattle on such swards.

A further strategy to reduce GHG emission from livestock farming is to reduce finishing age for beef animals. Achieving optimum animal lifetime performance is key to getting animals finished at a younger age. In this context, an experiment was established at Teagasc Grange to evaluate grass-clover and multi-species swards, within suckler steer weanling-to-beef production systems, finishing animals at either 19-, 23- or 26-months of age.

Grass-clover and multi-species swards establishment

During July to August 2022, a 27 hectare (ha) land block was divided into 90 paddocks and alternate paddocks were sown to either grass-clover or multi-species mixtures. Following desiccation with Roundup and two passes of a power harrow, seeds were then over-sown with a pneumatic drill and the seedbed rolled. No post-emergence herbicides were applied. The grass-clover mixture composed of late-heading diploid and tetraploid perennial ryegrasses in addition to 2.5 kg/ha of white clover (equal proportions of Chieftain and Crusader). The multi-species mixtures also contained these grasses and clover, but in addition contained Timothy, Red clover, Chicory and Plantain, with the aim to establish an equal plant population of the component species. Once established, the new swards were grazed by weanlings during September to late-November. Of note, is that incidences of animal bloat occurred at this time.

During 2022 and 2023 half of each pasture type was assigned to either grazing (receiving zero fertiliser N) or to silage production (receiving 80 and 70 kg inorganic N/ha for silage harvest 1 and 2, respectively). Seventy two Charolais crossbred yearling steers (~400 kg live weight) were turned out to pasture during the third week of March and grazed their respective grazing areas (~2100 kg live weight/ha, and daily feed demand of approximately 40 kg DM/ha). Target post-grazing sward height was 5.5 cm for both pasture types. Within each pasture type, animals were grazed in three replicate groups. From turnout until late-June, animals remained on their assigned grazing areas, and then some of the first-cut silage areas were added to the grazing block. After second-cut silage in mid-July, the entire farm became available for grazing until animals were housed in early-November.

In terms of the production systems, on each sward type, one third of the animals were finished from pasture at ~19-months of age (early-November). A further third were housed, and finished at ~23-months of age (mid-March) having received their respective silages, supplemented with 5 kg concentrates daily, while the final third were also housed, received their respective silages, were supplemented with 1 kg concentrates and returned to pasture for a short 'third' grazing season and finished at ~26-months of age. Two full grazing seasons have been completed to date, while the second production cycle of 26-month old animals will be completed in mid-June 2024.

Animal performance

During the 2022 grazing season (late March to early-November) animal daily live weight gain was similar (1.15 kg) for both pastures. When finished at 19-months of age, carcass weight (~350 kg) and conformation score was similar for both pastures; however, overall, carcass fat scores were borderline (2=/3-) and animals grazing multi-species swards were leaner. When finished at the end of the winter (23-months of age), having received their respective silages, plus 5 kg concentrates daily, carcass weight (~400 kg) and conformation score was similar for both pasture types, but again animals on the multi-species swards treatment were leaner. Steers receiving silage plus 1 kg concentrates gained ~0.5 kg live weight per day for the winter and on return to pasture in late-March gained in excess of 1.3 kg live weight/day over a 55-day pasture finishing period. When finished at 26-months of age, carcass weight (~406 kg) and conformation score did not differ between the pasture types, but once again carcass fat score was lower for animals on the multi-species swards treatment.

The 2023 grazing season proved to be much more challenging in terms of weather conditions. Overall, animal performance was again similar for both pasture types with animals gaining ~0.97 kg live weight per day from late-March to mid-August; however, from late-August until early-November, when weather and grazing conditions deteriorated dramatically, cattle gained very little weight. Weanling winter performance, where the grass-clover and multi-species silages were supplemented with 1.5 kg concentrates daily was similar for both pasture types.

During the grazing seasons of 2022 and 2023, faecal egg counts indicated low levels of gut worm infection and, in both years, animals were not treated for worms while at pasture.

Grassland composition and herbage production

The change in botanical composition (dry matter basis) of the grazed pastures for each sward type are shown in Figure 1. In 2022, the one-year-old grass-clover sward contained ~10% clover in April and its proportion increased throughout the year to reach a peak of ~40% in August and remained at ~30% for the remainder of the year. In 2023, the proportions of clover in this sward followed a similar monthly pattern, but its content was lower, reaching a peak of ~30% in August. For the multi-species swards, in 2022, the combined white and red clover content was equivalent to white clover content in the grass-clover sward, and the change in total clover proportion over the two years reflected the grass-clover sward. The herb content (chicory and plantain) dominated the multi-species swards in April and May 2022, contributing in excess of 50% of the herbage dry matter, before declining to ~45% by year end, whereas for 2023 the proportion of the two herbs combined was invariably less than 15%. During 2022, perennial ryegrass accounted for less than 25% of the herbage dry matter content in the multi-species swards, but during 2023 it dominated the swards.

In comparison to the grass-clover swards, the visual appearance of the multi-species swards was in stark contrast, especially in June/July, when the chicory and plantain flowered. On this site, weeds were generally not a problem and remained low (~2% of dry matter); however, on some areas where docks were present in the old sward, they proliferated over the two years.

Although visually very different, both sward types produced a similar quantity of herbage, of broadly similar *in vitro* dry matter digestibility (DMD), when grazed. In general, pre-grazing herbage mass (~1800-1900 kg DM/ha), grazing rotation length (25-30 days) and post-grazing sward height (5.5 cm) were similar on both pasture types. Likewise, silage herbage yields and DMD were similar on both swards. Of note, is that the multi-species swards had lower herbage dry matter content (~1.5-2.0%) than in grass-clover swards. It is likely that such swards will pose an additional challenge in silage making if wilting is undertaken.

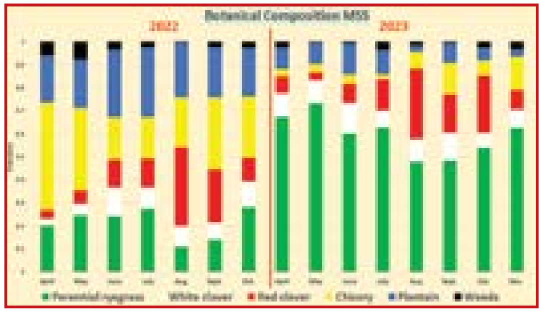

Figure 1. Changes in grass-clover and multi-species sward (MSS) botanical composition (dry matter basis) over two years

Methane production and anthelmintic properties of multi-species swards

It is purported that plant species such as plantain and chicory may contain secondary plant compounds, capable of reducing the activity of methane-producing microbes in the rumen. Furthermore, some literature sources attribute anthelmintic properties to some herbs. However, there is limited published research evaluating these claims in beef cattle. From May to September 2023, 40 yearling Charolais crossbred steers at Teagasc Grange were offered fresh zero-grazed herbage *ad libitum* each day from either grass-clover or multi-species swards (as outlined earlier), and from October to December were offered *ad libitum* silage, also made from these respective swards. Whether offered as fresh or conserved herbage, daily methane output was similar for both sward types (see p66).

A study was carried at Teagasc Grange to investigate whether or not pasture from multi-species swards had potential anthelmintic properties compared to grass-clover. Animals that were indoors and zero-grazed on grass-clover and multi-species swards for the summer months were initially treated with an anthelmintic to remove all gut worms from their digestive tract (dose effectiveness confirmed by faecal monitoring). Subsequently, known amounts of infective *Ostertagia* larvae were administered to each animal. In the following months faecal egg outputs were monitored and the data showed similar worm egg counts irrespective of the sward type offered.

Conclusions

Based on the two years data collected to date at Teagasc Grange, it is concluded that growth performance of suckler beef cattle grazing grass-clover and multi-species swards, or offered silages conserved from these pastures, was similar. Furthermore, herbage production and digestibility of both swards was similar. Seasonal fluctuations in sward composition were as expected for the grass-clover swards, but plant species content varied considerably in multi-species swards, both within and between years. In particular, the herb content had decreased substantially by the start of the second grazing season. Additionally, no differences in animal methane production or in anthelmintic properties were found between the two sward types.

High quality silage: a must for beef production systems

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Summary

- Silage quality (as measured by dry matter digestibility, DMD) remains at 66% on drystock farms. This is suitable only for dry suckler cows in good body condition.
- To achieve good performance on silage diets, growing/finishing cattle and calved suckler cows require silage of at least 74% DMD.
- Consider silage quality and quantity together in feed plans.
- Cutting swards at the correct growth stage determines silage quality.
- Soil fertility, reseeded swards and correct nitrogen fertiliser application are the key elements to maximizing silage quality and quantity.
- Completing a fodder budget after first-cut silage is advised to plan ahead for feed security the following winter.

Introduction

Grass silage typically makes up around one-quarter to one-third of total feed dry matter (DM) consumed on drystock farms. Compared to grazed grass it is expensive to produce (usually twice the cost per tonne DM); however, when taken as part of an integrated grazing system it is good value compared to concentrates and alternative forages. Recent experiences with national fodder shortages have underlined the value of having a good reserve of 'quality' silage available on beef farms. Teagasc national fodder surveys in 2020-21 showed that while the majority of beef farms had adequate silage reserves (15-20% relative to winter demand), a cohort of 10-12% of farms are consistently running a significant feed deficit of more than 20% of winter requirements. This is a high-risk strategy, especially during periods of fodder scarcity and high input prices. During such periods, it will be very expensive for these farms to bridge deficits with purchased forage and/or concentrates. Early intervention to correct shortages is advised, starting with completing a winter feed budget. Although most beef farms have tended to secure adequate quantities of silage (tonnage) in recent years, average silage quality (as measured by dry matter digestibility, DMD) remains consistently poor on drystock farms at 65-67% DMD. The principal challenge for beef producers, therefore, is to balance the dual objectives of having adequate supply of silage while meeting feed quality targets for good animal performance.

Defining targets for grass silage production

The three key elements to cost-effective grass silage production are:

1. *High grass DM yields* for first-cut and subsequent cuts, with high total annual grass yield (>14.0 tonnes DM/hectare (ha)). Guideline yields are 4.8 t DM/ha and up to 6.2 t DM/ha for silage harvested in mid-May and early June, respectively.

2. *Appropriate feed quality* for the category of livestock to be fed. This is best measured as digestibility of the crop dry matter (DMD); protein content is also important and is positively associated with DMD. Silage quality is a function of growth stage at cutting (leafy swards have higher DMD than stemmy swards).
3. *Clean, stable feed* with good intake potential. This is achieved through good fermentation and can be assessed from silage pH (3.9 to 4.2 for un-wilted crops), ammonia (target less than 9%), and lactic acid (target over 8%) content. High DMD (leafy) swards can be well-preserved with good management.

First cut silage quality targets for different livestock types

Grass DM yield at harvest is the single most important factor determining the cost per tonne of silage in the pit. Fixed costs per hectare (e.g. land charges, contactor fees) are diluted over the extra tonnage for a given cut, and so too are some variable costs associated with fertiliser and slurry applications. Many beef farms have largely abandoned any consideration of feed quality when planning first-cut silage crops, focussing only on feed bulk. Dry suckler cows in good body condition can be adequately fed on 67-68% DMD grass silage. However, for growing/finishing cattle (and suckler cows in early lactation) the target is to have silage at 72-74% DMD or higher. This is illustrated very well by results of a study carried out at Grange, where a good quality silage sward was harvested at four different dates and fed to growing cattle the following winter (Table 1). While first-cut yield was lower with earlier cutting as expected, average daily live weight gains were much improved on the leafy silage. Feeding the higher quality (75% versus 65% DMD) silage at farm level would result in approximately 40 kg extra live weight gain over a 150-day housing period, or 2.0-to-2.5 kg reduction in daily concentrate intake for similar daily gain. In fact, it took less than half the amount of silage DM to achieve 1 kg carcass gain with the better quality sward.

Table 1. Effect of silage quality on daily weight gain and feed efficiency in growing cattle

	First-cut silage quality			
DMD %	**75**	**70**	**65**	**60**
Harvest date	20 May	2 June	15 June	28 Jun
Silage yield (t DM per ha)	4.8	6.0	7.0	7.7
Daily live weight gain (kg)	0.83	0.66	0.49	0.31
Feed efficiency (DM intake/kg carcass gain)	17.6	21.1	28.1	46.7

It is clear, therefore, that poor silage quality is a major limitation to growing animal performance over the winter period on many farms. Feeding low DMD silage made for 'bulk' may actually contribute to a silage shortages in the long term because, to achieve a given final carcass weight, animals may either require more days on-farm in the subsequent grazing season reducing area available for silage cutting or an additional housing period during the subsequent winter thereby increasing overall winter feed demand. Furthermore, delaying first-cut will limit yield and/or delay date of second-cut silage, resulting in a potential reduction in total annual forage yield per ha. Management decisions around first-cut date should prioritize meeting DMD targets and improving annual grass tonnage per hectare, rather than focussing solely on the yield from first-cut.

Finding the right balance between yield and quality

While growing cattle require silage made from leafy swards, there is a risk of unnecessary/excess body condition gain for late gestation suckler cows offered this type of feed. Beef farms with a mix of livestock (e.g. dry suckler cows, weanlings and finishing cattle) must plan for making silage at varying DMD levels. Differences in silage DMD can be created by varying the cutting date within a well-managed grass sward. High quality silage is produced by cutting in mid-May when grass has high leaf content, while lower DMD silage is produced by delaying cutting into early June when grass has become stemmy after seed head emergence. Therefore, while the objectives of good DM yield and excellent preservation remain consistent, target DMD should dictate the optimum stage of grass maturity at which to harvest the crop. The practical reality for beef farms feeding varied livestock types over the winter is that no single cutting date is suitable for all stock. A simple silage management plan that takes this into account can be developed for the farm, using the following steps:

1. Define the highest quality silage required on the farm first.
2. Estimate the total quantity of this silage needed.
3. Calculate the area of first and subsequent cuts needed to produce this silage.
4. Mark on the farm map and set targets for spring grazing, fertiliser and cutting date.
5. Manage the remaining area to produce silage of standard quality.

Flexibility is needed around cutting date management, and each farm should develop a plan that suits its own scale, facilities, and livestock type. For example, a farm carrying spring-calving suckler cows plus some finishing cattle may take an early-cut of high DMD bales in mid-May on 20-30% of silage area, with the remainder of first-cut taken at 67-68% DMD in early June for feeding to dry cows.

Table 2. Effect of silage quality (dry matter digestibility, DMD) on winter concentrate costs for a calf-to-beef farm

	High DMD	Low DMD
Number of cattle: Weanling cattle	40	40
Store cattle	40	40
Silage type and quantity		
High quality bales (74% DMD)	350	0
Low quality bales (66% DMD)	0	350
Winter concentrate cost @ €380/tonne	**€5,791**	**€10,944**

Table 2 outlines the potential farm-scale value of taking this approach to achieve the correct target silage DMD. In this simple example, a farm with 40 weanlings and 40 forward store cattle requires 350 silage bales for a standard winter. The cost of total winter concentrates required to maintain target performance is reduced by 47% by moving from national average silage quality to target silage quality for the stock type on hand.

Management guidelines for cost-effective grass silage production

Timing of silage cutting date: Swards should be managed such that good grass DM yields (4.8 to 5.0 t DM) are present at or before grass heading date. A decision can then be made whether to harvest at high DMD or delay beyond heading date to increase yield (to >6.0 t DM per ha) of a maintenance-level feed. Timely nitrogen (N) fertiliser application and closing is important. A useful guide for fertiliser N is that grass uses 2.5 kg N (2.0 units) per day on average, so final N should be applied approximately 50 days before planned cutting date. However, the crop may still be safely harvested sooner depending on nitrate and sugar levels. If weather conditions are otherwise suitable, test the grass crop rather than sticking rigidly to the '2-unit rule'. Wilting the crop to >28% DM aids preservation if nitrate readings are high.

Grazing prior to 'closing' for silage: To achieve good quality silage in May, it is essential that the sward is clean and green to the base in early March. Graze to <4 cm residual in February/

March before applying fertiliser for silage. A similar effect can be achieved by tight grazing with young stock in late autumn. Swards with yellow/dead material must be grazed off otherwise silage DMD may be reduced by up to 6-7 percentage points. Re-seeded swards should have been grazed at least twice before closing for silage.

Fertiliser and lime: The first step to improving silage yield and quality on most beef farms is to take soil samples and develop a field-by-field fertiliser plan based on the phosphorus (P), potassium (K) and lime requirements (Table 3). Treat P and K separately as silage fields may be adequate for one nutrient but be lacking in the other. Reduce the N application rate by 20-25 kg per ha for 'old' swards with low perennial ryegrass content. Soil pH is often the first limiting factor for silage yield, so ensure the target pH 6.3 is met. Apply lime through summer/autumn but avoid for 3-4 months before silage cutting as it may adversely affect the fermentation process.

Table 3. Fertiliser nutrient application rates guidelines for first cut silage (kg/ha)

Soil Index	1	2	3	4
P required	40	30	20	0
K required	175	155	125	0
N required	125 (reduce by 25 kg on 'old' pasture)			
Sulphur required	12-14 (10% of N applied)			

Achieving good preservation: Good preservation occurs when lactic acid bacteria present on the grass crop ferment available sugars to lactic acid. This causes a decline in pH, which preserves the feed value of the stored silage. High available sugars, low buffering capacity and air-free (anaerobic) conditions are necessary for achieving good preservation. Grass sugar content is more critical to good preservation than nitrate readings. Ideal conditions for high sugars are ryegrass swards, dry sunny weather, cool nights and mowing in the afternoon. Add a sugar source (e.g. molasses) if conditions are good but sugars readings are low. Under good ensiling conditions, there is no clear benefit to using additives. Adding inoculants will not significantly improve feed value if the standing grass crop is of poor quality. Where wilting is likely to be of benefit, reaching the target DM of 28-32% is a function of swath type and duration of drying. Dry matter will not increase sufficiently in large rows (>3 metres), even if left for 48 hours. Grass tedded out and left for more than 36 hours in good conditions may become be too dry (>40% DM) for pit silage. There is no advantage to wilting beyond 32% DM.

Reseeding: Old permanent pasture with low perennial ryegrass content is less responsive to fertiliser nutrients for first-cut crops, leading to delayed harvest and poor DMD. Lower sugar content makes preservation more difficult. The decision to reseed should be based on sward composition and performance. A rule of thumb is that areas designated for silage harvest should be reseeded every 8-10 years (5-6 years for multiple-cut systems). Many farms do not reach this target, especially if silage ground is on short-term lease. Reseeding is unlikely to be successful if soil fertility and post-emergence management to promote tillering and weed control are lacking.

Managing DM losses: Reducing DM losses at ensiling and feed-out is often overlooked as a means of improving efficiency. These losses range from 15-30% of standing crop DM, which can significantly increase the requirement for purchased feed. The main sources of DM loss are poor aerobic stability, failure to seal and maintain pits/bales fully, excessive exposure to air across the silage pit face, and waste at the feed barrier.

Increasing usage of PastureBase Ireland and grass growth predictions on Irish beef farms

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Summary

- PastureBase Ireland (PBI) is a web-based grassland management system, which now has over 6,200 regular users.
- Beef farmers recording farm covers regularly on PBI have grown between 9.4 and 10.5 tonnes pasture dry matter/hectare per annum over the last four years.
- Farmers are encouraged to download the 'PBI Grass' app, which now has increased functionality.
- A number of new applications for fertiliser and silage management are now available on PBI.
- Utilising grass growth predictions at regional and farm level through PBI is the next step in grassland decision support systems.

Introduction

PastureBase Ireland (PBI) is a web-based decision support system freely available to farmers to assist in short-, medium- and long-term grassland management decisions. PastureBase Ireland consists of a range of tools that can be used to record pasture growth and utilisation on the farm, along with other pasture-related measurements such as fertiliser application, and provide guidance on the most effective use of pasture on both a weekly and seasonal basis. There are multiple benefits of utilising PBI including increased pasture growth, more efficient nutrient application and higher 'quality' pasture being available to grazing animals.

PastureBase Ireland is continually expanding its functionality to meet the demands of grassland farmers. Clover has an increasing role to play on beef farms and a number of tools have been developed within PBI to cater for this requirement. Furthermore, many regular users of PBI will be offered individual farm grass growth predictions over the coming years to aid grassland management decisions.

Current usage

There has been a significant increase in grassland measurement on Irish beef farms over the past four years and the number of beef farmers using PBI, and the number of measurements taken by these farmers, is increasing year-on-year (Table 1). The use of the primary management tools of grass covers and rotation plans have increased by 92% and 108%, respectively, over the past four years. The use of other tools on beef farms has fluctuated in the same period. More widely, almost 12,000 grass covers were recorded on beef farms in 2023, which is double the number recorded in 2020. Research has consistently shown that farmers who are measuring grass regularly can grow more grass compared to those who do not measure grass, which leads to less reliance on more expensive imported feeds. There remains a huge opportunity for beef farmers to increase the production and utilisation of pasture on farm.

Grass growth

In the last four years (2020-2023) grass growth on Irish beef farms using PBI varied by 1.1 tonnes dry matter/hectare (t DM/ha) (Table 1). These figures are lower than those observed on Irish dairy farms, indicating that there is potential to increase home-grown feed supply on Irish beef farms.

Table 1. Usage of PastureBase Ireland tools and pasture growth on beef farms 2020-2023

Year	Grass covers completed	Fertiliser uploads	Fodder budgets	Rotation plans	Grazing/ silage events	Annual yield (t DM/ha)
2020	6244	1509	526	785	6.3	10.1
2021	7621	1758	302	1223	5.9	10.1
2022	10203	2086	420	1391	6.1	9.4
2023	11961	1369	202	1636	5.8	10.5

Nutrient management

Improving nitrogen (N) fertiliser usage on beef farms is a major focus to improve pasture growth and utilisation, and this requires more focussed nutrient management and fertiliser application planning. Farmers can now record fertiliser applications on the app, while also uploading soil test results directly from commercial soil testing labs. A substantial number of Irish beef farmers are now using PBI to track their current fertiliser applications (Table 1). As the season progresses and applications are uploaded, a clear picture of the farm fertiliser strategy is developed on the system. This data is used to generate individual farm reports, which farmers can utilise to better plan for subsequent years and get more value from their fertiliser. The 'Nitrogen Planner' tool on PBI can assist farmers to plan their N application before the grass growing season starts for more efficient use of chemical and organic fertilisers.

Silage production and recording fodder stocks

Tools are now available online and in the app to allow farmers to calculate their silage requirements and record the level of silage produced on farm. The grass and fodder budgets in PBI allow for more targeted use of winter feedstuffs and reduce the risk of fodder shortages on farm. While current usage of PBI 'fodder budgets' is limited on Irish beef farms (Table 1), recent redevelopment of this tool means that it is now easier for farmers to measure on-farm fodder stocks on a regular basis.

Grass growth model

Currently within PBI, farmers can only make decisions based on historical information. Grass growth in Ireland is highly seasonal and depends heavily on climate conditions and soil type. The Moorepark St. Giles (MoSt) grass growth model was developed at Moorepark for Irish grazing systems and Irish meteorological conditions. The model predicts daily grass growth (kg DM/ha) depending on weather conditions, soil type and grazing management. Farmer decisions that impact grass growth within the model are N fertiliser application rate and timing, as well as the pre- and post-grazing sward height. The model takes into account the impact of soil type and the grazing animal (through urine and dung patches) on grass growth. The MoSt grass growth model has also been developed with the aim of recreating the nitrogen flows in the soil and the plant to predict the nitrogen content of the grass as well as nitrogen leaching at the paddock level.

On-farm grass growth prediction

Most of the data required to predict grass growth are already captured in PBI. The data necessary to run the grass growth model in PBI for each farm are: the paddocks and their area, the grazing and cutting dates, the number of animals grazing and their supplementation and the N fertilisation (chemical and organic) level. The other data necessary are the soil type for each paddock, which is determined using the Irish Soil Information System, and the weather data, both historical and forecasted, provided by Met Éireann. Initially, 84 pilot farms were chosen for this program as they were farms who were measuring grass at least weekly during the main grazing season and recording their N fertiliser applications on PBI - these 84 farms are spread throughout Ireland. Researchers have observed that the MoSt grass growth model accuracy increases as the number of grass measurements conducted by the farmer increases.

While the grass growth predictions are currently provided as a precise number, each farm is different. This is why the trend of the grass growth prediction (i.e. increasing or decreasing compared to the previous week) is more important than the actual number. A specific farm could be consistently growing less than the prediction, but the overall trend should be similar.

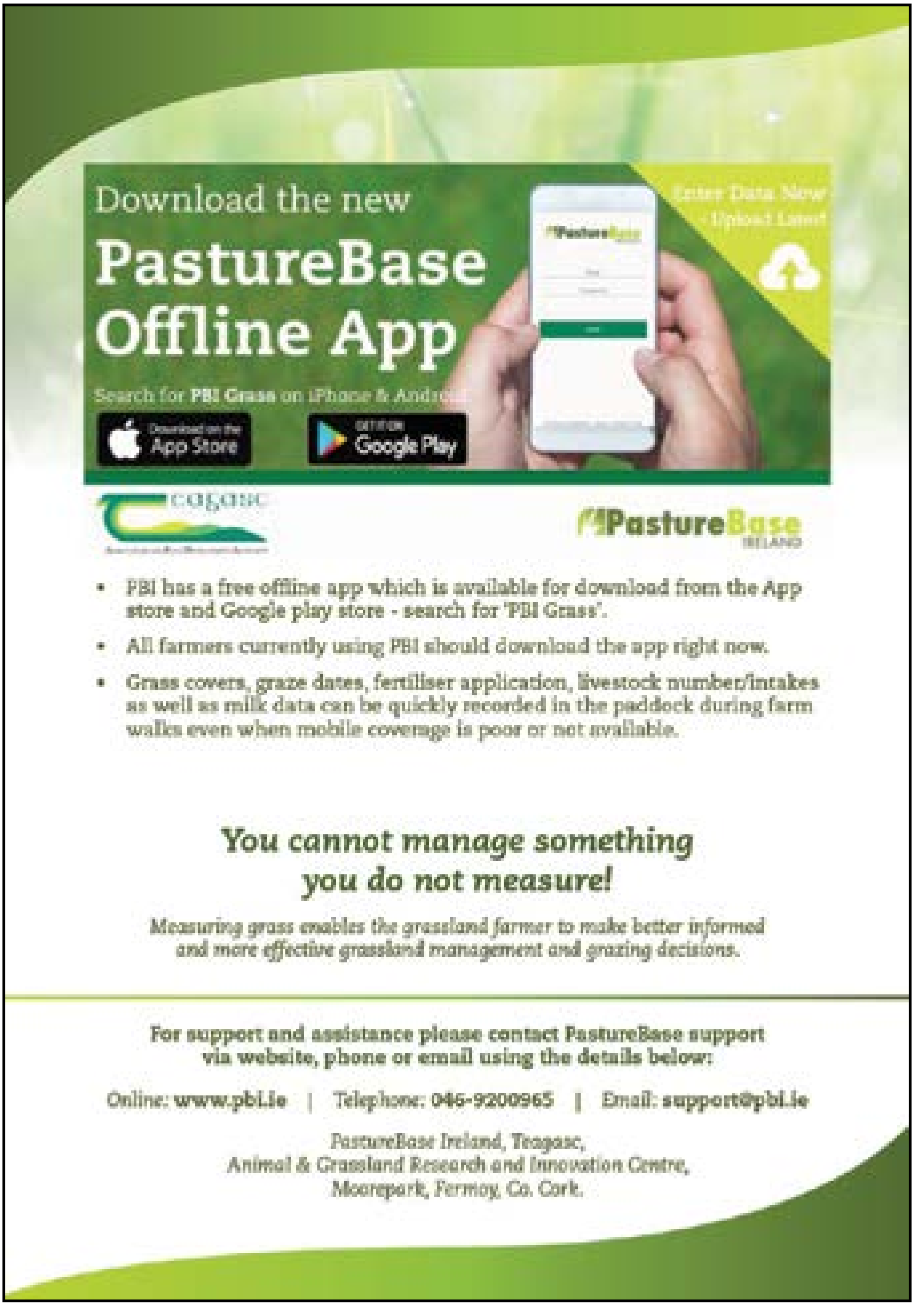
Where can I access the grass growth predictions?

The integration of the current version of the MoSt GG model into PBI has started. This service will be rolled out to PBI users over the next two years where it will give individual users a grass growth prediction for their own farm for seven days after a grass cover is entered on PBI. Users will need to be regularly using PBI and entering sufficient grassland management information (at least 25 grass measurements per year, chemical N fertiliser and slurry applications) on the site to be offered individual farm grass growth prediction.

Currently, national and regional grass growth predictions, based on the 84 pilot farms, are available to the public on the PBI website. These grass growth predictions are also presented each Sunday by Met Éireann on RTE 1 during the Farming Forecast.

Conclusion

PastureBase Ireland is a multi-purpose web-based system that allows farmers to improve pasture management. Utilising all of the tools outlined above can increase the economic sustainability of Irish beef farms. PastureBase Ireland is always evolving and the current development in PBI is centred around the integration of the MoSt grass growth model into the system. This new tool will allow individual farms to predict their own weekly grass growth, which will greatly help with weekly grassland management decision making. PastureBase Ireland is freely available to all Irish grassland farmers. If you wish to sign up or require more information please call our dedicated help centre on 046-9200965 or email **support@pbi.ie.**



Dietary focused anti-methanogenic research in beef cattle

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Summary

- Enteric methane originates as a by-product from the ruminal fermentation of ingested feed.
- Growing beef cattle have been shown to produce 22 to 27 g of methane for every kg of feed dry matter consumed.
- Numerous anti-methanogenic dietary-based strategies are under investigation at Teagasc Grange.
- Daily methane reductions from dietary inclusion of various fats and seaweed-derived products ranged from 8 to 19%.
- Bovaer® and novel oxidising methane inhibitors, reduced methane by 17 to 30%.
- Development of anti-methanogenic feed additives and/or their active compounds is a major challenge for pasture-based livestock production systems, particularly in relation to administration to grazing animals.

Introduction

The microbial ecosystem residing in the rumen or forestomach of the ruminant animal facilitates the conversion of human inedible plant matter into high-quality sources of meat and dairy protein. However, this digestive process results in the production of methane as a metabolic by-product during the microbial fermentation of ingested feed. Methane is the second most important greenhouse gas (GHG), after carbon dioxide, and accounts for 74% of Irish agricultural related GHG emissions, 87% of which originates from the rumen. Both the quantity, and quality, of the feed consumed by ruminant livestock is the predominant contributor to the volume of methane emitted by an animal. Simply put, as an animal's level of feed intake increases, more feed is fermented in the rumen, which increases the supply of energy and protein to the animal, but also elevates the supply of substrates to methanogens (microbes that produce methane), leading to an increased synthesis of methane in the rumen. Based on work conducted by Teagasc Grange, across various different diets, including intensive finishing rations and forage-based diets, and animal types, beef cattle have been shown to produce 22-27 g of methane for every kg of dry matter (DM) intake. Reducing the quantity of methane emitted by ruminant livestock will be pivotal to achieving a 25%

reduction in Irish agricultural GHG emissions by 2030. Findings from the most recent Teagasc Marginal Abatement Cost Curve (MACC) suggest that reducing the average finishing age of the beef cattle population and implementing anti-methanogenic dietary-focused strategies (predominantly feed additives) have the potential to meet up to one-third of the Irish agricultural sector's 2030 GHG reduction target. The predominant factors influencing the finishing age of beef cattle are addressed elsewhere in this publication, and currently are being investigated as part of *Beef-Quest*, a recently funded project by the Department of Agriculture, Food and the Marine (DAFM). Consequently, this paper will summarise current research on dietary focused anti-methanogenic strategies at Teagasc Grange.

Dietary focused anti-methanogenic research

Grassland management

Low feed costs are the hallmark of grass-based ruminant production and a pre-requisite for profitable beef farm systems. However, striking a balance between the quantity and quality of grass produced within the sward can be a challenge. As grass matures, the concentration of fibre increases within the plant, which reduces the digestibility of the grazing sward. A reduction in sward digestibility leads to a notable increase in the quantity of methane emitted per unit of feed intake. It has been suggested that plant species such as clover, plantain and chicory may contain secondary plant compounds, capable of reducing the activity of methane-producing microbes in the rumen. Indeed, in laboratory-based experiments conducted by researchers at Teagasc using the artificial rumen simulation technique (RUSITEC) systems, chicory and plantain were associated with a lower methane output, in comparison to a monoculture of perennial ryegrass (PRG). However, a recent experiment at Teagasc Grange, found no differences in daily methane output or animal performance between Charolais crossbred steers (initial body weight 350 kg), offered zero-grazed pasture from a PRG + white clover sward or a multi-species sward (MSS), containing PRG, Timothy, white clover, red clover, chicory and plantain, over 114 days. Therefore, based on research conducted to date, adding additional forage species to PRG and white clover swards does not appear to reduce methane output in beef cattle. Further research is ongoing to compare the methanogenic output and animal performance of beef cattle grazing monocultures of PRG and PRG + white clover swards using the GreenFeed emissions monitoring system (Figure 1).

Plant-based additives

The addition of lipids (fats) containing high proportions of polyunsaturated fatty acids (PUFAs), has been shown, across numerous studies, to reduce methane output in beef cattle, with a maximum dietary inclusion rate of 5-6% of DM recommended in order to prevent any negative impacts on feed intake. The anti-methanogenic effects of linseed (flax) oil and rapeseed oil are well established, due to their fatty acid profile. Research at Teagasc Grange has shown that supplementing linseed oil at 4% of total daily DM intake to Angus/Hereford dairy beef bulls, lowered daily methane output by 19% with no significant reduction in DM intake. Additionally, a recent experiment at Grange has shown that rapeseed oil and rapeseed cake [by-product from the rapeseed industry which has a different oil extraction (cold-pressed) method to conventional rapeseed meal (solvent extracted)] both reduced enteric emissions by approximately 8%, without adversely affecting feed intake, when included to provide 2.5% total oil in the dietary DM.

Figure 1. The GreenFeed Emissions Monitoring System used to estimate enteric methane emissions from grazing beef cattle in Teagasc Grange.

Feeding seaweed to ruminant livestock to reduce enteric methane emissions, has gained international interest, with some studies reporting methane reductions of up to 80% for the red seaweed (*Asparagopsis taxiformis*) both in the lab and when fed to cattle. As the red seaweed *Asparagopsis taxiformis*, is not indigenous to Irish waters and its anti-methanogenic compound (*bromoform*) has been identified as a potential carcinogen, research at Teagasc Grange has investigated the methane mitigation potential of a variety of indigenous brown and green seaweeds. Over 30 seaweeds underwent laboratory screening, using a microbial assay at Teagasc Ashtown and the RUSITEC system in Grange. The brown seaweed (*Ascophyllum nodosum*) was identified as a potential methane inhibitor, reducing methane *in vitro* by 36% when included at 4% of the diet. Likewise, an extract of *Ascophyllum nodosum* also exhibited anti-methanogenic properties (16% reduction when included at 4% of the diet). However, when fed to both beef cattle and sheep, no reductions in methane output were observed for *Ascophyllum nodosum* but the seaweed extract reduced methane by 8 and 9%, in cattle and sheep, respectively. The seaweed extract contains phlorotannins, plant compounds, which are claimed to negate ruminal methanogenesis. Therefore, a greater reduction in methane is expected with the seaweed extract than the seaweed.

Synthetic methane inhibitors

Three-nitrooxypropanol (3-NOP) or Bovaer® (developed by DSM) is one of the most widely researched and effective commercially available anti-methanogenic feed additives. When consumed, Bovaer® inhibits the key enzyme involved in ruminal methanogenesis, with methane reductions of >30% observed across both beef and dairy cattle. However, the continued suppression of methane synthesis requires a constant supply of the compound in the rumen. Ruminal 'washout' of Bovaer® results in methane emissions returning to near pre-supplementation levels within two hours. Research conducted at Teagasc Grange has contributed towards the EU licencing application for the use of Bovaer® in beef cattle. In a recently published experiment, Bovaer® was included (150 mg/kg of feed DM) as part of a 50:50 grass silage: concentrate total mixed ration (TMR) offered to young bulls over 12-weeks. In comparison to the 'control' animals, cattle supplemented with Bovaer® consistently produced 30% less methane and had the same growth rate and DM intake. However, once supplementation with Bovaer® ceased, methane output from the previously supplemented bulls returned to the same level as the control animals.

Research is ongoing in Grange to investigate the methane abatement potential of a new novel oxidising methane inhibitor called RumenGlas (Glasport Bio, Co. Galway). This is a calcium peroxide-based product, and has an inhibitory effect on methanogenesis by introducing a small amount of oxygen into the rumen as it is broken down during microbial fermentation. The methane mitigation potential of RumenGlas has been investigated at different supplementation levels across two separate beef cattle experiments at Grange. Preliminary results to date have shown RumenGlas to have a similar methane inhibition effect to that of Bovaer®, with reductions ranging from 17 to 28%, and despite the fact that it was only offered twice daily in a small quantity of concentrates (rather than in a TMR).

Although many methane reducing feed additives cannot be incorporated into pelleted feed due to the heat and temperature associated with the process, our research has concluded that RumenGlas is effective when included in a pellet. This means that the additive can be easily delivered as part of a concentrate feed included in the diet offered to cattle.

Table 1. Summary of beef cattle experiments conducted at Teagasc Grange evaluating the effects of anti-methanogenic feed additives included in diets with different forage: concentrate (F:C) ratios, on daily methane emissions (DME; g/day), average daily live weight gain (ADG, kg) and dry matter (DM) intake (kg/day)

Additive	**Animal Type**	**Diet (F:C)**	**DME**	**ADG**	**DM intake**
Linseed oil	Young bulls	60:40	↓19%	No effect	No effect
Rapeseed oil	Steers & heifers	50:50	↓8%	No effect	No effect
Rapeseed cake	Steers & heifers	50:50	↓8%	No effect	No effect
Brown seaweed	Young bulls	60:40	No effect	No effect	No effect
Seaweed extract	Young bulls	60:40	↓8%	No effect	No effect
Bovaer®	Young bulls	50:50	↓30%	No effect	No effect
Rumenglas	Young bulls	60:40	↓17-28%	No effect	No effect*

** No effect when Rumenglas (CaCO2) was included in a concentrate coarse ration supplement at a rate equivalent to 1.35% of dietary DM intake, or in a pelleted concentrate supplement at a rate equivalent to 2.25% of dietary DM intake: however, daily DM intake was reduced by 10% when included in a concentrate coarse ration supplement at 2.25% of dietary DM intake.*

Conclusions

The methane reduction potential of anti-methanogenic feed additives varies across different dietary-based strategies (Table 1), primarily due to differences in their mode of action for suppressing ruminal methanogenesis. Their cost-effectiveness and potential impacts on product quality (meat and milk) is currently being investigated. Aside from costs associated with anti-methanogenic feed supplements, the delivery of additives and/or their active compounds to grazing livestock is a major challenge. Currently, this is a barrier to realising the full mitigation potential of additives in Ireland. In their current form, anti-methanogenic additives are only suited to winter and indoor feeding periods. Researchers in Teagasc are actively engaging with industry to develop technology suited to the delivery of anti-methanogenic compounds for grazing ruminants. Additional work is ongoing to assess the mitigation potential of administering bacteria, with known anti-methanogenic properties, as potential early-life probiotics via the DAFM-funded *RU-MINING* project. Furthermore, as it is now possible to genetically select low-methane emitting beef cattle, the recently funded DAFM project, *MAGS* (Methane Abatement for Grazing Systems), aims to determine potential synergies and/or trade-offs associated with combining low-methane emitting genetics with methane supressing feed additives.

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TECHNOLOGY VILLAGE

Suckler Beef Systems

Suckler beef systems for profitable production

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Summary

- Suckler beef production in Ireland is characterised by having an array of different production systems.
- Within weanling-to-beef production systems, finishing steers at the end of the 'second' grazing season (20 months of age) produced the greatest net margin/hectare and lowest greenhouse gas (GHG) emissions/kg carcass.
- Within suckler calf-to-beef systems, under 16 month bull production systems combined with finishing heifers at the end of the second grazing season produced the greatest profit/hectare and lowest GHG emissions/kg carcass.
- The Derrypatrick herd at Grange is currently evaluating the role of animal genetics and clover to further enhance animal growth performance from pasture and to reduce production costs.
- Suckler yearling steers and heifers grazing grass-white clover swards had a greater live weight gain (+ 0.1 kg/day), and were 23 kg heavier at the end of the grazing season resulting in a 14 kg heavier carcass, than those grazing grass-only swards.

Introduction

Suckler beef production in Ireland is characterised by having an array of different production systems operating at a range of stocking rates. The majority of farms operate at low-to-modest stocking rates (<130 kg organic nitrogen (N)/ hectare (ha)) with only very few farms requiring a derogation from the Nitrates Directive (>170 kg organic N/ha) for their farm. The Irish suckler herd is predominantly spring-calving, with 75% of cows calving between January and June. Broadly speaking, suckler beef production systems can be categorised as calf-to-weanling systems and weanling-to-beef systems. Integrated suckler calf-to-beef systems are less common. Post-weaning, a number of finishing options are available. Nationally, the majority of male cattle are finished as steers during the third grazing season.

Suckler beef systems analysis

The profitability and greenhouse gas (GHG) emissions (life cycle analysis (LCA) approach) from a suckler calf-to-weanling system and five (two bull and three steer) suckler beef finishing systems were evaluated using the beef systems models developed at Teagasc Grange (Table 1).

In the suckler calf-to-weanling system, a spring-calving system (cows calving between February and April with a mean calving date of 6 March) was assumed with cows and calves turned out to pasture in mid-March (or immediately post-calving in the case of April-calvers). Weaning weight was 330 kg and 315 kg for male and female calves, respectively.

Calves were assumed to be weaned at the end of October and sold in November or retained for finishing in one of five suckler calf-to-beef finishing systems as outlined in Table 1. Replacement heifers were produced within the herd, which meant that the number of heifer weanlings available for sale was reduced by approximately 20%.

Considering that the majority of suckler calves are sold at weaning, four (one bull and three steer) weanling-to-beef production systems were also evaluated separately (Table 2). Given that weanling-to-beef production systems do not have a suckler cow group on the farm, these systems can produce more finishing cattle from the same land area compared to suckler calf-to-beef systems. In the weanling-to-beef systems, male weanlings were purchased in November and finished at the ages outlined in Table 2.

In the analysis, a 40 ha (100 acres) farm area was assumed and concentrate rations were purchased. Fertiliser N as 'protected' urea application was applied at a rate of 135 kg N/ha. This level of N application and forage production result in stocking rates of approximately 170 kg organic N/ha. Given the variation in feed budget and animal category (i.e. numbers of 0-1, 1-2 and 2+ year old cattle) for each system, stocking rates varied somewhat for each system (Tables 1 and 2). Systems that finished cattle at older ages resulted in fewer animals sold on the farm, due to 'carrying' animals for a longer time on the 40 ha farm.

Compared to suckler calf-to-beef systems, selling calves as weanlings was less profitable, resulting in a net margin of €401/ha or €16,040 for a 76-cow suckler farm (Table 1).

Table 1. A summary of the profitability and greenhouse gas (GHG) emissions of a suckler calf-to-weanling and five suckler calf-to-beef production systems based on a 40 hectare farm.

Steer/bull production system	Weaning	16-mth bull	19-mth bull	20-mth steer	23-mth steer	27-mth steer
Heifer production system	Weaning	19-mth	19-mth	19-mth	22-mth	19-mth
Steer/bull carcass weight (kg)	-	400	393	350	388	420
Heifer carcass weight (kg)	-	297	297	297	327	297
Cows calving	76.2	68.4	61.3	58.3	53.9	49.8
Organic nitrogen (N) (kg/ha)	169	186	177	172	173	170
Whole farm N fertiliser (kg/ha)	131	135	134	132	137	134
Carcass output (kg/ha)	87	550	487	434	436	409
Gross margin (€/ha)[1]	953	1376	1180	1157	1160	1174
Net margin (€/ha)[1]	401	780	608	595	581	612
Net margin (€/livestock unit)[1]	178	318	261	264	257	272
Price sensitivity (impact on margin, €/ha)						
Weanling price (+/- 50 c/kg)	244	-	-	-	-	-
Beef carcass price (+/- 50 c/kg)	-	236	208	183	187	176
Concentrate price (+/- €50/t)	15	79	56	28	36	20
GHG emissions per carcass weight (kg CO_2eq.)	-	16.1	17.2	17.9	18.8	18.7
GHG emissions per cow unit (t CO_2eq.)	-	5.19	5.47	5.33	6.09	6.16

16-mth = under 16 month old bulls finished indoors on ad-libitum concentrates; 19-mth = under 19 month old bulls finished indoors on ad-libitum concentrates after 100 days at pasture in the 'second grazing season'; 20-mth steers = steers finished at the end of the 'second grazing season' on grass + concentrates; 23-mth steers = steers finished during the second indoor winter on silage + concentrates; 27-mth steers = steers finished off pasture (only) in the third grazing season.

Concentrate feeding levels for finishing males were: 1612 kg for 16-mth bulls, 967 kg for 19-mth bull, 381 kg for 20-mth steer, 575 kg for 23-mth steer, 130 kg for 27-mth steer, 357 kg for 19-mth heifer and 474 kg for 22-mth heifer.

[1]Weanling price, €3.00/kg. Beef carcass price, €5.00/kg (different systems have a different carcass price to account for seasonality). Protected urea fertiliser, €550/t. Finishing concentrate ration, €350/t fresh. No charge was applied for labour or land, and direct payments was not included.

Consistent with previous analysis and evidence from commercial farm data, 16 month bull production had the greatest profit (€780/ha) and lowest GHG emissions per kg carcass and per cow unit. However, this system is the most sensitive to a change in concentrate price, carries the highest number of cows among the calf-to-finish systems, and does not provide a 'guaranteed market' for new producers. Profitability was relatively similar across the three calf-to-beef steer production systems. Greenhouse gas emissions per cow unit was reduced by 13 % when steers were finished at the end of the second grazing season rather than during the third grazing season.

Table 2. Profitability and greenhouse gas (GHG) emissions of a 19 month suckler bull system and three suckler steer weanling-to-beef production systems finished at 20, 23 and 27 months of age.

	19-mth bull	20-mth steer	23-mth steer	27-mth steer
Progeny finished	227	153	118	77
Organic Nitrogen (N) (kg/ha)	223	170	173	165
Carcass weight gain (kg/ha)[1]	1,174	629	596	449
Gross margin (€/ha)[2]	2,051	1567	1487	1410
Net margin(€/ha)[2]	1,423	1,030	882	851
Net margin (€/livestock unit)[2]	518	494	414	394
Price sensitivity (impact on margin, €/ha)				
Weanling price (+/- 50 c/kg)	980	664	512	338
Beef carcass price (+/- 50 c/kg)	1,112	671	573	406
Concentrate price (+/- €50/t)	313	65	87	21
GHG emissions per kg carcass weight gain (kg CO2eq.)[1]	11.0	12.2	15.5	16.6
GHG emissions per finishing animal (t CO2eq.)	2.27	1.99	3.10	3.81

19-mth = under 19 month old bulls finished indoors on ad-lib concentrates after 100 days at pasture in the 'second grazing season' ; 20-mth steers = steers finished at the end of the 'second grazing season' on grass + concentrates; 23-mth steers = steers finished during the second indoor winter on silage + concentrates; 27-mth steers = steers finished off pasture in the third grazing season on grazed pasture.

[1] *Carcass weight gain = weight gain between purchase as weanlings and sale.*

[2] *Prices are given in Table 1*

Weanling-to-beef systems can carry more finishing animals per ha than suckler calf-to-beef systems, resulting in greater carcass output per ha (Table 2). Using the assumed prices in this analysis, suckler weanling-to-steer systems were more profitable than calf-to-beef systems. In a weanling-to-beef scenario, the 19-month bull system was more profitable than the three steer production systems albeit with very substantial sensitivity to weanling and beef prices (Table 2). Within steer weanling-to-beef systems, finishing steers at the end of the second grazing season (20 months of age) provides a 'win-win scenario' for greater profit and lower GHG emissions/kg carcass weight gain. Compared to the other weanling-to-beef systems, this system benefits from higher beef output and a high proportion of grazed grass in the total feed budget, and is also less sensitive to changes in concentrate and fertiliser prices. However, this system requires excellent management to ensure that carcasses are sufficiently heavy and have adequate fat cover. The profitability of 23- and 27-month weanling-to-beef steer systems was similar.

Grass-based suckler steer weanling-to-beef production systems: effect of breed and slaughter age on animal performance

The performance of purchased early-maturing (Angus/Hereford) and late-maturing (Limousin/Charolais) sired suckler weanling steers, finished at one of three ages – 20, 24, 28 months was evaluated at Teagasc Grange. The mean finishing ages reflect, respectively, animals finished at the end of their second grazing season (~20 months of age), at the end of their second indoor winter (~24 months of age) or after a short duration at pasture during their third grazing season (~28 months of age). Animals were offered a grass-forage-only diet (GO) (no concentrate from post-weaning to 'finish'), receiving grass silage-only during the 'first' and/or 'second' winter, and grazed grass-only during the 'second' and/or 'third' grazing season, as applicable). Alternatively, animals were offered grazed grass-only during the grazing season but grass silage + concentrate during the winter and finished at 24 months of age (GC, standard/ 'control' system).

Key findings from this study showed that early-maturing steers tended to have a heavier live weight at slaughter, but late-maturing steers had a heavier carcass (reflecting their higher kill-out proportion), with superior carcass conformation, and a lower carcass fat score (Table 3). When finished directly off pasture-only (no concentrates) at a mean age of 20-months, only the early-maturing breed steers achieved the minimum carcass fat score (2+ or 6 on a scale 1-15), whereas mean carcass fat score was acceptable for all breed types when finished at older ages.

Current research studies at Teagasc Grange are evaluating the role of improved animal genetics and pasture type (clover and multi-species) to increase carcass weight and carcass fat score of animals in order to reduce finishing age in these systems.

Table 3. Effect of sire breed maturity (B) and production system (PS) on average slaughter weight and carcass traits of suckler steers

Breed (B)	**Early-maturing**				**Late-maturing**				Sig[1].	
Production System (PS)	***GO***	***GO***	***GC***	***GO***	***GO***	***GO***	***GC***	***GO***	***B***	***PS***
Finishing age (mths)	***20***	***24***	***24***	***28***	***20***	***24***	***24***	***28***		
Slaughter weight (kg)	528[a]	596[b]	663[c]	708[d]	527[a]	558[b]	649[c]	690[d]	NS	***
Kill-out (g/kg)	531[a]	527[a]	543[b]	538[b]	560[a]	569[a]	576[b]	576[b]	***	**
Carcass weight (kg)	280[a]	314[b]	361[c]	381[d]	295[a]	319[b]	375[c]	397[d]	*	***
Conformation (1-15)	5.8[a]	5.7[a]	6.9[b]	7.8[b]	7.5[a]	8.1[a]	8.9[b]	9.1[b]	***	***
Fat (1-15)	6.1[a]	8.5[b]	9.9[c]	10.1[c]	4.1[a]	6.1[b]	8.0[c]	7.9[c]	***	***

*[1] NS= not significant, * = P < 0.05; ** = P < 0.01; *** = P < 0.001*

The Derrypatrick herd

The Derrypatrick herd is a suckler calf-to-beef research herd at Teagasc Grange. The current Derrypatrick research project herd entails "developing more sustainable suckler beef systems in the context of grass-clover swards and animal genetics". The objectives of this project, using an 80 cow spring-calving herd stocked at 2.2 livestock units/ha (170 kg organic N/ha), are to increase farm profitability and decrease environmental footprint through reducing:

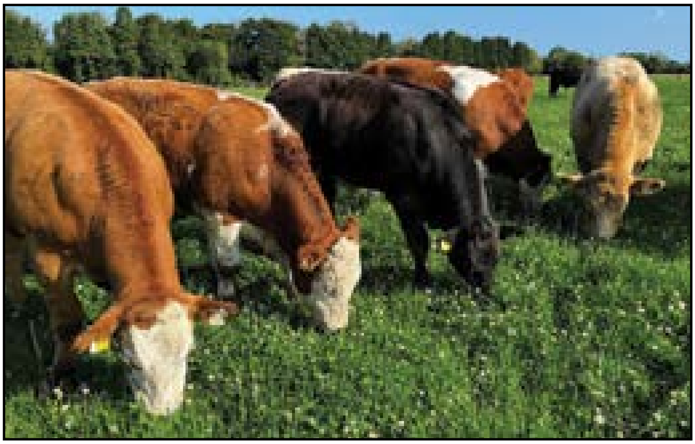
1. Animal finishing age
2. Concentrate input
3. Nitrogen fertiliser input

The research project will validate and quantify the role of legumes (red and white clover) and the role of animal genetics (Aberdeen Angus and Charolais terminal sires) in helping to achieve these objectives, and can thereby provide increased confidence to beef farmers in what these technologies can achieve on a commercial basis in terms of economic and environmental sustainability.

Experiment 1: Evaluating beef cattle live-weight gain on grass white-clover vs. grass-only swards

There is relatively little information available on the live weight gain response of beef cattle grazing grass-white clover swards compared to those grazing grass-only swards. In spring 2023, suckler-bred yearling steers (average weight 442 kg) and heifers (average weight 346 kg) in the Derrypatrick herd at Teagasc Grange were assigned to either a 1) perennial ryegrass-only or 2) perennial ryegrass white-clover sward for the entire 'second' grazing season. The objective of the experiment was to quantify the carcass gain on grass-white clover compared to grass-only swards over one grazing season. Heifers were initially turned to pasture on 30 January 2023, and steers were turned out on 5 April 2023. However, heifers were re-housed between 9 March and 6 April, due to poor weather conditions. At the end of the grazing season (11 October 2023 for heifers and 1 November 2023 for steers), animals were transported to a commercial abattoir and carcass traits were determined.

Animals grazing grass-white clover swards had a greater live weight gain (+ 0.1 kg/day), and were 23 kg heavier resulting in a 14 kg heavier carcass, than those grazing grass-only swards (Table 4). Therefore, beef farms that incorporate white clover into pastures can obtain the combined benefits of superior animal growth and reduced N fertiliser input. There were no incidences of bloat on the farm last year; however, it is important to remain vigilant and, where required, take the necessary precautions for bloat prevention.



Based on this experiment, the profitability and greenhouse gas emissions of grass-only (134 kg N fertiliser/ha) vs. grass white clover (67 kg N fertiliser/ha) grazing swards in a suckler calf-to-beef system where progeny are finished at 20 months of age was assessed. The analysis incorporated the findings from the experiment described above; thus cattle grazing grass-clover swards gained and additional 0.1 kg/day live weight gain during the second grazing season, swards received a lower rate of N fertiliser (70 kg N/ha), while the cost of over-sowing 25% of the farm each year for the grass-clover system was included. Results indicate that there was a slightly lower stocking rate for the clover system due to a higher animal intake. Overall, under the price assumptions used above, incorporating white clover into the grazing sward increased net margin by 16 % (€581 to €688/ha) and reduced GHG emissions per carcass weight and per cow unit by 3% and 6%, respectively.

Table 4. Effect of pasture type (grass-only or grass-clover) on suckler-bred heifer and steer performance during the 'second grazing season'.

	Heifers			Steers			*Difference*
	Grass-only	Grass-clover	Sig.	Grass-only	Grass-clover	Sig.	
Turnout weight (kg)	347	346	NS	443	442	NS	
Daily live weight gain at pasture (kg)	0.70	0.80	***	0.66	0.75	*	*+ 0.10*
Live weight gain at pasture (kg)	178	204	***	137	158	*	*+ 23*
Final live weight (kg)	525	550	*	580	600	0.08	*+ 23*
Kill-out proportion (g/kg)	0.54	0.54	NS	0.55	0.55	NS	
Carcass weight (kg)	282	298	*	317	329	*	*+ 14*
Conformation score (1-15)	7.96	8.19	NS	7.37	7.52	NS	
Fat score (1-15)	6.07	7.86	***	5.85	5.24	NS	
Finish age (days)	591	588	NS	613	612	NS	

Experiment 2: Developing more sustainable suckler beef systems in the context of grass-clover swards and animal genetics

Building onto the results of Experiment 1, where animal performance of grass clover swards was compared over one grazing season, the current Derrypatrick herd experiment is evaluating the lifetime performance (birth-to-finishing) of suckler cattle on:

1. Grass-only (150 kg N/ha) vs. grass-clover (75 kg N/ha) based production system, and
2. Aberdeen Angus vs. Charolais terminal sires

The design of the study is outlined in Figure 1.

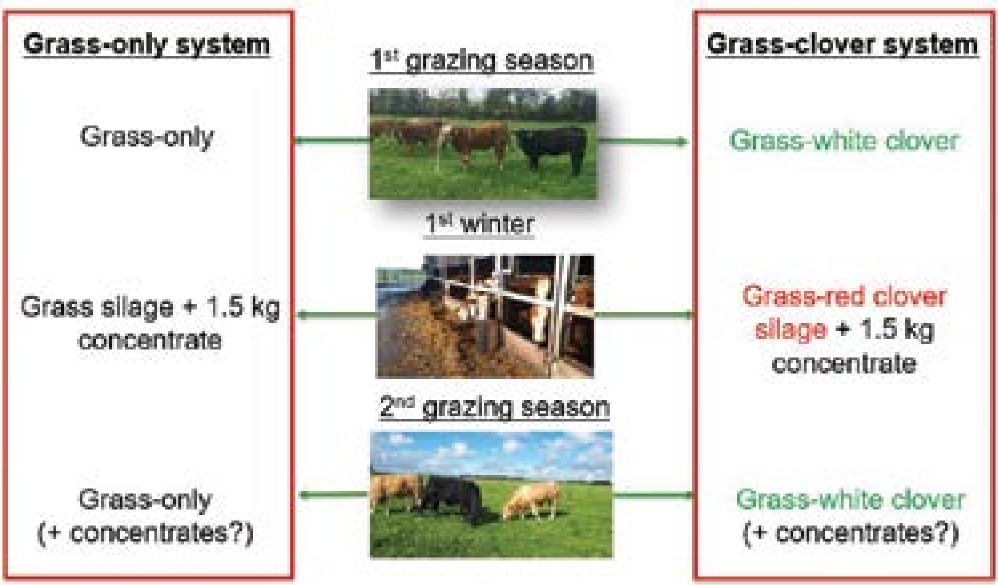


Figure 1. Pasture treatments (grass-only vs. grass-clover system) imposed on the Derrypatrick Herd.

The aim of the systems experiment is to finish progeny off pasture in the second grazing season at 19 to 20 months of age, and therefore avoid the 'second indoor winter'. Challenges with this pasture finishing based system include achieving sufficient carcass weight and an adequate carcass fat score (> 2+) at 20 months of age. In this regard, specific sires were chosen with a focus on 'weight-for-age' with the aim being to produce carcasses with 'improved' fat cover at young ages. Within breed, the Aberdeen Angus and Charolais sires were chosen under the following selection criteria for cows:

- Calving difficulty: < 8 % (*easy calving*)
- Carcass weight PTA: 5 star (*high carcass weight*)
- Age to slaughter PTA: 4 and 5 star (*early slaughter age*)
- Carcass fat PTA: lower stars (*improved 'fleshing' ability*)
- Reliability of key traits: >70 % (*proven bulls*)

An example of some of the sires used to date include:

Aberdeen Angus: BJG, AA4089, AA4323, AA4638, AA4640, AA8559

Charolais: CH2216, CH4251, CH4562, CH6271, CH6298, CH6310

The first 'production cycle' of this experiment will be completed in autumn 2024. Key measurements include, animal intake, growth performance, carcass traits, nitrogen excretion, enteric methane emissions, herbage production, biological nitrogen fixation of white and red clover and soil nitrate leaching.

Derrypatrick farm performance in 2023 and 2024

2024 calving results:

- 82 cows calved, with 81 live calves on the ground.
- There were two sets of twins, and mortalities included one set of twins dead at birth and one calf that died one hour post-birth.
- 83 % of cows calved in the first 6 weeks
- 83 % calved unassisted
- One caesarean-section

2023/24 progeny performance:

The 2023 born animals were weaned over a three-week period from 9 October and housed on 13 November. Due to the poor weather and grazing conditions in spring, animals did not return to grass full-time until 12 April 2024. The live weight performance of these animals is outlined in Table 5.

Table 5. Live weight performance of the 2023 born animals.

	Live-weight (kg)			Average daily gain (kg)	
	Weaning weight (09/10/23)	**Housing weight (13/11/23)**	**Turnout weight (12/04/24)**	**'200 day' weaning**	**First winter**
Males	326	342	430	1.31	0.59
Females	305	322	409	1.22	0.58

Conclusions

Suckler beef production in Ireland is characterised by having an array of different production systems. Each system directly affects farm profitability and GHG emissions. The environmental impact of beef cattle production is under increased scrutiny with GHG emissions of particular interest. It is important that beef systems improve both economic and environmental sustainability into the future. The analysis presented here, showed that this can be achieved by reducing finishing age in bull and steer systems; however, grass-based systems finishing animals earlier require a high level of technical management to ensure animal 'weight-for-age' targets and that carcass fat score is adequate. There are technologies available to improve beef farm profitability and environmental sustainability within each farm system. Beef farms that incorporate white clover into pastures can reap the combined benefits of superior beef cattle growth during the second grazing season and reduced fertiliser input.

Using beef indexes to improve the profitability of your suckler herd

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Summary

- The beef Eurostar Terminal and Replacement Indexes were updated in November 2023 to include revised economic values, two new traits and the impact of beef production on carbon emissions.
- There are clear benefits in favour of 5-star cows ranked on the revised indexes for performance metrics such as calving, fertility, maintenance costs and survival rates on the cow side, and weaning and lifetime carcass revenue on the progeny side.
- When selecting suitable sires to improve your cow herd, it is important to assess the individual traits making up the overall index value of your cows and thus, identify the 'strengths' and 'weaknesses' of your herd in the context of the production system operated.

Introduction

The Eurostar Replacement and Terminal breeding indexes combine, into a single expected profit rank, individual trait estimates of genetic merit along with the relative economic impact for a series of traits related to beef production. The Terminal Index is for the selection of bulls to produce cattle for 'finishing'. The Replacement Index is to help select bulls and cows to produce progeny that will eventually enter the suckler cow herd. The Replacement Index contains 16 traits, nine of which relate to the calf itself and are also in the Terminal Index. The indexes were revised in November 2023 to: 1) update the costs and prices of production thereby making the relative emphasis on each trait more relevant to modern production systems, 2) add the new traits of 'age at finish' and 'tuberculosis susceptibility', and 3) future-proof the indexes by considering the impact on carbon for relevant traits.

Recent updates

The last update to the relative economic importance of the different traits in the index was in 2016. While modest price changes occurred between then and 2020, subsequent price increases were much more substantial, particularly beef carcass as well as fertiliser, feed and fuel prices. The economic values used, like in 2016, are calculated using the Teagasc Grange Beef Systems Model that has been developed using many years of research at Teagasc Grange.

Two new traits have also been included in recent updates. 'Age at finish' is a new trait which reflects the average number of days it takes the progeny of a sire or cow to reach an acceptable level of weight and fat cover. There are both economic and carbon benefits to reducing the national finishing age in the suckler herd. Genetics is responsible for 25% of the differences within a breed in finishing age, which is similar to existing carcass traits. The estimates of genetic merit have a spread of over 20 days in the pedigree beef population indicating ample genetic variation to shorten age at finish. When undertaken in the context of a selection index, this can be achieved without any deterioration in carcass weight or quality.

'Tuberculosis (TB) susceptibility' is the second new trait included in the beef indexes. The herd incidence of bovine TB in Ireland has increased in recent years. The data used in the TB genetic evaluation includes data from herd-management-groups that have several confirmed TB reactors. The TB trait definition can be interpreted as the expected prevalence of TB infection in an animals' progeny. Susceptibility to TB is 18% genetic, consistent with reports in the UK. The estimates of genetic merit for TB typically ranges from one to 14%, with lower values being more desirable (i.e. expect fewer TB reactors). The inclusion of TB within the beef indexes should help to stop the unfavourable TB genetic trends.

A further update to the beef indexes was the inclusion of 'carbon'. The greenhouse gas emissions associated with changes in performance for each trait were quantified on a per animal basis and converted from carbon dioxide equivalents to monetary values by assuming a carbon price of €80/t.

Table 1 outlines the current relative emphasis of trait groups in both the Replacement and the Terminal index. Relative emphasis is useful as a guide to the contribution of certain trait groups to the overall index construction at a population level. The relative emphasis is a function of the genetic variation in the traits coupled with the relative economic importance of the trait. Every animal will have a different trait emphasis because the genetic merit of each trait, as measured by the predicted transmitting abilities (PTAs), is different for every animal. Hence, it is important to examine what constitutes the overall Eurostar index of an animal when deciding to use that animal to breed the next generation.

Table 1. Relative emphases on traits within the Replacement and Terminal indexes

Trait	Replacement	Terminal
Calving traits	16%	20%
Feed efficiency traits	7%	18%
Carcass traits	25%	47%
Fertility traits	15%	-
Milk	11%	-
Cow maintenance	11%	-
Carbon	10%	5%
TB	2%	1%
Docility	3%	1%
Polled	-	2%
Breed bonus	-	6%

Comparing the performance of 5-star and 1-star cows

In order to compare the performance of 5-star and 1-star cows, those born between August 2017 and April 2018 were chosen. The purpose for choosing this time period was to allow these animals the opportunity to reach maturity (up to fifth parity) and express their genetic potential across most of the traits in the Replacement Index while still being a relevant and important group given a sizeable portion of them will still be alive on farm. In total, there were 87,053 cows in the analysis. Table 2 shows the current Replacement Index and relevant estimates of genetic merit for these cows. In terms of genetic potential, the 5-star cows in this dataset are predicted to be €111 more profitable per lactation over their 1-star contemporaries. This is made up of a combination of superior genetic potential for calving traits, fertility traits, milk yield as well as lower expected maintenance costs through lower cow live weight. The 1-star cows are superior for carcass genetic potential and cull cow carcass weight. Hence, the benefit of reduced costs associated with the 5-star cow outweighs the lower expected progeny average revenue of these cows – the end outcome is greater profit.

Table 2. Current genetic profile (PTAs) of cows born Autumn of 2017 to Spring 2018 by star rating

Replacement Star Rating	**5**	**4**	**3**	**2**	**1**	**5 *vs.* 1**
Cow numbers	19,843	16,546	16,268	17,390	17,006	
Replacement Index (€)	149	114	96	76	38	*+111*
Beef heifer calving difficulty (%)	5.94	6.9	7.38	7.95	9.27	*-3.33*
Beef cow calving difficulty (%)	2.85	3.38	3.65	4.00	4.86	*-2.01*
Maternal calving difficulty (%)	5.57	5.50	5.48	5.50	5.53	*+0.04*
Gestation (days)	0.87	1.68	1.98	2.22	2.61	*-1.74*
Mortality (%)	-0.27	-0.2	-0.15	-0.1	0.01	*-0.28*
Docility (1-5)	0.05	0.04	0.03	0.02	-0.01	*+0.06*
Age at finish (days)	-3.13	-2.77	-2.57	-2.16	-1.63	*-1.50*
Carcass weight (kg)	7	10	11	13	15	*-8*
Carcass conformation (1-15)	0.8	1.01	1.07	1.16	1.31	*-0.5*
Age at first calving (days)	-9	-7	-5	-4	-1	*-8*
Calving interval (days)	-2.71	-1.41	-0.79	-0.2	0.83	*-3.54*
Survival (%)	2.94	2.14	1.8	1.49	0.95	*+1.99*
Milk (kg)	10	7	6	5	3	*+7*
Cow live weight (kg)	12	19	22	26	34	*-22*
Cull cow carcass weight (kg)	16	21	23	26	31	*-15*

Phenotypic or "on-the-ground" performance

The 5-star cows have more calves born to date compared to the other star categories due to an earlier age at first-calving, shorter calving interval and better survival (Table 3). In terms of calving traits, level of calving assistance, gestation length, and mortality at birth were all more favourable for the 5-star cows. Similarly, weaning efficiency (calf weight as a percentage of cow weight) was superior for 5-star cows due to heavier calf weaning weight concurrent with lighter cows. In terms of carcass performance, progeny from 5-star cows were finished younger and had, on average, lighter carcasses and poorer conformation; however, 5-star cows had more progeny finished resulting in a higher lifetime carcass progeny weight per cow, and greater total lifetime carcass revenue from progeny sales. Cull cow carcass weight was heaviest for the 1-star cows and lightest for the 5-star cows. The Terminal and Replacement Index values of the sires mated to the cows was similar across cow star ratings with a slight tendency for higher Terminal Index sires being bred to 1-star cows, and higher Replacement Index sires bred to 5-star cows.

Using the indexes to breed replacements for your own herd

Many farmers can find the Euro-Star Indexes hard to interpret. To apply them effectively to your herd, you must first ask yourself three questions:

What is my farming system? What market do you target your animals at, and what are the important traits for this market i.e. for export weanlings or kept for finishing in Ireland. This will help you to identify the traits that you need to focus on.

What are the strengths and weaknesses of my cows? Assess the genetic merit of your cows on the traits of importance for your system. The ICBF HerdPlus Euro-Star report (Figure 1) gives a snapshot of your herd average Replacement Index, carcass weight, milk and calving interval (fertility) PTA values.

Am I using sires that are genetically superior to my cows? Sires have a much bigger impact on a herd's genetics than cows, simply because a sire has multiple progeny. Often herds have one stock bull, therefore, that single animal accounts for 50% of the genetic makeup of every calf born in the herd. Your sires, be they stock bulls or AI sires, should be superior to your cows on the traits that you want to improve on.

When you have decided which index to choose from, you then need to decide the criteria on which to select your bulls. To do this you need to know your own herd's genetic level. The Herdplus Euro-Star profile or Euro-Star report (Figure 1) will allow a herd owner to assess the current genetic level of their herds. The report shows the average Replacement Index by cohort from the mature cows down to the first-calvers.

Table 3. Current phenotypic performance of cows in Table 2 by star rating

Replacement Star Rating	**5**	**4**	**3**	**2**	**1**	**5 v 1**
Cows still alive (%)	65	65	64	62	57	*+8*
Age at first calving (days)	889	914	927	939	959	*-69*
Calving interval (days)	388	396	402	408	419	*-32*
Cows reached a third calving (%)	74%	72%	69%	67%	60%	*+14*
Calves born to date (number)	3.35	3.24	3.13	3.05	2.81	*+0.54*
Calving assistance % (score of 2 or greater)	9	11	12	13	16	*-8*
Calving difficulty in heifers % (score 3 or 4)	2.1	3.4	4.0	5.7	10.0	*-8*
Calving difficulty in cows % (score 3 or 4)	1.0	1.4	1.9	2.7	5.4	*-4*
Calf mortality (%)	0.6	0.7	1.0	1.4	2.1	*-1*
Gestation length (days)	286	288	289	289	289	*-3*
Cow 200 day post calving weight (kg)	600	613	618	626	637	*-37*
Calf 200 day weight (kg)	295	292	289	288	285	*+10*
Weaning efficiency (%)	50	48	47	47	45	*+4*
Progeny still alive (average count)	2.18	2.14	2.10	2.04	1.96	*+0.22*
Progeny slaughtered to date (average count)	1.42	1.34	1.28	1.24	1.15	*+0.27*
Age at slaughter (days)	778	785	793	793	806	*-28*
Progeny carcass weight (kg)	351	354	355	355	360	*-9*
Progeny conformation (1-15 scale)	8.0	8.2	8.3	8.3	8.5	*-0.6*
Average slaughter price (€)	1802	1820	1831	1830	1858	*-56*
Total progeny carcass weight (kg)	610	591	580	566	545	*+65*
Total progeny carcass revenue (€)	3132	3039	2990	2922	2815	*+317*
Cull cow carcass weight (kg)	323	336	338	345	358	*-36*
Terminal Index of sires of calves (€)	101	105	106	105	106	*-5*
Replacement Index of sires of calves (€)	99	96	94	93	89	*+10*

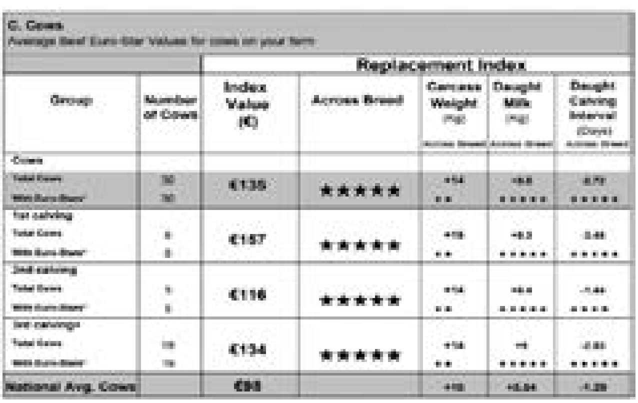

Figure 1. Example of the HerdPlus Euro-Star report

Improving reproductive performance of suckler beef herds

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Summary

- Reproductive efficiency is key to the economic and environmental sustainability of suckler beef herds and is influenced by four main factors:
- Puberty and age at first calving.
- Duration of the post-calving anoestrous interval, which is largely influenced by cow-calf bonding and pre-calving nutrition.
- Heat detection efficiency where artificial insemination (AI) is used.
- Bull fertility in herds using natural service.

Introduction

Reproductive efficiency is a major factor determining the productivity and ultimately, profitability and environmental impact of beef cow enterprises. Despite this, there is evidence of a general lack of consistent improvement in the reproductive performance of the national suckler beef herd over the past decade. For example, average national calving-to-calving interval is in excess of 390 days with only 86 calves born to every 100 cows over a 12-month period and cows lasting, on average, for 4.5 lactations within the herd. Additionally, the average six-week calving rate, a key metric indicating reproductive management and herd fertility, remains less than 60%, nationally. With less than 20% of beef heifers calving for the first time at 24 months of age (average age 31 months), together with only 16% of calves born to beef cows bred from an AI sire, it does not bode well for sustained genetic improvement of the national suckler beef herd, profitability of beef farms, or indeed a reduction in the environmental footprint of beef production.

So, how can such poor reproductive performance be reversed? Firstly, we must set clear targets for a reproductively efficient suckler beef herd. The reproduction and production targets for a beef cow herd are:

1. 365 day calving-to-calving interval;
2. <5 % cows culled annually as barren;
3. >95% of cows calving to wean a calf;
4. Heifers calving at 24 months of age;
5. Compact calving with 80% of cows calved in 42 days;
6. Replacement rate of 16 to 18%;
7. Sustained genetic improvement of the cow herd for economically important traits relating to reproduction, calving ability, health and calf weaning weight; and
8. Close alignment of calving date with onset of pasture availability in the spring.

There are three key benchmarks that must be met in order to achieve these targets in a timely fashion including:

1. Occurrence and timing of puberty and breeding of replacement heifers,
2. Resumption of oestrous cycles after calving,
3. Breeding and the establishment of pregnancy.

1. Occurrence and timing of puberty and breeding of replacement heifers

Replacement heifers represent the next generation of cows in a herd and each year's cohort of heifers should be genetically superior to their predecessors. Significant costs are incurred during the rearing of replacement heifers and it is imperative that they become pregnant early in their first breeding season, encounter minimal dystocia (calving difficulty), are successfully rebred to calve again within 365 days and ultimately have long (~ 6 lactations) and productive lives within the herd. Research studies clearly show that delaying first calving beyond two years of age significantly increases costs and the environmental impact of suckler beef production. Indeed, beef heifers that conceived early during their initial breeding season and calved at two years of age have a greater probability of becoming pregnant as first-calving cows, have greater lifetime production (calf weaning weights), and tend to calve earlier in subsequent years compared with heifers that conceive later in their first breeding season. Hence, age at which puberty occurs, (defined as the developmental stage that supports normal oestrous or heat cycles combined with the ability to become pregnant) will affect the time of conception in the first-breeding season and, ultimately, lifetime productivity.

Factors affecting puberty in heifers: Crossbred heifers typically reach puberty up to six weeks earlier than the average of their parental breeds. Larger European continental breeds of cattle are older and heavier at puberty than traditional British beef breeds or dairy breeds (Table 1). Breeds historically selected for milk production such as the Simmental, attain puberty significantly younger than breeds such as the Charolais and Limousin. Replacement heifers should reach approximately 0.65 of 'mature' body weight at the start of the breeding period so that a high proportion of them will be pubertal and conceive early in the breeding season with a target of 60 to 70% pregnant after 3 weeks of the breeding season.

Table 1. Recommended target weight at 14 months of age for heifers of some of the common beef breed crossbreds

Breed	Target weight at 14 months of age (kg)
Aberdeen Angus ×	370
Simmental ×	400
Limousin ×	420
Charolais ×	430

Breeding of heifers: Replacement heifers should be bred during the first six weeks of the breeding season, allowing these young animals more time to recover between first calving and second breeding. Studies at Teagasc Grange and elsewhere have clearly shown that nutrition and performance of the young heifer up to 8 months of age is a key determinant of age at puberty. Although offering heifers a high plane of nutrition over their 'first' winter, in order to achieve a high live weight gain (~1.0 kg/day) can advance the onset of puberty by 2 to 3 weeks compared with contemporaries growing at 0.5 kg/day, the impact is expected to be much greater if this gain is achieved during the pre-weaning and early post-weaning period.

2. Resumption of oestrous cycles post-calving

Studies at Teagasc recorded average calving to first ovulation intervals of 50 to 55 days in beef cows, which is almost twice as long as the interval for dairy cows. For first-calving beef cows, this interval is usually 10 to 15 days longer than for mature cows. There are two key factors influencing post-partum anoestrous interval.

1. Cow-calf bonding: The predominant reason for long anoestrous intervals in suckler cows is the strong maternal-offspring bond that exists between the dam and her calf. This bond is predominately affected through sight and smell. Teagasc studies have shown the "cow-calf bonding effect" is further compounded by having beef cows in a low body condition score (BCS) at calving. The effect of low BCS at calving are only partially reversed by offering cows a high plane of nutrition after calving. Extended postpartum intervals beyond 55 days in duration result in only one opportunity for a cow to become pregnant and calve again within 12 months. Short-term restriction of access of the calf to the cow (ideally out of sight and sound) in the form of implementing a twice-daily suckling regimen from when the calf is one month old, can lead to between 85 to 90% of cows exhibiting a fertile heat within 18 to 22 days. About 10 to 15% of cows fail to ovulate in response to calf separation and are typically those in poor BCS. It is unlikely that these cows will respond to synchronisation either until such time that their BCS is improved. Calf separation is particularly applicable to autumn-calving cows, early spring-calving cows and first-calvers, and additionally facilitates the use of AI in such cows, though it does entail some additional labour and logistical challenges.

2. Cow nutrition: From published research studies it is clear that,

(i) pre-partum nutrition is more important than post-partum nutrition in determining the duration of post-partum anoestrus;

(ii) energy is the primary nutrient regulating reproduction in female beef cattle and inadequate dietary energy during mid-to-late pregnancy delays the resumption of subsequent heat activity even when dietary energy is adequate during lactation;

(iii) a BCS of 2.5 to 3.0 (scale 0-5) at calving will ensure that body reserves are adequate for post-partum reproduction.

If cows are in good BCS (3.25-3.5) at housing, moderate dry matter digestibility (DMD 65-68%) grass silage fed *ad libitum* during the 'dry' period, is sufficient to allow for some mobilising of body reserves and aim for a BCS of 2.5 to 3.0, post-calving. It is important to remember that 80% of the calf birth weight is attained during the last three months of pregnancy and minimising the risk of dystocia or calving difficulty is a key management objective. Where herd BCS is not uniform, group cows by BCS at housing and feed as appropriate to reach the target BCS at calving. If cows are in good BCS (>3.0) at housing and only better quality silage (>70% DMD) is available, farmers should restrict access to silage or incorporate straw into the silage to dilute the 'quality' of the offered feed. A pre-calving mineral should be offered to cows at least six weeks before calving to reduce the risk of health and metabolic problems around calving. Minerals and vitamins can be offered via water supply, boluses, mineral licks, dusting on silage or in concentrate feed, if offered. Pre-calving calcium should be minimised and magnesium increased to aid calcium metabolism. Vitamins A, D and E should be fed at high levels to ensure good immune function and reduce the post-calving risk of infection and milk fever. Conducting a silage quality analysis will provide the nutritional value, preservation efficiency and mineral profile.

Body condition scoring has been frequently advocated as a practical tool for the nutritional management of beef cows. From the foregoing and from published literature it is clear that the critical time to achieve a minimum target BCS is at calving. The recommended BCS at calving for mature cows, and first- and second-calving cows are score 2.5 and 3.0 on a scale of 0-5, respectively. The somewhat higher BCS is warranted for younger cows and heifers because, after calving, they have an additional feed requirement for growth.

3. Breeding and the establishment of pregnancy

Beef cows typically achieve conception rates of 60 to 70% to either AI or natural service, unless there are problems with semen quality, AI technique or bull fertility. Conception rates reach a normal level in cows bred at 60 or more days after calving. However, when cows are bred at 40 days or less after calving conception rate is usually <40% but it is still advisable to breed such cows once the breeding season has commenced. What's more, post-calving conception rates are often lower for first-calvers compared to mature cows, which is a reflection of the increased nutritional demands of the young cow for growth in addition to maintenance and lactation requirements. Where AI is practised, fertility is highest following AI at 12 to 18 hours after heat onset but is not greatly reduced following early insemination. However, late insemination, at 24 hours or later, after onset of standing heat, should be avoided. Timed AI based on use of oestrous synchronisation programs, can substantially reduce the labour requirements of heat detection and assembly of cows and have been tested extensively at Grange. Indeed, the combination of timed AI and natural service or AI for repeat breedings can result in up to 80% of treated cows pregnant in three weeks.

Bull fertility

Bull fertility is key to maintaining a compact calving period and overall herd profitability. While the reported incidence of infertility in stock bulls is generally low (3-5%), subfertility is much more common (20-25%), with significant differences among individual bulls. Subfertility may be caused by low libido, sperm quality/quantity, defects or physical factors affecting bull mobility or mating ability. Frequently, sub-fertile bulls go undetected and farmers may be unaware of the problem until much of the breeding season has elapsed or until pregnancy scanning. Furthermore, there is no guarantee that a bull will retain his fertility from season to season or even within a season. Thus, farmers must be continually vigilant for potential fertility problems so that corrective action can be taken. Bull Breeding Soundness Evaluation (BBSE) is widely recommended to aid the identification of potential fertility issues in advance of the onset of the breeding season. Ideally, a BBSE should be conducted annually by a veterinary surgeon at least 60 days prior to the start of the breeding season. This will facilitate re-testing and timely replacement of bulls that may fail the examination. While these evaluations identify bulls with substantial deficits in fertility, and principally semen quantity and quality, they do not consistently identify sub-fertile bulls. Therefore, farmers should monitor and record heats during the breeding season to identify potential problems.

Animal health

A comprehensive health plan is vital for prevention of diseases that may cause reproductive wastage in suckler cows. A farm-specific vaccination protocol should be discussed and implemented in consultation with your vet. Some common diseases include, rotavirus, coronavirus (vaccines should be administered between 12 and three weeks before calving), bovine viral diarrhoea, leptospirosis (vaccines should be administered approximately four weeks before breeding) and infectious bovine rhinotrachitis (IBR) (vaccines should be boosted every six months).

Effect of suckler cow breed type and parity on the development of the cow-calf bond post-partum and calf passive immunity

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Summary
- Two studies at Teagasc Grange aimed to determine the effect of suckler cow breed type and parity on the development of the cow-calf bond and its relationship with calf passive immunity.
- It was found that cow breed type had little effect on cow-calf behaviour.
- Primiparous cows expressed maternal inexperience and their calves were less vigorous than multiparous cows.
- Colostrum immunoglobulin (IgG) concentration and calf passive immunity measures were unaffected by cow breed type.
- Calves from primiparous cows had lower passive immunity than multiparous cows.

Introduction
The cow-calf bond is formed following parturition, and maternal behaviour post-calving influences calf survival, health and pre-weaning performance. To initiate and form the bond, the dam licks and sniffs the calf coupled with low-pitched vocalisation. Learning to suckle quickly is vital as the neonatal calf is born with an underdeveloped immune defence, and obtains passive immunity through ingestion of colostrum. This colostrum provides immunologic protection during the first two-to-four weeks of life until its own immune system is developed. To ensure a newborn calf receives colostrum, an alternative to suckling is artificial-feeding of the dam's colostrum using either an oesophageal tube or teat-bottle. This colostrum management practice is advantageous as a known volume of colostrum can be fed in a timely manner.

In Ireland, suckler cow replacement strategy comprises of heifers sourced from within the suckler beef herd (beef × beef, B×B) or, to a lesser extent, beef crossbreds sourced from within the dairy herd (beef × dairy, B×D). Therefore, the primary objectives of this study were to determine the effect of suckler cow breed type (B×B *vs*. B×D) and parity on the development of the cow-calf bond and its relationship with calf passive immunity under conditions where calves suckled colostrum 'naturally' (Experiment 1), or were artificially-fed colostrum (Experiment 2), post-partum.

Pre-partum management
Cows were accommodated within pens in a concrete slatted floor shed approximately two to five months pre-calving at a space allowance of 3.3 m^2/animal. In both experiments, cows were offered second-harvest grass silage (dry matter (DM) digestibility and crude protein

concentration of 689 g/kg and 118 g/kg DM, and 679 g/kg and 146 g/kg DM in experiments 1 and 2, respectively) *ad libitum* pre-partum. In addition, all cows received vitamin and mineral supplementation supplied through the drinking water. A combined bovine rotavirus and E. coli vaccine along with a live vaccine of Infectious Bovine Rhinotracheitis (IBR) was administered to all cows by intramuscular injection 4-to-12 weeks prior to expected calving date as part of routine husbandry management. Between one and four days prior to their expected calving date, cows were transferred to single straw-bedded pens (4.5 m × 4.8 m).

Post-partum management

Calf births were supervised by the stockperson via direct visual observation and the use of CCTV cameras in each calving pen. Immediately post-partum all cows were momentarily restrained in a head gate to allow the stockperson to apply disinfectant to the calf navel using iodine spray, weigh the calf, determine the calf 'suckle reflex' (in Experiment 1, described below), and to milk colostrum or obtain a colostrum sample from the cow. Once the aforementioned procedures were implemented, the cow was immediately released from the head gate and left to bond with her calf. The cow and her calf remained together in the individual straw-bedded calving pens for 24 hours post-partum, and had freedom to express natural behaviour. Post-partum, all cows continued to receive the same grass silage *ad libitum* as offered pre-partum, and first-parity animals were additionally supplemented with 1.5 kg of a barley-based concentrate per head daily.

Experiment 1

A total of 78 B×B cows (Aberdeen Angus, Charolais, Limousin and Simmental crossbreds) and 74 B×D cows (Aberdeen Angus and Limousin crossbreds from Holstein-Friesian dams) were used. They comprised of 38 primiparous and 114 multiparous cows. The calves either suckled the dam naturally (suckled, n = 126) with no intervention, or were fed colostrum from their dam (hand-milked without oxytocin administration) using an oesophageal-tube (artificially-fed, n = 26). Intervention was primarily based on the strength of the calf suckle reflex, which was determined immediately post-partum by placing two fingers longitudinally into the calf's mouth and gently rubbing the roof of the mouth. Calves exhibiting a strong jaw tone with a rhythmic suckle reflex were characterised as 'strong', and calves with weak jaw tone or non-rhythmic suckle reflex as 'weak'. Calves exhibiting a 'strong' suckle reflex were left to naturally suckle for up to four hours. Calves were artificially-fed colostrum when they exhibited a 'weak' suckle reflex (n = 23), or if they failed to suckle naturally by approximately four hours post-partum (n = 3). Artificially-fed calves were observed by farm staff to ensure that suckling occurred in due course. Only calves that 'naturally' suckled their dams within the first approximately four hours post-partum were included in the behaviour observations (n = 126).

There was no effect of cow breed type on any of the variables that were measured (Table 1). Multiparous cows licked their calves sooner, and for longer than primiparous cows (Table 1). Calves from multiparous cows made fewer attempts to stand, they stood for longer and had fewer attempts to suckle before suckling occurred than calves from primiparous cows. Multiparous cows had greater colostrum immunoglobulin G (IgG) concentrations and their calves had greater serum IgG concentrations, ZST units and total protein (TP) concentrations than primiparous cows.

Table 1. Effect of cow breed type (beef × beef, (B×B) and beef × dairy, (B×D)) and parity (primiparous, PP and multiparous, MP) on cow-calf maternal behaviours, colostrum IgG concentration, calf serum IgG concentration, ZST units and Total Protein (TP) concentration for Experiment 1 (suckled calves)

	Breed type			**Parity**		
	B×B	**B×D**	Sig.[1]	**PP**	**MP**	Sig.[1]
Time to first-licking the calf (sec)	70	84	NS	98	56	*
Total duration of first-licking (sec)	77	75	NS	42	110	**
Total no. of attempts to stand by the calf	9	10	NS	12	7	***
Total duration of the attempts to stand (sec)	84	93	NS	76	100	NS
Time to calf standing on all fours (min)	56	64	NS	66	53	NS
Duration of the first standing on all fours (sec)	94	62	NS	52	104	*
Total number of attempts to suckle before suckling occurred	10	11	NS	13	8	***
Total duration of the attempts to suckle before suckling occurred (min)	4.6	5.7	NS	4.6	5.7	NS
Time to first-suckle (min)	103	119	NS	108	114	NS
Duration of the first-suckling bout (sec)	55	72	NS	63	64	NS
Colostrum IgG (mg/ml)	132	119	NS	117	134	*
Calf serum						
IgG (mg/ml)	47	47	NS	44	50	*
ZST (units)	20	22	NS	20	23	*
TP (g/dl)	6	6	NS	5.8	6.2	*

*Sig[1] = Statistical significance; NS= not significant, Parity effects; * = P < 0.05, ** = P<0.01, *** = P < 0.001.*

There were no breed type × parity interactions

Experiment 2

A total of 29 B×B cows (Aberdeen Angus, Limousin and Simmental crossbreds) and 31 B×D cows (Aberdeen Angus and Limousin crossbreds from Holstein-Friesian dams) were included. They comprised of 39 primiparous and 21 second-parity cows. Immediately post-partum, the cow was momentarily restrained for hand-milking colostrum to feed the calf using an oesophageal-tube as described above. The mean volume of colostrum fed to calves from primiparous and second-parity cows was 1.1 L, and 1.3 L, equivalent to 2.8% and 3.1% of birth weight, respectively. The behaviour of all cow-calf pairs was observed up to the first suckling, following which observations ceased.

Calves from B×D cows had a greater mean number of attempts to suckle before suckling occurred compared to those from B×B cows (Table 2). There was no effect of parity on the number of attempts to suckle. There was no effect of cow breed type or parity on the other cow-calf behaviours, or on colostrum IgG concentrations and calf passive immunity measures.

Table 2. Effect of cow breed type (beef × beef (B×B) *v.* beef × dairy (B×D)) and cow parity (parity 1 *v.* parity 2) on cow-calf maternal behaviours, colostrum IgG concentration, calf serum IgG concentration, ZST units and Total Protein (TP) concentration for Experiment 2 (artificially-fed calves)

	Breed type			**Parity**		
	B×B	**B×D**	Sig.[1]	**PP**	**MP**	Sig.[1]
Time to first-licking the calf (sec)	29	25	NS	52	40	NS
Total duration of first-licking (sec)	115	107	NS	71	151	NS
Total number of attempts to stand by the calf	9	9	NS	9	9	NS
Total duration of the attempts to stand (sec)	112	105	NS	91	126	NS
Time to calf standing on all fours (min)	77	84	NS	85	76	NS
Duration of the first-standing on all fours (sec)	287	163	NS	165	284	NS
Total number of attempts to suckle before suckling occurred	4	6	0.05	5	5	NS
Total duration of the attempts to suckle before suckling occurred (min)	2.7	2.9	NS	2.5	3.1	NS
Time to first-suckle (min)	142	198	NS	144	196	NS
Duration of the first-suckling bout (sec)	122	138	NS	133	127	NS
Colostrum IgG (mg/ml)	122	127	NS	122	127	NS
Calf serum						
IgG (mg/ml)	45	51	NS	46	51	NS
ZST (units)	19	21	NS	19	21	NS
TP (g/dl)	6.0	6.1	NS	5.9	6.2	NS

Sig[1] = statistical significance; NS = Not significant. There were no breed type × parity interactions (P > 0.05) for maternal behaviours or colostrum IgG concentration or calf passive immunity measures.

Conclusion

Overall, there was little effect of cow breed type on cow-calf behaviours but primiparous cows expressed maternal inexperience and their calves were less vigorous compared to multiparous cows. Colostrum IgG concentrations and calf passive immunity measures were unaffected by cow breed type, but calves from primiparous cows had lower passive immunity. The findings from this study indicate that greater vigilance is required for primiparous suckler cows and their calves compared to multiparous cows in relation to calf passive immune status. Furthermore, the current results indicate that passive immunity in suckler calves is largely successful when colostrum-feeding intervention, based on scoring calf vigour ('suckle reflex'), is implemented.

Managing the health of suckler herd progeny

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Summary

- Scour, navel ill and respiratory disease present the major health problems in pre-weaned suckler calves.
- Infectious bovine rhinotracheitis (IBR) is a respiratory disease, which results in life-long infection. In herds with a low sero-prevalence, culling infected animals is feasible, whereas in herds with high sero-prevalence, vaccination is the preferred control strategy.
- Clostridal diseases can potentially cause mortality in suckler progeny; however, vaccination is highly effective.
- Parasites such as gut worms, lung worms and liver fluke can reduce the performance of suckler cattle and should be monitored, and treated accordingly.

Introduction

Health problems in the progeny of the suckler herd can have a major negative effect on profitability. This is mainly through animal mortality, reduced live weight gain, cost of treatment, cost of prevention and additional labour. Identifying the key times when herd health is at the highest risk and taking actions to mitigate this is critical to maintaining the health of the suckler herd progeny. In this paper, we identify the major disease areas and options for risk mitigation. In the pre-weaning period, three major disease groups represent the majority of morbidity and mortality. They are; 1. neonatal calf scour, 2. navel ill, and 3. bovine respiratory disease (BRD). Ensuring adequate calf passive immunity through the timely ingestion of sufficient high-quality colostrum post-partum is a prerequisite in relation to protection against all of these diseases (see p88). In the post-weaning period, BRD, Clostridal disease and gastrointestinal parasites represent the majority of mortality and morbidity. Preparing a herd health plan that includes specific management tasks (i.e. vaccination, monitoring) can help to mitigate the impact of these diseases.

Neonatal calf scour

Scour is the most commonly diagnosed cause of mortality in suckler calves less than one month of age (25.9%) according to the All Island Disease Surveillance Report. Scour can be caused by numerous pathogens but those most commonly identified are rotavirus and cryptosporidium. Rotavirus is a virus and cryptosporidium is a parasite, but both are transmitted via the faecal oral route.

Prevention of calf scour begins prior to the calving season with full cleaning and disinfection of calving pens and calf creep areas. Both cryptosporidium and rotavirus are capable of surviving in housing for a long time i.e. from one calving season to the next. To achieve adequate disinfection, calf areas must have all organic material removed prior to a thorough power hosing, following which they are allowed to dry before a disinfectant is applied. When

choosing a disinfectant be sure to choose one that is capable of killing cryptosporidium and rotavirus. When using disinfectants it is also important to adhere to the correct dilution rates and contact time (time that the disinfectant must be wet on a surface to kill).
Other methods of scour prevention include vaccination of the dam to induce the production of colostrum with antibodies that are protective against a specific pathogen. Currently there are vaccines available for protection against rotavirus. A new product has recently been released which should provide similar protection against cryptosporidium. There are also a number of veterinary medicines that are licensed for the treatment and prevention of cryptosporidium. Use of these should be discussed with a veterinary practitioner to determine if they are appropriate for use on a given farm.
In calves that have developed scour, the major goal of treatment is replacing the water and electrolytes lost due to the scour. Electrolyte solutions should be fed to all calves that show any signs of scour with the volume administered increasing according to the severity of the signs.

Navel ill

Navel ill is an infection of the navel seen in pre-weaning calves. It is generally associated with contamination of the navel by bacteria in the calving pen. If left untreated, navel ill can result in joint ill. Navel ill was observed in 8% of calves under one month old submitted to regional veterinary labs. To reduce the risk of navel ill, maintain a clean calving area and apply an antiseptic dip to the navel as soon as possible after calving. Navel dips can be either iodine or chlorohexidine. If heat, swelling or discharge is noticed from a calf's navel or joints, a veterinary practitioner should be consulted.

Bovine respiratory disease

Numerous different bacteria and viruses cause BRD. It is a disease that causes significant mortality and morbidity in pre-weaned calves, weanlings and adult/finishing cattle. Respiratory disease is typically associated with periods of stress in suckler cattle. This may vary from farm to farm but can include periods such as weaning and/or housing. Managing BRD in suckler herds involves a two-pronged approach; 1. minimising stress, 2. vaccination prior to a high-risk period. It is very useful to review treatment records from the previous year to determine when most treatments for BRD occurred in animals. Once these have been identified management decisions around housing and weaning can be made to reduce stress.
Vaccination: Depending on when the high-risk period occurs, there are two main vaccination types available for the common BRD pathogens: intranasal vaccines and injectable vaccines. In herds where calves are being treated for BRD during the pre-weaning period, intranasal vaccines are useful as they provide a rapid onset of protection after a single dose. However, intranasal vaccines only provide protection against viral pathogens such as bovine respiratory syncytial virus (BRSV), para influenza virus 3 (PI-3), bovine coronavirus (BCoV) and IBR. In herds where disease is primarily seen in cattle at weaning or housing there are alternative injectable vaccines widely available. Some of those vaccines also provide protection against bacterial pathogens such as *Mannheimia haemolytica*. However, they generally require two doses before the onset of protection and so planning ahead to ensure that the second dose is completed prior to the stress event is important. Injectable vaccines against BRD also tend to provide longer-term cover when compared to intranasal vaccines. This can be important if the winter housing has poor ventilation.

Detection: If a calf or older animal is affected by BRD, rapid diagnosis and treatment is very important. Clinical signs such as nasal discharge, rapid breathing and coughing are all indicators of BRD, and warrant a closer examination of an animal. In situations where an outbreak of BRD has occurred and multiple animals have been treated, it is useful to sample the affected animals and get it tested to determine which bacteria or viruses are causing the problem. Please consult your veterinary practitioner to develop an appropriate diagnosis and treatment plan.

Infectious bovine rhinotracheitis

IBR is a highly infectious disease of cattle caused by a virus called bovine herpesvirus 1 (BoHV-1). In Ireland, IBR is mostly associated with respiratory infections, being one of the viral agents involved in the BRD complex. Infected animals typically recover but become carriers and, despite appearing healthy, may start shedding virus when under stress (transport, calving, mixing of animals etc.). It is estimated that approximately 75% of Irish herds contain animals that have been exposed to IBR and are carriers. In addition to the impact on health and productivity, it also affects the trade of animals, semen and embryos. Animals seropositive to IBR cannot be traded to many regions and countries in the EU that are officially recognised as free of IBR (e.g. Germany, Switzerland, Austria, Denmark) or have an approved IBR control programme (e.g. Belgium, France). Bulls with antibodies to IBR (including those due to vaccination) are prohibited from entering semen collection centres.

IBR testing with the National Beef Welfare Scheme (NBWS) 2024

During 2024, DAFM launched the NBWS as a support measure to enhance animal health and husbandry on suckler farms. To meet the requirements of the scheme, farmers were required to feed meal to suckler calves in advance of and after weaning, and to test for the presence of IBR in their herds. The testing applied to participating herds was called IBR 'snapshot' test and consisted of sampling up to 20 randomly selected animals over 9 months of age and testing for antibodies to IBR gE.

What do we know about the outcome of the testing?

A total of 10,225 farmers undertook snapshot testing of their herds for IBR. Preliminary results shows that some 50% of participating herds and 88% of animals tested negative for IBR.

What do the results mean?

All results should be discussed with your veterinary practitioner. If either none or only one animal is positive to IBR, the proportion of infected animals within the herd (the within herd prevalence) is estimated to be between 0-15%. At this low prevalence, screening of the whole herd to identify and remove any carriers present is justified where herd freedom is the target. These herds should review their biosecurity to minimise the risk of introducing the disease (for example when introducing animals) and consider introducing/extending/maintaining vaccination as agreed with their vet to the whole herd to reduce the impact from a reintroduction of the virus.

If more than two seropositive animals are identified, the likely within herd prevalence is greater than 15%. Provided that the animals have been randomly selected, the results also allow you to estimate the overall prevalence of infected animals in the herd. In these herds, identification and removal of all carriers is unlikely to be feasible in the short term, and therefore other control measures are required. It is recommended that these herds commence a herd-level IBR vaccination programme as agreed with their vets as one of the measures to control this disease on their farms. The vaccine makes it less likely that a carrier will reactivate and shed the virus, and less likely that a naïve animal will become ill and spread the virus after exposure. Over time, with appropriate biosecurity measures, the prevalence should decrease as carrier animals leave the herd and are replaced by uninfected animals.

Clostridal diseases

Clostridal diseases are associated with a group of bacteria found in soil, faeces and decaying organic matter. In 2022, it was the third most common diagnosis in post mortems of weanling cattle in the All Island Disease Surveillance Report. Mortality associated with Clostridal disease is also a relatively common occurrence in adult cattle. Disease is rapid in onset and usually results in death. The most common example of this is blackleg. Because of the widespread nature of Clostridal bacteria, the most effective management strategy is vaccination. The grazing period is when the highest number of blackleg cases are seen. Therefore, vaccination of calves prior to grazing is recommended. There are numerous vaccines available on the market, and products that provide protection against multiple Clostridal bacteria are recommended above those that only provide protection against one. These vaccines usually require two doses, and need to be completed before they will provide protection.

Parasites

Gut worms, lung worms and liver fluke are the three main categories of parasites that present a threat to the health of suckler progeny. All of these parasites are associated with grazing grass so the extent to which they affect a calf is somewhat determined by the level of grass in its diet.

Gut worms are primarily associated with ill thrift. There are three main groups of anthelmintic that can be used to treat gut worms: 1) white wormers (benzimidazole), 2) yellow wormers (levaimzole), and 3) clear wormers (macrocyclic lactones). However, resistance has been documented to all of these wormers so treatment must be guided by faecal testing to determine worm egg counts and veterinary advice.

Lung worms are associated with coughing at grass or “hoose”, and rapid treatment is advised if calves show any signs as it can quickly lead to death. The same wormers can be used to prevent lung worm and gut worm.

Liver fluke is usually associated with damp or wet land-types. Generally, the treatment of cattle for liver fluke should take place during the housing period. Triclabendazole is a commonly used product to treat liver fluke; however, Teagasc research has identified liver fluke resistance to Triclabendazole. Other products are available but require multiple doses. Consult your veterinary practitioner prior to treating cattle for liver fluke to make sure that you are using the correct product at the correct time.

Conclusion

It is important to have a herd health plan in place for management of the health of suckler progeny throughout the year. In particular, identifying the diseases that have the greatest prevalence and impact on the animal health on your farm is critical. Collaborating with your veterinary practitioner to develop a proactive herd health plan will reduce these diseases and associated costs.

Welfare management of beef-suckler calves

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Summary

- Calves should be disbudded while horn development is still at the bud stage and when it is large enough to be easily palpable/visible.
- Horn buds develop later in beef-suckler calves than dairy calves.
- Castration of beef-suckler calves at 2.5 months old is less stressful than at 5.0 months old.
- Weaning is a multi-factorial stressor, during which nutritional, social, physical and psychological stressors are combined.
- Reducing cumulative stressors at weaning will allow the calf have an easier transition from social and nutritional dependence on the dam to complete social and nutritional independence post-weaning.

Introduction

The improvement of farm animal welfare is an important consideration for the ethical treatment of animals, food safety and for improving the standards of animal husbandry. This is reflected in international and European legislation that collectively, governs the standards of animal welfare in the European Union. There are management aspects of beef cattle production such as the disbudding, castration and weaning of animals, which have the potential to cause stress if not managed correctly. Depending on the severity of a stressor, potential stress responses can suppress immune function, lower resistance to disease-causing factors and contribute to, and result in, reduced animal welfare.

Weaning of beef calves is a necessary husbandry practice involving separating the calf from its mother, resulting in numerous stressful events including dietary change, social reorganisation and the cessation of the maternal-offspring bond and is often accompanied by housing. Hot-iron disbudding is the most common method of disbudding calves and is the only method allowed in Ireland. Burdizzo castration is the most common castration method used in Ireland, and is less stressful than surgical or rubber ring castration. Despite being frequent husbandry procedures, castration and disbudding induce pain, tissue trauma, stress and inflammatory responses following the procedure. There is a view that castration and disbudding are less stressful for young animals. However, the scientific literature is conflicting regarding what recommendations should be transferred to farmers and practitioners regarding the preferred age to castrate and disbud calves. This lack of scientific support to guide recommendations is even more noticeable in suckler beef calves, as most disbudding studies have used dairy calves and most castration studies have used dairy calves, or calves older than 6 months.

Calf disbudding

Disbudding of calves is performed for health and safety, animal welfare, economic and practical reasons. Disbudding prevents injury to other animals (with implications for productivity and carcass damage respectively), and improves human safety during handling. Cautery (hot-iron disbudding) is recommended by the European Food Safety Authority (EFSA) and other authorities, and is the only method of disbudding allowed in Ireland under S.I. 127 of 2014. This legislation permits disbudding of calves up to 28 days old using a hot-iron. Local anaesthetic (LA) is required for disbudding of calves that are over 15 days of age. Most of the recommendations and legislation concerning when the disbudding should be performed are based on the age of calves. These age limits are not based on empirical evidence, but rather on opinion related to the physical development of horns in calves and that the horn buds become attached to the underlying skull surface at approximately two months of age.

A recent study at Teagasc Grange examined the effect of breed type and age on horn bud size of calves at the time of disbudding. They consisted of 88 Holstein-Friesian male dairy-bred calves and 191 suckler-bred male and female calves, comprised of 86 Charolais (39 male & 47 female), 67 Limousin (32 male & 35 female) and 38 Simmental (22 male & 16 female) sired animals. Calves were retrospectively assigned to two age categories at time of disbudding: 1) 14-28 days of age, and 2) 29-60 days of age.

On the day of disbudding, calves were moved individually to a disbudding crate and gently restrained. The hair surrounding each horn bud was trimmed using a scissors and the horn bud exposed. The diameter and height of left and right horn buds were measured in millimetres (mm) using a digital calliper. Cornual nerve blockade was achieved by injecting 2.0 ml of local anaesthetic (Adrenacaine) through the skin between the eye and the base of the horn bud on the left and right side of each calf. Calves were released from the disbudding crate and allowed to mix with pen mates for 20 minutes to allow the nerve blockade to develop. After 20 minutes had elapsed, calves were again restrained in the disbudding crate and the left and right horn buds were removed using hot-iron disbudding. The hot-iron disbudder used had an internal diameter of 15 mm (model 17460; Kerbl, De). Following removal of each horn bud, silver aluminium spray was applied to the wound area.

Holstein-Friesian calves had a greater horn bud diameter and height compared to suckler-bred calves, with no difference among the Charolais-, Limousin- and Simmental-sired suckler calves (Table 1). Horn bud diameter and height was greater in calves disbudded at 28-60 days of age compared to 14-28 days of age (Table 1). Suckler-bred male calves had a greater horn bud diameter (14.5 *v.* 13.3 mm) and height (5.0 *v.* 3.9 mm) than suckler-bred female calves. The relationship between calf age and horn bud diameter and height was very weak in all breeds studied, inferring that age is a very poor predictor of horn bud size.

Setting definite ages for disbudding is difficult. Despite visibility of the horn bud being the characteristic normally adopted by farmers when selecting animals for disbudding, most recommendations are still based on the age of the calf. Based on the findings of the present study, recommendations for disbudding of calves should be based on horn bud size rather than calf age. The implications of these findings is that, calves should be disbudded when horn buds are large enough to be easily palpable/visible, but not too large that disbudding could lead to severe tissue trauma.

Table 1. Effect of breed and age on horn bud diameter and height of male dairy-bred and suckler-bred calves at disbudding

	Calf breed type					Calf age		
	Holstein-Friesian	Charolais	Limousin	Simmental	Sig.[1]	14-28 d	29-60 d	Sig.[1]
Diameter (mm)	17.0[a]	15.1[b]	13.8[b]	14.4[b]	**	14.3	15.8	*
Height (mm)	7.8[a]	5.1[b]	4.7[b]	5.4[b]	**	4.9	6.6	**

*[1.] * $P < 0.05$, ** $P < 0.01$; [a,b] Within rows, values without a common superscript letter differ*

Calf castration

Castration of cattle is usually performed in order to prevent sexual behaviour, reduce aggression, and increase handling safety. In Ireland cattle can be castrated, other than by a veterinary practitioner, before they reach six months of age using a Burdizzo or before they reach eight days of age using a rubber ring, in both cases without the use of anaesthesia and analgesia (i.e. pain relief). Over these age limits, a veterinary practitioner must administer local anaesthesia, using an anaesthetic. Surgical castration is permitted at any age but only by a veterinary surgeon and requires anaesthesia and analgesia. The regulations require that 'painful procedures' are carried out under hygienic conditions and by competent persons who are familiar with the procedure, have the necessary training and experience, the technical skill and the requisite equipment to carry out the procedure.

Research experiments investigating the effect of age at castration on stress response are important to obtain recommendations on what is the optimum age to castrate calves. Furthermore, understanding how calves castrated at different ages respond to pain post-castration will be helpful in providing recommendations regarding the timing of pain relief in order to minimize stress responses.

An experiment was carried out at Teagasc Grange to examine effect of age at castration on stress indicators of beef-suckler calves. Calves were assigned to two age groups and two 'castration' treatments; 2.5 months old (mean live weight, 121 kg) or 5.0 months old (mean live weight, 218 kg) and they were either 'sham-handled' (control) or Burdizzo castrated. The study was conducted without the use of analgesics or local anaesthesia, as the calves were under six months of age. Blood samples were obtained before and after castration to measure changes in the concentration of the stress hormone, cortisol.

Results showed that, following castration, the concentration of cortisol increased immediately until 0.5 hours and then decreased until four hours after treatment (i.e. 'primary response'), followed by another smaller increase, which remained elevated until at least nine hours post-castration (i.e. 'secondary response'). In terms of calf age, cortisol concentrations during the first four hours ('primary response') after castration did not differ between the two age groups, but the concentrations of cortisol in the subsequent 'secondary response' were higher for the 5.0 month old compared to the 2.5 month old calves.

The practical implications from these findings are that if calves are to be castrated without analgesia or anaesthesia then, in order to minimize the stress associated with burdizzo castration, it would be preferable to do this at 2.5 months of age rather than later.

Suckler calf weaning management

Within seasonal, grass-based suckler beef production systems, calves are generally spring-born and reared with their dam at pasture for approximately eight months until the end of the grazing season in autumn when they are weaned. In addition to separation from the dam and removal of milk from the diet, the weaning procedure is generally compounded by other stressors/practices occurring around the same time, e.g. change of environment (outdoors to indoors), change of forage diet (grazed grass to conserved forage with or without concentrates), and transport/marketing. Weaning therefore can be a multi-factorial stressor, in which, nutritional, social, physical and psychological stresses are combined. Physical and nutritional stressors are often present through the introduction and adaptation to a new diet and new environment, whereas psychological stress is present in the form of maternal separation and social disruption. Alterations in calf behaviour, hormonal mediators of stress, and consequently measures of immune function, are evident post-weaning.

Research at Teagasc Grange has shown that reducing the cumulative effect of multiple stressors around weaning time results in a reduced stress response in the calf. Compared with the practice of weaning and housing at the same time, delaying housing of calves post-weaning reduces the magnitude of the stress response.

Concentrate supplementation of suckling beef calves at pasture prior to weaning (‘creep feeding’) compensates for decreasing cow milk yield and also declining grass supply and quality. Additionally, this practice is advocated as a means of reducing the ‘nutritional’ component of the weaning stress in calves through the familiarisation to a palatable feed, and, internationally, has been reported to decrease morbidity in feedlots. Research at Teagasc Grange has found that suckler calves supplemented with concentrate prior to weaning had a lower immune cells reduction, started consuming meal faster when housed indoors and spent more time lying down (rather than standing and walking) post-weaning compared with non-supplemented calves.

Effect of concrete slats versus rubber-covered slats on the performance and welfare of finishing and weanling cattle

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Summary

- Compared to concrete slats (CS), animal growth and feed efficiency was significantly improved in finishing steers accommodated on slats overlaid with rubber mats (RM).
- Finishing steers on RM lay down for longer and had more frequent getting up and lying down movements.
- No hoof lesions were found on either floor type.
- Steers accommodated on RM were dirtier than those on CS by the end of the finishing period.
- Intake, growth performance, hoof health and cleanliness of weanling cattle accommodated on CS and RM was similar.

Introduction

Measuring the responses of animals to different floor types, in terms of intake, growth performance, hoof score, dirt scores, behaviour, and physiological variables provides an insight into their welfare during indoor housing. Two of the most important metrics in the evaluation of animal 'comfort' in relation to floor type 'environment' are duration of standing and lying behaviour, and the number of getting-up and lying-down movements.

Two experiments were conducted at Teagasc, Grange to investigate the effect of concrete slats (CS) and concrete slats overlaid with rubber mats (RM) on; i) growth performance, behaviour, hoof wear, dirt scores, physiological response and carcass traits of 'finishing' beef steers, and ii) growth performance, hoof health and dirt scores of spring-born suckler-bred weanling cattle undergoing a 'backgrounding/store' period (i.e. first winter indoor feeding period).

Experiment 1 – 'Finishing' cattle

One hundred and forty, Charolais and Limousin crossbred steers, with a mean initial live weight of 597 kg were allocated to one of two treatments for 120 days; (i) CS (17 pens of four animals) or (ii) RM (18 pens of four animals) at a space allowance of 2.89 m2 per animal. Durapak mats (Durapak Agri Ltd. Ballincollig, Co. Cork, Ireland), 22 mm thick (compressibility of 0.839 mm, mean wet friction of 0.59 μ, mean dry friction of 0.71 μ) were fitted to the respective pens including the concrete apron at the feed face by a commercial technician. Mats were slotted and overlaid on the concrete slats to allow drainage through the void spaces (Figure 1). The drainage area/void space of CS and RM pens was 12.1 % and 5.2 %, respectively. Adjacent pens were separated by a metal 'gate-like' structure that allowed visual and limited physical contact between animals.

Figure 1. Photograph showing (**A**) concrete slatted floor pen (CS), and (**B**) the concrete slats overlaid with rubber mats (RM)

Steers were offered a total mixed ration (TMR) based on high dry matter digestibility (DMD ~74%) grass silage and a rolled barley-based concentrate (60:40 DM basis), ad libitum. Animal daily feed dry matter intake (pen basis), live weight (14-day intervals), feed conversion ratio, carcass weight and hide weight was determined. Animal behaviour was recorded continuously in each pen for 24 hour throughout the study using high definition infra-red cameras connected to a network video recorder. Additionally, hoof health (presence of hoof lesions, and toe angle and length) was measured at the start and end of the experiment, animal cleanliness (16-body dirt scoring system) was determined every 28 days, and animals were blood sampled to measure blood metabolic and haematological variables.

Total dry matter intake did not differ between the two floor types at any stage (Table 2). However, finishing steers accommodated on RM had a 0.17 kg greater average daily live weight gain, resulting in a 17% superior feed conversion ratio compared to those on CS. Carcass weight was 11 kg heavier for steers accommodated on RM compared to CS. There was no difference in kill-out proportion, carcass conformation score or carcass fat score between the floor types.

Steers on RM lay down for longer, had more frequent getting up and lying down movements and lying and standing bouts. There was no effect of floor type on eating behaviour or drinking behaviour. In terms of dirt scores, there was no difference between treatments from day 0 to day 56 but from day 56 until 'finished' steers housed on RM were dirtier than those on CS. Overall, there was no difference in toe length or toe net growth between treatments; however, the steers housed on RM had an increase in sharpness in the toe angle of the right front medial claw and left hind lateral claw. No hoof lesions were reported on either floor type. There was no effect of floor type on blood metabolic or haematological variables.

Table 1. Total dry matter intake, live weight gain, food conversion ratio (kg dry matter intake/ kg live weight gain) and carcass traits of finishing steers housed on concrete slats (CS) or concrete slats overlaid with rubber mats (RM) (Experiment 1)

	Floor type		
	CS	RM	Significance[1]
Total dry matter intake (kg/day)	12.10	12.25	NS
Live weight gain (kg/day)	0.98	1.15	***
Feed conversion ratio (kg DM/ kg ADG)	12.40	10.60	***
Carcass weight (kg)	403	414	***
Kill-out (%)	56.3	56.4	NS
Carcass conformation score (1-15)	8.9	9.2	NS
Carcass fat score (1-15)	8.7	8.5	NS
Hide weight (kg)	51.9	54.0	*

[1]*NS = not statistically significant; * P < 0.05; *** P < 0.001*

Experiment 2 – 'Weanling' cattle

A total of 200 weanling heifers and steers with a mean initial live-weight of 315 kg and age of 262 days were allocated to one of two treatments for 84 days; (i) CS (20 pens with 5 animals/pen) or (ii) RM (20 pens with 5 animals/pen) at a space allowance of 2.5 m^2 per animal. The animal accommodation, dimensions of the experimental pen and rubber mats used in this experiment were the same as described above for Experiment 1.

The weanlings were offered a diet consisting of high dry matter digestibility (DMD ~75%) grass silage only *ad libitum* supplemented with a general-purpose mineral-vitamin supplement daily, or the same grass silage *ad libitum* supplemented with 2.0 kg/head daily of a rolled barley-based concentrate. Animal daily feed intake (pen basis), live weight (weekly), hoof health (lesions) and animal cleanliness (16-body dirt scoring system) were determined as described in Experiment 1.

Overall, housing weanling cattle on CS or RM had no effect on dry matter intake, daily live weight gain or final live-weight (Table 2). Furthermore, there was no effect of floor type on dirt scores or on hoof health).

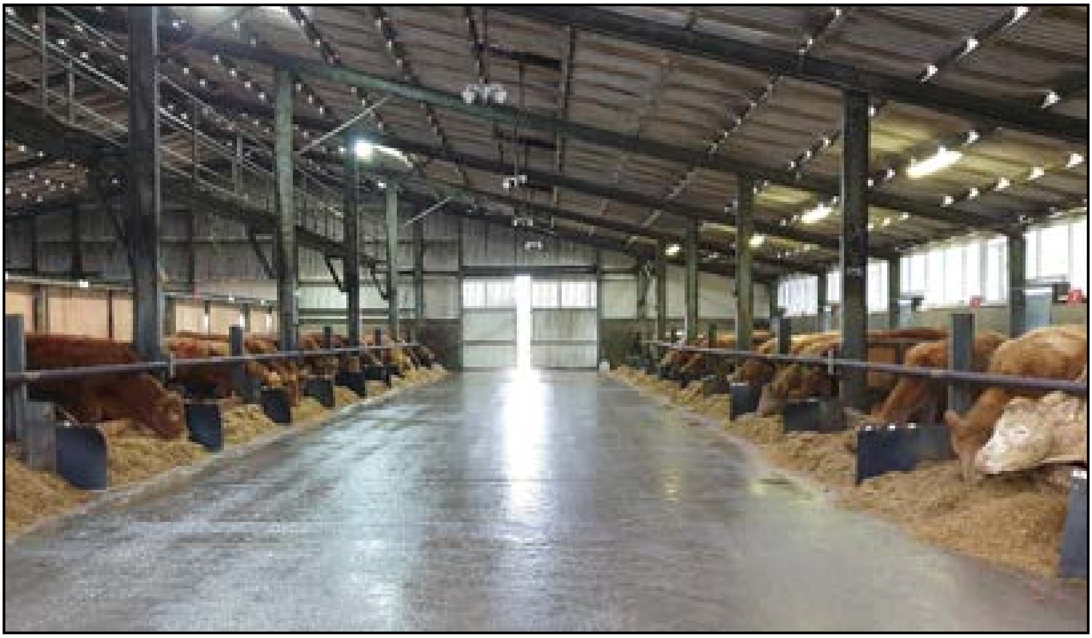
Table 2. Total dry matter intake, live weight and live weight gain of suckler-bred weanlings housed on concrete slats (CS) or concrete slats overlaid with rubber mats (RM) (Experiment 2).

	Floor type		
	CS	RM	Significance[1]
Total dry matter intake (kg/day)	5.65	5.67	NS
Initial live weight (kg)	316	315	NS
Final live weight (kg)	362	361	NS
Live weight gain (kg/day)	0.55	0.53	NS

[1]*NS = not statistically significant;*

Conclusion

Compared to CS, growth performance and feed efficiency of finishing steers was significantly improved as a result of housing on RM. The production benefits were complemented by enhanced animal behaviour traits indicative of greater resting and underfoot comfort of steers accommodated on the RM floor type and the absence of any negative impacts on hoof wear, haematological and metabolic variables. The growth performance benefit associated with the RM floor type found with finishing steers was not evident in the lighter weanling animal undergoing a 'store' period. Floor type had no effect on hoof health or cleanliness of weanlings.



Indoor nutritional management for growing-finishing cattle

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Summary

- Improvements in the feed efficiency of beef cattle production can have a large influence on farm profitability and environmental performance.
- Dry matter digestibility (DMD) is the primary factor influencing forage nutritive value, and consequently performance of forage-fed cattle.
- Increasing the level of concentrates in the diet reduces forage intake, and increases live and carcass weight gains, although at a diminishing rate.
- The advantage of concentrate supplementation of young cattle indoors is diminished by subsequent compensatory growth at pasture.
- High-DMD grass silage with moderate concentrate supplementation can sustain a large proportion of cattle performance achieved on high-concentrate diets.
- Intake of grass silage and growth performance of finishing cattle was similar when offered supplementary concentrates based on *maize meal*, *rolled wheat* or *rolled oats* compared to *rolled barley*.
- The feeding value of *flaked beans* and *peas* were equivalent to each other and to *maize dried distillers grains* or *corn gluten feed* when included in a cereal-based ration offered as a supplement to grass silage. In a second experiment, the feeding value of *beans* was superior to peas.
- The relative nutritive value of by-product feedstuffs depends on their inclusion level in the concentrate and the amount of concentrates fed.

Introduction

Feed provision accounts for approximately 75% of total costs of beef production; therefore, small improvements in feed efficiency can have a relatively large influence on farm profitability. Additionally, feed efficient cattle excrete fewer nutrients, and produce less gaseous emissions, to the environment. Of the predominant feedstuffs available, grazed pasture is cheapest, purchased concentrate is the most expensive and grass silage and other conserved forages are intermediate (page 34). Because of the comparatively lower cost of efficiently produced grazed grass, pasture-based beef production systems have evolved to optimise the contribution of high-nutritive value grazed herbage to lifetime intake of feed, and to providing grass silage and concentrate as efficiently and at as low a cost as feasible. However, seasonality of grass growth and inclement grazing conditions means that an indoor 'winter' period is required on practically all Irish farms. Feeding concentrates is a key component of beef production systems, especially during the indoor winter and the finishing period. The main feed costs on beef farms relate to this period.

Feeding concentrates: key principles

- Energy is the most important nutrient required by growing-finishing cattle. Comparisons of feedstuffs should always be based on their net energy (and protein) concentrations on a DM basis. It is important to ensure that an adequate level of an appropriate mineral/vitamin mix is included in the ration.
- Dry matter digestibility (DMD) is the primary factor influencing the nutritive value of forage. Consequently, the performance of beef cattle increases with increasing grass silage DMD and the impact of DMD increases as the proportion of silage in the diet increases. For example, in finishing cattle, a one-unit increase in silage DMD was associated with an increase in carcass gain of 21–29 g/d when supplemented with concentrates at 0.20–0.40 of dietary DM intake, but when no concentrates were offered and silage intake was higher the response was greater (33 g/d).
- Low DMD forages require higher levels of concentrates to achieve the same growth rate (Table 1). For example, each one-unit decline in DMD of grass silage requires an additional 0.3 to 0.4 kg concentrate daily to sustain performance in finishing cattle. Consequently, providing high-DMD silage for growing/finishing cattle is important.
- When feeding concentrates *ad libitum,* particularly cereals, there is a risk of acidosis. Therefore, ensure; (i) gradual adaptation to concentrates (over ~3 weeks), (ii) minimum roughage inclusion (~10% of total DM intake) for rumen function, (iii) meal supply never runs out and, (iv) a constant supply of fresh water is provided.
- Growth response to concentrate feeding is higher in 'high-growth potential' animals.
- Efficiency of feed utilisation by finishing cattle primarily depends on the live weight of the animal (decreases as live weight increases), potential for carcass growth (e.g. breed type, gender, compensatory growth potential) and duration of the finishing period (decreases as length increases). For example, in terms of breed type, research at Teagasc Grange found that, at the same age, Holstein-Friesian steers offered a high-concentrate diet, were lighter, grew more slowly and consumed 10% more feed DM resulting in a 20% inferior feed efficiency compared to suckler-bred Charolais steers. Similarly, bulls are 10 to 20% more feed efficient than comparable steers and heifers.
- The optimum level of concentrate supplementation primarily depends on animal production response (kg gain/kg concentrate), forage substitution rate and the relative prices of animal product at sale and feedstuffs.
- Subsequent *compensatory growth* ("catch-up") at pasture diminishes the advantage of excessive concentrate supplementation of young "weanling" cattle offered grass silage. Research at Teagasc Grange has shown that live weight gains of 0.5 to 0.6 kg/day through the 'first' winter are acceptable for steers, heifers and suckler bulls destined to return to pasture in spring. This feeding regime also applies to older 'store' cattle in their second winter destined for subsequent finishing at pasture. However, higher level of feeding is generally warranted during the first winter for replacement beef heifers, who have heavier threshold weight targets to achieve earlier in life. Conversely, cattle growing too slowly during winter (<0.5 kg/day) will not be able to compensate sufficiently at pasture, and consequently, will not reach target weights later in life.
- Target animal growth rates during the first winter and during finishing can be achieved on grass silage supplemented with concentrates as outlined in Table 1.

Table 1. Concentrate supplementation (kg/day) necessary for weanlings to grow at ~0.5 kg and for finishing steers (600 kg) to grow at ~1.0 kg live weight/day, when offered grass silage of varying dry matter digestibility (DMD) to appetite

Grass silage DMD (%)	~60	~65	~70	~75
Weanlings	2.0-3.0	1.5-2.0	1.0-1.5	0-1.0
Finishing steers	-	7.0-8.0	5.5-6.5	4.0-5.0

- Increasing the level of concentrates in the diet reduces grass silage intake but increases live and carcass weight gains, although at a diminishing rate (i.e. curvilinear response) especially when high-DMD silages are offered (Figure 1).
- *Substitution rate* of concentrates for grass silage (i.e. kg reduction in forage DM intake per kg concentrate DM intake) is a function of silage digestibility, and concentrate feed level – it increases with an increase in both.
- Animal production response to concentrate supplementation is higher with forages of lower DMD.
- Increasing the level of concentrate supplementation reduces the importance of forage nutritive value, especially when feeding concentrates *ad libitum*.
- Where silage DMD is poor (e.g. 60%) or in short supply, and animal growth potential is high, feeding concentrates *ad libitum* should be considered.

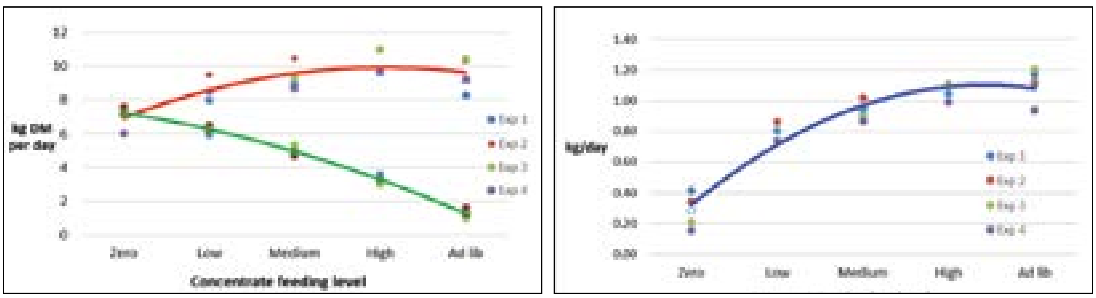

Figure 1. Effect of concentrate feeding level on silage (**green** line) and total (**red** line) dry matter intake, and daily live weight gain (**blue** line), of finishing cattle offered high-DMD grass silage *ad libitum*.

- Research at Teagasc Grange has shown that equivalent animal intake and performance is obtained from concentrate rations containing contrasting energy sources (e.g. rapidly-fermentable starch vs. slowly-fermentable starch vs. 'digestible' fibre-based), offered as a supplement to grass silage or *ad libitum* with silage, provided that they are formulated to the same net energy (and protein) concentration.
- Teagasc Grange research has shown that weanling and finishing steers and heifers generally do not require protein supplementation when fed barley-based concentrates and high DMD grass silage, but for suckler bull weanlings, a significant, but small, response to protein supplementation occurred. However, weanling and finishing cattle are likely to respond to supplementary protein in barley-based concentrates when grass silage has moderate to low DMD and/or low protein content.

Concentrate feed ingredients

The primary role of concentrates is to redress the deficit in nutrient supply from forages to allow cattle reach performance targets. In particular, beef cattle rarely consume sufficient grass silage to achieve their production potential and as a result, energy-rich concentrates are routinely supplemented in practice. Cereals, which make up a substantial proportion of beef ration formulations, are usually supplemented with higher protein-rich feed ingredients to satisfy assumed animal protein requirements. Ireland has a significant deficit in concentrate feed ingredients and most of the feedstuffs used nationally, especially protein sources, are imported. In order to increase self-sufficiency nationally, there is growing interest in increasing the proportion of 'home-grown' feeds, both 'native' grains and proteins in livestock rations used in Ireland. At Teagasc Grange, the 'standard' concentrate offered in most beef production system studies contains 862 g *rolled barley*, 60 g *soya bean meal*, 50 g *molasses*, 28 g minerals and vitamins per kg fresh weight fresh weight, prepared as a coarse mixture.

'Native' grains and proteins

Research at Teagasc Grange has shown that intake and growth performance of finishing steers offered grass silage *ad libitum* was similar when offered supplementary concentrates at ~0.40 to 0.50 of dietary dry matter (DM) intake based on *maize meal* (one experiment), *rolled wheat* (four experiments) and *rolled oats* (two experiments), compared to *rolled barley*. Similarly, the feeding value of *flaked beans* or *flaked peas* were equivalent to each other, and to maize dried distillers grains or corn gluten feed when included in a cereal-based ration offered as a supplement to grass silage. In a second experiment, the feeding value of *flaked beans* was superior to *peas*.

By-product feeds

By-product feeds, also known as co-products, are secondary products mainly from the food processing and the biofuel/ethanol industries. A potential limitation of feeding by-products to cattle is that significant variation can exist in their chemical composition and nutrient content, and this can change over time as the primary manufacturing processes, from which they are derived, evolve. Periodic re-evaluation of the nutritive value of by-products is therefore required for accurate formulation of feedstuffs for beef cattle.

Research at Teagasc Grange, has shown that by-product feed ingredients including *molassed sugar-beet pulp, citrus pulp, soya bean hulls, palm kernel expeller meal, corn gluten feed, maize-dried distillers grains* and *wheat-dried distillers grains* can fully or partially replace *rolled barley* (and *soya bean meal*) in concentrate rations as a supplement to grass silage without negatively impacting animal performance, depending on particular feeding circumstances.

Interactions or 'associative effects' between grass silage and concentrate feed ingredients have consequences for feed utilisation, and thus, the nutritive value assigned to feed ingredients. This means that the relative feeding (and economic) value of by-product feed ingredients is influenced by feeding practices, such as inclusion level in the concentrate ration and the amount of concentrates fed. For example, *soya bean hulls* were shown to have an equivalent feeding value to *rolled barley* when 2 kg/day of concentrate supplement containing 933 g soya hulls/kg was offered to weanling cattle. In contrast, when higher levels of concentrate (4 kg/day or *ad libitum*) were offered to growing-finishing cattle, soya hulls inclusion at >200 g/kg concentrate resulted in inferior animal performance. Of note is that by-products have relatively little value as a foodstuff for humans but are suitable as a feed for cattle due to the ability of cattle to digest fibrous, plant cell-wall material. Research at Teagasc Grange has shown that replacing cereals (and especially soyabean meal) in beef concentrate rations with by-products substantially improves the human edible protein ratio of grass-based beef production systems, which is extremely favourable from a 'feed-food competition' perspective.

Newford suckler demonstration farm update

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Summary

- The Newford farm was set up in 2015 by Teagasc and Dawn Meats Group to demonstrate best-practice in profitable and sustainable grass-based suckler beef production.
- The herd was relocated from Athenry, Co. Galway to Athleague, Co. Roscommon in 2023.
- The 90-cow herd (Angus and Hereford dairy crossbreds) are mated by artificial insemination (AI) to high Terminal Index sires.
- Calving occurs over 10-weeks, commencing 1 February.
- Steers are finished at 21.5 months, and heifers at 19.3 months of age.
- All variable, fixed and capital costs have to be funded by the farm, except for land rental and the farm manager's salary; the farm has a BISS payment.
- Farm practices are designed to optimise labour efficiency.
- Despite excellent animal performance and technical efficiency, net profit to-date is relatively modest. The highest gross margin to date was achieved in 2023 at €1,171 per hectare.
- Newford Farm is part of the 'Signpost' and 'Future Beef' programmes.

Introduction

In 2015, Teagasc and Dawn Meats established a stand-alone suckler herd at Athenry, Co. Galway with support from the Irish Farmers Journal and McDonalds, to demonstrate best-practice in sustainable suckler beef production. The objective for the Newford farm is to demonstrate the potential of a large, well-run suckler calf-to-beef (steer and heifer) farm to generate a viable family farm income. In May 2023, the IDA announced they had secured a new tenant for the site of the farm in Athenry and, while Teagasc welcomed this significant investment for the West of Ireland, it meant that the Newford suckler herd had to vacate its existing location. Teagasc and Dawn Meats consulted with its stakeholders and there was a strong view that the Newford suckler demonstration farm had a significant positive impact on delivering key messages to suckler beef farmers. All of the key stakeholders agreed that Newford farm should continue on a new site, thus ensuring that progress achieved to date can be built upon. Consequently, an alternative farm was identified near Athleague, Co. Roscommon, and leased for 7 years.

The present-day Newford farm is laid out in two separate divisions. The main block of farmland, comprising of 58 hectares (ha), is dry (loamy limestone soil), good-quality grassland with its highest point 156 meters above sea level, and is used for grazing the suckler cows and calves. Included also is 5 ha of 'biodiversity' on this block of land. The main farm has extensive winter accommodation for cattle but also requires a lot of capital expenditure in terms of grassland reseeding, fencing, water troughs and calving facilities etc. The outside block of land, Neilan's farm, comprises of 22 ha (including a 3.5 ha turlough) located 10 km away and has a 'medium/heavy' soil type. This out-farm also has cattle accommodation and handling facilities, but will require reseeding, too.

Suckler cow type, breeding and productivity

The cow breed types at Newford are Aberdeen Angus × Friesian and Hereford × Friesian with an average live weight of 660 kg. They have good maternal traits, especially milk production, resulting in high pre-weaning live weight gain of the calves. The average Replacement Index of the suckler cows and the 2024 replacement heifers is €136 and €156, respectively. Heifer replacements for the herd are purchased as calves (~one month old) by selecting progeny of proven high-Replacement Index AI sires within Hereford, Angus and Aubrac breeds. Spring 2024 is the first year that Newford has purchased Aubrac × dairy calves as breeding heifer replacements. Replacements are chosen on their genetic ability to first-calve at 24 months of age and produce offspring that 'finish' at a young age.

The criteria used for selecting high-Terminal Index AI sires within Charolais, Limousin and Aubrac breeds for use on the cow herd, are as follows:

- 5-Star Terminal Index (within & across breed)
- < 5.1 % calving difficulty for all adult and young cows
- 68 % reliability for calving difficulty for all cows
- 1.95 units (1-15) carcass conformation score
- 35 kg predicted carcase weight mature cows
- 25 kg predicted carcase weight young cows
- < 6.1 % calving difficulty for beef first-calvers
- Cost of AI straw = less than €20

Only AI is carried out on the farm and this has been proven very successful. During the breeding season, insemination takes place each day at midday. This means that if a cow is inseminated at 12 noon and is still displaying standing heat that evening she is inseminated again the next day. The reproductive and maternal performance of the herd to-date is shown in Table 1. The breeding season is kept short to ensure compact calving, which is closely aligned with the grazing season, and that the calving season is finished before breeding starts. This is very important for labour and management efficiency.

Newford calving performance 2024

Calving performance has been positive with few problems and much of this success can be attributed to sire selection and cow management. The first and last calf born was 29 January and 15 April, respectively. After six weeks, 86% of the herd had calved with 100% of the herd calved by 11 weeks. This compares with a 10-week duration in the previous year, and is attributed to the adverse weather at the start of the 2023 breeding season. Out of the 91 cows scanned in-calf, one cow aborted and one cow suffered embryo-loss. Of the 89 cows that calved there are 85 live calves. The average weight of all calves born in 2024 was 45 kg (46 kg, bulls; 43 kg, heifers).

Table 1. Newford cow numbers and performance from 2017 to 2023

	2017	2018	2019	2020	2021	2022	2023
Cows (number)	107	110	110	100	94	93	89
Calving interval (days)	349	362	366	360	366	359	364
Breeding season (weeks)	10	10	10	10	10	10	10
Weaning weight (kg)	301	315	289	314	316	328	315
Calf live weight gain from birth to weaning (kg/day)	1.26	1.21	1.24	1.35	1.35	1.35	1.28
Weaning date	21 Sept	4 Oct	17 Sept	12 Sept	17 Sept	16 Sept	14 Sept
Calf mortality 28 days (%)	0.9	4.5	5.3	5	4.3	5.3	4.4
Non-pregnant mature cows (%)	6	9	13	10	6	9	8

Progeny performance post-weaning

All progeny from the Newford herd are finished on-farm between 18 and 21.5 months of age (Table 2). In terms of carcass conformation score, the beef × dairy cows are primarily O-grade cows but when mated to high-genetic merit terminal sires they produce U and R grade progeny. Carcass weight has been increasing gradually over the last number of years due to a combination of increasing cow age, selection of better sires with regard to beef traits and extending the grazing season. The target for the farm is to finish as many of the progeny as possible before the second winter.

Table 2. Carcass traits of steer and heifer progeny between 2017 and 2023

	2017	2018	2019	2020	2021	2022	2023
Steers							
Conformation score	R -	R =	R +	R =	R =	R =	R =
Fat score	3 +	3 +	3 =	3 -	3 -	3 -	2 +
Finished weight (kg)	653	685	642	647	663	653	675
Carcass weight (kg)	341	367	350	350	357	358	365
Finishing age (mo)	21.0	21.3	21.4	20.3	21.1	20.5	21.5
Carcass value	€1,400	€1,434	€1,315	€1,389	€1,611	€1,776	€1,905
Price, €/kg carcass	€4.10	€3.90	€3.76	€3.96	€4.51	€4.96	€5.22
Heifers							
Conformation score	R =	Sold Live	R =	R =	R =	R -	R =
Fat score	4 -	-	3 =	3 =	3 -	3 =	3 +
Finished weight (kg)	560	-	569	570	583	564	588
Carcass weight (kg)	291	-	299	299	311	296	320
Finishing age (mo)	18.9	16.0	19.7	20.0	19.9	17.9	19.3
Carcass value	€1,167	€1,035	€1,117	€1,188	€1,396	€1,507	€1,602
Price, €/kg carcass	€4.01	€2.25	€3.74	€3.97	€4.49	€5.06	€5.01

**In 2018, land area was reduced at Newford farm due to a land compulsory purchase order*

The 2023 progeny were drafted for sale later than previous years. This was due to the extremely wet weather in 2023, which negatively impacted animal growth performance at grass, and consequences associated with the farm relocation from Athenry to Athleague. Similarly, in 2024, Newford is expecting cattle performance to be behind target, particularly as turnout date to pasture this spring was almost two months later than normal.

Financial performance

The financial performance data for Newford farm between 2017 and 2023 is presented in Table 3. The farms fixed costs are exceptionally high due to the interest repayments on the debt associated with the establishment of the farm, and the depreciation of the significant capital investment associated with the initial conversion from a sheep farm to a cattle farm. This substantial depreciation of capital investment will continue on the new farm in terms of reseeding, building alterations and fencing costs etc. Overall, the key focus is to increase the amount of grass grown and utilised, and to reduce the quantity of feed purchased as well as increasing individual animal output through genetic selection on both the sire and the dam side.

Table 3. Profit monitor data (€/ha unless stated) for Newford farm for 2017 to 2023

	2017	2018	2019	2020	2021	2022	2023
Gross output	2,005	2,476	1,657	1,936	2,124	2,284	2,790
Variable costs	1,332	1,853	1,584	1,115	1,439	1,691	1,654
Gross margin	674	624	73	820	685	593	1,136
Fixed costs	723	781	651	761	633	755	767
Net margin	-49	-158	-578	60	52	-162	369
Net margin + premia (BGDP + BEEP)	77	11	-378	298	276	59	621
Net margin (€/farm)	-3,145	-7,883	-36,725	4,068	3,517	-11,465	21,686
Net margin + premia (€/farm)	4,954	559	-23,975	20,278	18,771	4,175	36,502

Future farm plans

The main priorities for Newford farm are to;

- Incorporate more clover into the paddocks and therefore reduce the amount of inorganic chemical nitrogen fertiliser applied.
- Reduce age at finishing.
- Reduce environmental losses by using protected urea.
- Continue to maximise profitability.
- Planting of hedgerows to increase biodiversity on the farm.

The farm is planning to maintain cow numbers but to improve the 'quality' of the replacement heifers through increased emphasis on carcass weight and carcass conformation when selecting sires.

The farm aims to finish the beef heifers at a younger age and thus reduce the number of animals requiring an indoor finishing period in the second winter. This will be achieved through earlier turnout to grass in spring.

Newford farm is committed to using key technologies to achieve its goals regarding forage production, selecting 'finished' cattle, health and welfare of housed cattle and improving the sustainability of the herd by further reducing its carbon footprint.

Carbon footprint improvement is essential. Newford will be using the "Greenfeed" system for measuring animal methane production, and the "carbon flux tower" for measuring carbon sequestration on the farm.

Newford farm is open to all beef and students discussion groups during the year.

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TECHNOLOGY VILLAGE

Dairy-Beef Systems

Dairy-beef systems for profitable production

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Summary

- A range of dairy-beef systems exist to suit labour and facilities available on farms, and can complement on-farm and off-farm enterprises.
- Dairy-beef systems can achieve profits in excess of €1,000 net margin/hectare.
- High-beef merit (i.e. high Commercial Beef Value, CBV) animals are more profitable and have a lower environmental impact.
- The inclusion of clover or clover + herbs in grass swards can reduce inputs and improve animal performance.
- Production systems with younger finishing age support high carcass output, are profitable and have a lower carbon footprint.

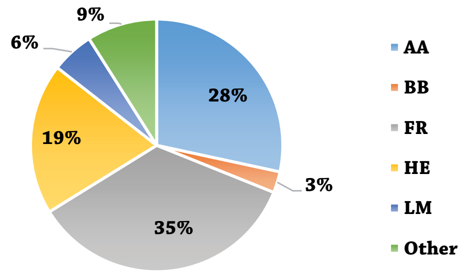
Introduction

Dairy-beef is often viewed as a by-product of the dairy industry; however, ongoing research and experience from commercial dairy-beef farms have reinforced the opportunity that exists to produce profitable and environmentally sustainable beef from a predominately grass-based diet. Due to the increase in the national dairy cow-herd, the number of dairy-beef animals has increased in recent years, accounting for over 58% of prime cattle processed in Irish meat plants in 2023. Annually, there are now approximately 1.1 million calves available from the dairy herd for beef production. Furthermore, as a result of reduced herd expansion and the increased uptake of sexed semen technology, the use of beef sires on dairy cows has increased substantially; in 2023, 48% of calf registrations from the dairy herd were to a beef sire, and this is expected to be higher in 2024.

Early-maturing beef breeds (Angus and Hereford) are responsible for the highest number of calf registrations, followed by Holstein-Friesian and late-maturing beef breeds (Belgian Blue, Limousin etc.), respectively (Figure 1). Contrasting animal breed types and genders allow for a range of dairy-beef production systems to be implemented on farms to produce beef throughout the year, utilising a predominantly forage-based diets. Nationally, there is a policy and market ambition to reduce finishing age and to lessen the environmental footprint of beef, while maintaining carcass specification and grass-based credentials. Research has found dairy-beef steers to have a high probability of meeting overall market specification (i.e. weight, conformation, fat and age); however, dairy-beef heifers, primarily due to light carcass weights and excessively fat carcasses, have the lowest probability of all prime cattle categories in meeting market specification.

Figure 1. Sire breed profile of calves registered from the dairy herd available for beef production

Source: Animal Identification and Movements (2022)



Since 2010, the finishing age of beef × dairy steers has reduced by over three months to ~27 months, yet overall carcass specification (weight, conformation and fat) has been maintained. Given the increased use of genetic selection tools and breeding technologies, there should be an increasing proportion of beef × dairy cattle capable of achieving carcass specification at younger finishing ages, thus facilitating current policy ambitions to reduce finishing age by up to three months across all beef cattle. Breeding technologies such as sexed semen will result in 'low-value' dairy × dairy male calves being replaced with higher carcass merit beef × dairy calves of increased profit potential.

The commercial beef value (CBV) is a genetic selection tool to help dairy-beef farmers identify the most profitable calves to purchase for their dairy-beef system, taking into account the sires' and dams' genetic merit for beef production efficiency (page 122). The CBV is a genetic value, expressed in euros, for non-breeding beef cattle, focused on identifying animals with superior carcass traits and feed efficiency. To be provided with a CBV value calves must have a sire and dam recorded, and for this value to appear on mart boards, animals must be genotyped to avoid parentage errors. This paper presents the benefits of using high-CBV animals to increase economic and environmental efficiency of dairy-beef production. Farmers should request this information when purchasing calves for their system.

Choosing a dairy-beef system for your farm

Choosing a dairy-beef system which suits you and your farm is based on a number of criteria, including land, labour, facilities and work-life balance. The financial return from your most limited resources should be used to evaluate your chosen system. Typically this is land, hence, net margin per hectare (ha) is commonly used. To optimise profit per ha, farmers generally have higher stocking rates and target younger finishing ages to support high beef output, through careful animal and grassland management. However, where systems are not restricted by facilities or land resources, and producers are more focused on a work-life balance, lower stocking densities and finishing cattle older, during a 'third' grazing season, can provide a good return on labour input.

1. Labour

How much time can you devote to the farm? Dairy-beef systems have a structured labour requirement in comparison to other livestock enterprises, making them complementary to other on-farm or off-farm enterprises. However, even within dairy-beef systems there are options to further improve labour efficiency such as, purchasing animals directly from a limited number of source-farms, using once-a-day or automated feeding systems, purchasing weanlings/stores rather than calves, and minimising the number of animal groups. Based on the experience from farm improvement programmes such as "Green Acres" and the "DairyBeef500 Campaign" (page 134), successful dairy-beef farmers are those that have good animal husbandry and grassland management/feed-budgeting skills.

2. Facilities

The availability of appropriate housing facilities for calves, weanlings and finishing cattle will determine the most suitable dairy-beef system for your farm. Certain dairy-beef systems require less housing facilities than others do. For example, heifers or early-maturing steers, which can be finished during or by the end of the 'second' grazing season, offer farmers the opportunity to be well-stocked without further investment in farm buildings. Investment in cattle-handling facilities will improve farm safety, labour efficiency and is necessary to monitor animal performance and for timely drafting of finished cattle.

3. Land/grazing infrastructure

On dairy-beef farms, the ability to support moderate-to-high stocking rates through high levels of grass growth and utilisation is a key driver of profit. The production potential of swards is dependent on land quality, soil fertility, drainage, sward type and level of grazing management/grass budgeting skill. Investment in paddock and roadway infrastructure will improve labour efficiency and facilitate grassland management. The incorporation of red and white clovers into silage and grazing swards is a key strategy to reduce fertiliser inputs and maintain/increase animal performance. Where systems can grow high quantities of grass and opt to carry moderate-to-high stocking rates, farmers must become proficient with grass measuring and budgeting, using technologies such as "PastureBase Ireland" (page 62), to help manage the supply and 'quality' of grass and foresee when deficits or surpluses occur.

Key performance periods and growth targets for dairy-beef cattle

When aiming to reduce finishing age in grass-based systems it is essential that animal growth is maximised throughout its life, but this must be done in a cost-effective manner during each stage of the animal's life. The management and minimum growth target for each performance period of a dairy-beef animal's life based on Teagasc research system studies is as follows:

1. Calf rearing

Calf rearing is the most expensive and labour-intensive period in dairy-beef systems. This is a critical time-period, as the nutritional and health status of calves during this phase can influence overall lifetime animal performance. To ensure a successful calf-rearing period, purchasing healthy calves is vital. Calves should be sourced from herds of a high health status with a good colostrum management programme (ensuring calves get sufficient quantities of high quality colostrum in the first few hours of life). Specialist dairy-beef producers are focused on minimising the number source herds to reduce possible disease challenges. Calves should be housed in a well-ventilated, draught free environment, with calves grouped by source, age and weight.

In Teagasc Grange, calves receive 2 L (litres) of electrolytes on arrival, and receive initial intranasal vaccinations 24 hours post-arrival to boost immunity against bovine respiratory disease (page 126). Typically, calves arrive on-farm at three weeks of age, weighing 50 to 55 kg. For the first week on the farm, calves receive 6 L/day (0.75 kg solids) and ad-libitum access to concentrates, roughage and water. From four weeks of age, milk volume is reduced to 4 L/day (0.5 kg solids). This milk-feeding regime is based on research showing similar animal performance levels and reduced rearing costs compared to feeding higher milk volumes. This reduced milk feeding encourages increased concentrate intake, aiding rumen development. Weaning takes place when calves reach a target weight of 85 kg and are consistently consuming over 1.0 kg/day of concentrate. During the rearing phase, calves should achieve growth rates of 0.6 to 0.7 kg/day.

2. First grazing season

After weaning, calves are turned out to pasture from May onwards. They continue to receive 1 kg concentrate/day and have access to roughage (straw) for the first 3 weeks of the grazing season to ease the transition onto a grass diet, after which supplementation ceases. Recent research at Teagasc Grange found no benefit from supplementing February-born calves with concentrates throughout their first grazing season, when grazing high quality pasture. Due to declining pasture quality in the autumn, concentrates are reintroduced from mid-September until housing to maintain energy intake of calves. Calves should be offered high-quality pasture throughout the grazing season, with a target pre-grazing herbage mass of 1200 kg dry matter (DM)/ha early in the grazing season and increasing to 1400-1600 kg DM/ha as calves become more accustomed to grazing. Typically, calves are offered silage aftermath as these swards have the longest 'rest' period and the lowest parasite burden. In dairy-beef system experiments at Teagasc Grange and Johnstown Castle, a post-grazing residual sward height of ~5 cm is targeted for calf and cattle grazing. During the grazing season it is advised to monitor parasite burden through faecal egg counts throughout the grazing season and follow a targeted parasite control plan, developed with a veterinary practitioner (page 130). The target average daily live weight gain (ADG) during the first grazing season for calves is 0.7 to 0.8 kg, resulting in a housing weight of approximately 200 kg for heifers and 230 kg for steers.

3. First-winter indoors

In order to avail of compensatory growth at pasture during the following grazing season, weanling cattle need to achieve a moderate growth rate over the first winter, 0.6 to 0.7 kg live weight/day. Where silage DM digestibility (DMD) is high (e.g. 75% DMD), this can be achieved with less than 1.0 kg concentrate/day, whereas when silage DMD is low (e.g. 65%), 1.5 to 2.0 kg/day of concentrate supplement is required.

4. Second grazing season

Typically, yearling heifers and steers are turned out to pasture in mid-March weighing approximately 280 kg and 310 kg, respectively. Over the second grazing season, an ADG of 0.9 kg is targeted from a grass-only diet. In order to achieve this, cattle need to be offered high-quality pasture in a rotational grazing system. A pre-grazing herbage mass of 1400 to 1600 kg DM/ha should be targeted during the mid-season, with excessively heavy grass 'covers' removed as surplus baled silage. Cattle should receive a new grass allocation every 2 to 3 days, and be grazed to a residual height of approximately 5 cm. The priority of grazing management during the summer months is to ensure that there is sufficient quantities of high-quality grass and to ensure animal DM intake is not restricted, which would limit growth performance. The incorporation of white clover into the grazing sward can improve sward nutritive value and increase animal performance, while maintaining sward production from lower nitrogen fertiliser inputs. Dairy-beef heifer and early-maturing steer systems may draft cattle off pasture if desired fat levels are achieved. However, heifers and steers destined for indoor finishing are typically housed by early-October, weighing approximately 480 kg and 500 kg, respectively, to reduce grass demand, allowing weanlings to avail of an extended grazing season into late-autumn.

5. Finishing

The selection of 'finished' cattle (drafting) is primarily dependent on their ability to meet market specifications for carcass fat score, which is between 2+ and 4=. Nationally, a relatively high percentage of animals are being finished at excessively high fat scores, which means additional days on feed, and associated economic and environmental costs. Across Teagasc dairy-beef herds, the majority of early-maturing heifers achieve the target fat scores from pasture during the second grazing season, avoiding the need for an indoor finishing period. For early-maturing steers and late-maturing heifers this level of fatness can be achieved after a 60 to 80 finishing period (indoors or at pasture), while Holstein-Friesian steers will require 100 to 120 days of indoor finishing. Finishing diets should consist of high quality pasture or grass silage (>75% DMD) ad-libitum, in addition to 5 kg of concentrate daily. As finishing periods increase in duration, the conversion of feed into carcass reduces, and ultimately a point is reached where feed costs exceed carcass gain benefits. It is essential that live weight gain and the level of fatness of finishing cattle are monitored regularly, allowing for timely drafting. Physically determining the body condition score (BCS) of each animal is essential, paying particular attention to the tailhead, rump, loin, ribs and the level of fat deposited between folds of skin. The 'fleshing' ability of animals will determine the frequency of drafting; this is generally completed every 10 days during the finishing period across research herds in Teagasc.

Economics of dairy-beef steer and heifer systems

Steer system performance

Nationally, dairy-beef steers are finished at ~27 months of age during a third grazing season; however, with the policy ambition for younger finishing age, the economic efficiency of systems with lower finishing ages is of great interest.

An experiment was carried out in Teagasc Grange to investigate the potential of the CBV in predicting increased animal performance, as well as grass-based feeding strategies aimed at reducing finishing age. All calves on the study were born to Holstein-Friesian (HF) dams, and sired by Angus or HF sires. The Angus calves were subsequently split into two genetic groups, selected for being either 4-star or 5-star (High-CBV) or 1-star, 2-star or 3-star (Low-CBV) for CBV. This resulted in three genetic groups including HF. Within each genetic group, half of the animals were assigned to conventional management, receiving a grass-only diet during the second grazing season and being finished indoors from concentrates and grass silage (Conventional), and the other half received 4 kg of concentrates/head daily from the 1 July during the second grazing season until finished at pasture (Supplemented). Finished steers were drafted based on meeting a BCS of 3.75 (5-point scale), deemed to be equivalent of a carcass fat score of 3+/4-.

Overall, both Angus groups achieved a higher lifetime ADG than the HF steers. Finishing age was similar between the Low-CBV and High-CBV groups, indicating a similar 'fleshing' ability; however, High-CBV steers produced 18 kg more carcass than Low-CBV steers (Table 1). Animals are deemed to have met market specifications (i.e. "in-spec"), once they achieve a conformation score ≥ O=, carcass weight between 280 kg and 380 kg, a fat score between 2+ and 4=, and an age at finish ≤ 30 months. In terms of overall market specifications, 73% of High-CBV steers, 53% of Low-CBV steers and 22% of HF steers met the requirements. Failure to meet overall carcass specification was primarily caused by low carcass weights for Low-CBV animals, and poor carcass conformation for HF steers.

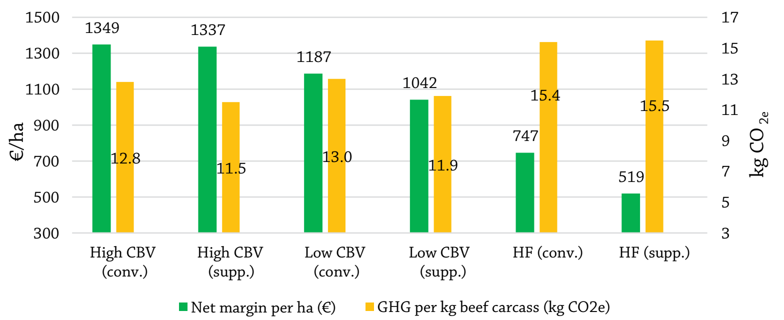
Table 1. Growth and carcass performance of 2020-born and 2021-born dairy-beef steers per feed management strategy and genetic group.

	Conventional			Supplemented		
	High-CBV	Low-CBV	HF	High-CBV	Low-CBV	HF
Finishing age (days)	641	652	717	603	601	711
Carcass weight (kg)	314	306	311	310	284	328
Carcass conformation score	O=/O+	O=	P+/O-	O+	O=	O-
Carcass fat score	3+/4-	3+	3+	4-	3+	3+/4-
Finishing period (days)	51	62	127	101	99	162
Finishing supplement (kg)	248	306	628	403	403	933
Lifetime ADG (kg)	0.91	0.88	0.82	0.92	0.86	0.85

Major improvements in beef production efficiency can be achieved from the use of high-beef merit genetics compared to HF. Although carcass weight was similar to HF, High-CBV animals were finished ~3 months earlier, requiring only half the number of finishing days indoors, which represents a major saving in feed costs.

Concentrate supplementation during the second half of the grazing season reduced finishing age of Angus steers by 1.5 months, which meant that an expensive indoor finishing period was avoided compared to their non-supplemented counterparts. In contrast, HF steers supplemented at pasture did not meet the desired fat level and required an additional 120 days of finishing indoors.

High-CBV steers generate more profit, and produce beef of a lower carbon footprint compared to Low-CBV and HF steers, regardless of management system (Figure 2). The CBV, along with the national genotyping programme offers farmers an opportunity to make informed decisions at market, allowing them to purchase the most efficient and profitable animal for their system.



*Base price of €4.85/kg. Finishing concentrate price €375/t. Protected urea price €550/t. *Net margin excludes land & labour charge and assumes a calf purchase price of €200 and €60 per head for early maturing (Angus) and HF bull calves.*

Figure 2. Profit and carbon efficiency of dairy-beef steer systems of contrasting beef merit (High-CBV, Low-CBV and HF) and feeding strategy (Conventional vs. Supplemented)

Heifer system performance

Despite the lower carcass weight of heifers compared to steers, grass-based dairy-beef heifer systems have the potential for very high carcass output/ha, due to increased numbers of animals finished at younger ages from pasture, which eliminates or reduces the need for an indoor finishing period. Carcass output, the level of inputs required and profitability can be optimised by grazing highly productive and high nutritive value pastures.

Clover and herb-rich swards have many benefits including increased sward nutritive value, animal performance, herbage DM production and biological nitrogen fixation. With chemical fertiliser nitrogen representing one of the most expensive inputs in a grass-based system, reducing reliance on this is vital to improve the viability of dairy calf-to-beef systems. Grass-clover and multispecies swards (MSS) can produce similar DM yields to a perennial ryegrass-only (PRG) sward, despite receiving reduced chemical nitrogen fertiliser. This means that nitrogen fertiliser input requirements are reduced representing a significant cost saving, and furthermore improving profitability for farmers. Recent research at Teagasc Johnstown Castle has shown that overall lifetime growth performance of early-maturing breed dairy-beef heifers consuming PRG plus red and white clover swards (CLOVER) and MSS (grass + clover + herbs (chicory and plantain)) was similar, but greater than PRG swards (Table 2). This resulted in a greater number of heifers being finished at pasture for the CLOVER and MSS treatments compared to the PRG treatment (86 vs. 75 vs. 68%, respectively). The indoor-finishing concentrate requirement was therefore, lower for the CLOVER (25 kg) and MSS (34 kg) treatments compared to PRG (62 kg). This represents a significant saving in costs associated with feed and housing, consequently increasing profitability. Results for the 2021-born and 2022-born calves showed that daily live weight gain over the first grazing season was greatest for MSS, whereas daily live weight gain as yearlings during the second grazing season was greatest for CLOVER (Table 2).

Table 2. Effect of pasture type - perennial ryegrass-only swards (PRG), PRG plus red and white clover swards (CLOVER) and multispecies swards (MSS) - on daily live weight gain (kg) of 2021-born and 2022-born dairy-beef heifers.

	PRG	CLOVER	MSS
First grazing season	0.61	0.62	0.79
First winter	0.65	0.65	0.68
Second grazing season	0.81	0.92	0.87
Lifetime	0.74	0.78	0.79

When dairy calf-to-beef heifers were drafted at a target fat score of 3=, CLOVER animals achieved the greatest net margin compared to the other two sward types (Table 3). This was due to a greater carcass weight, a lower chemical nitrogen application rate, and a greater proportion of these animals being finished at pasture during the second grazing season, which reduced overall costs. Incorporating clover or clover+herbs, meant that half the rate of chemical nitrogen fertiliser was applied and the same herbage production was achieved, resulting is significant cost savings. Despite having a light carcass weight, dairy-beef heifer systems have opportunity for high carcass output and are profitable, and this can be further improved by including clover or clover+herbs into pastures. The inclusion of clover or clover+herbs can generate an additional €100 to €150 net margin/ha, through improved animal performance and lower input costs, offering farmers an opportunity to improve efficiency, while also striving to meet sectorial climate targets.

Table 3. The effect of pasture type - perennial ryegrass-only swards (PRG), PRG plus red and white clover swards (CLOVER) and multispecies swards (MSS) - on animal, financial and environmental performance of dairy-beef heifers finished in 2022 and 2023.

	PRG	CLOVER	MSS
Carcass			
% drafted from pasture	68	86	75
Age (months)	19.6	19.2	19.2
Finished weight (kg)	482	492	490
Carcass weight (kg)	243	250	249
Carcass conformation score	O=	O=	O=
Carcass fat score	3=	3=/3+	3=/3+
System			
Stocking rate (LU/ha)	2.65	2.37	2.48
Animals finished on 40 ha	139	127	131
Organic N (kg/ha)	220	191	201
Lifetime concentrate (kg DM/head)	400	370	380
Carcass output (kg/ha)	849	791	813
Farm level financial performance (40 ha farm) (€,000)			
Gross output	141	133	135
Variable cost	72	61	64
Gross margin	69	71	71
Fixed costs	31	28	29
Net margin	38	44	42
Net margin (€/ha)	950	1097	1050
Net margin (€/head)	273	347	320
Environmental			
GHG emissions (kg CO 2e /kg carcass)	12.37	12.88	12.91

*Base price of €4.56/kg on the QPS grid; €0.20/kg QA payment and €0.20/kg breed bonus. Finishing concentrate price €400/t. Protected urea price €550/t. ***Net margin excludes land & labour charge** and assumes a calf purchase price of €150 per head for early-maturing breed heifer calves.*

Conclusion

Dairy-beef production offers opportunity for profitable farm systems, which make effective use of labour and facilities available, but these systems must be based on the efficient use of grazed grass. The use of high-beef merit sires gives greater flexibility in relation to the type of finishing system implemented and will increase farm profit and lower environmental impact, by supporting the production of ‘in-spec’ carcasses at younger ages. There is an onus on the dairy industry to produce calves with higher beef production efficiency and for dairy-beef farmers to seek information and procure calves based on CBV to encourage the continued breeding of profitable beef calves from the dairy herd. Improvements in the quality and profit potential of the beef calf crop from the dairy herd begins with reducing the number of dairy × dairy male calves in exchange for high-beef merit beef × dairy animals. The benefits of this will be rapid and widespread provided the current increased use of high-merit AI beef sires on the dairy herd continues.

The Commercial Beef Value (CBV): Potential catalyst for change

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Summary

- The Commercial Beef Value (CBV) is a purchasing selection index for 'non-breeding' cattle, which provides information on the predicted profitability of traits important to the beef farmer.
- The Dairy Beef Index (DBI) is a breeding index that dairy farmers can use to identify beef bulls to use on their dairy cows to achieve favourable calving, beef and carbon characteristics.
- Enhancing the beef carcass merit of dairy-beef cattle is imperative.
- Beef farmers now have more genetic-related information to facilitate improved purchasing of dairy-bred cattle.

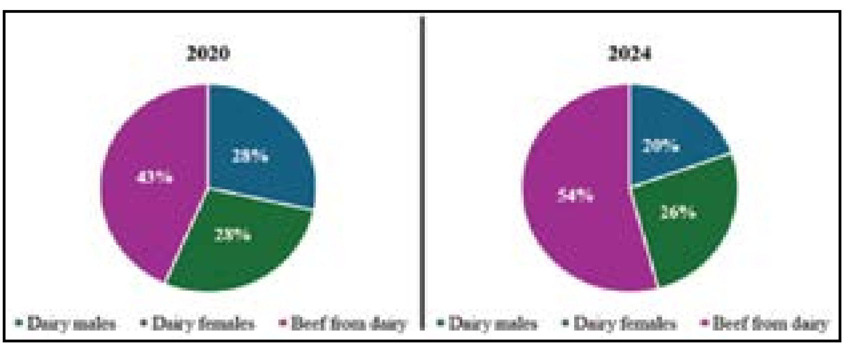
Introduction

In recent years, there has been a notable increase in dairy-beef cattle in Ireland. Historically, beef farmers lacked important information regarding the 'genetic quality' of dairy-bred cattle. However, the introduction of the Commercial Beef Value (CBV) has addressed this gap. It provides beef farmers with crucial insights for informed purchasing decisions, regardless of animal age. This decision support tool has the potential to instigate tangible transformations within the industry, if beef farmers leverage this information in their procurement of cattle and if breeders of such animals respond to industry demands.

Trends in the dairy-beef industry

Between 2017 and 2022, calves born to a beef sire have accounted for approximately 40% of births within the dairy herd; however, this pattern has shifted noticeably in the past two years such that in 2024, more than half of calves born in the dairy herd were from a beef sire. Indeed, dairy farmers are using more beef sires earlier in the breeding season. The increased proportion of dairy-beef calves has displaced dairy male calves (Figure 1).

Figure 1. Proportion of dairy × dairy male, dairy female and beef × dairy calves for spring-calving cows (up to 20 April) in 2020 and 2024.



The displacement of dairy males is largely due to the adoption of sexed semen technology, resulting in fewer male dairy calves as well as the reduced demand for dairy females within the dairy herd as the number of dairy cows stabilizes. It is expected that the dairy male segment will continue to decline, aligning with trends observed in other countries globally, with the reduction anticipated to lead to an increase in beef × dairy calves. With an increasing number of dairy-beef calves on the market, beef rearers now have a broader array of choices than ever before. The question then arises: are the calves being produced improving in quality while also becoming more cost-effective to rear?

What is the CBV?

The CBV, or Commercial Beef Value, is a tool for gauging the quality and anticipated profitability of non-breeding animals. The CBV offers farmers valuable insights into the genetic worth of their animals, encompassing traits important only for non-breeding (drystock) enterprises, such as carcass weight, conformation, and feed intake (Figure 2). Similar to the EBI and Euro-Star Indexes, CBV is denoted as a €uro value. A higher euro value signifies superior genetic merit across the included traits.

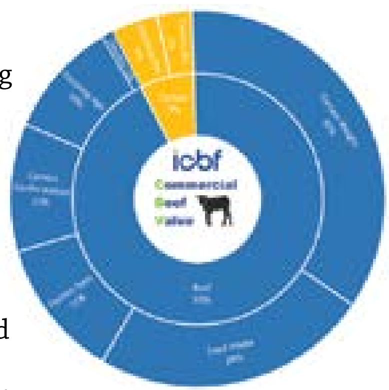


Figure 2. The Commercial Beef Value

The CBV will allow farmers to make more informed decisions when purchasing animals. Genotyped animals being traded through marts will have their CBV displayed on mart boards. When engaging in farm-to-farm sales, purchasers should request the CBV profile from the seller. The beef merit of calves can vary significantly even within the same breed (Table 1).

Table 1. CBV values by breed for 2023-born dairy-beef calves (source www.icbf.com)

2023 Born Beef Calves from the Dairy Herd					
Sire Breed	Btm 10%	Btm 1/3	Average	Top 1/3	Top 10%
Angus	<€43	<€63	€72	>€84	>€116
Aubrac	<€102	<€122	€132	>€145	>€179
Belgian Blue	<€106	<€141	€160	>€174	>€208
Charolais	<€126	<€153	€167	>€184	>€218
Friesian	< -€25	< -€3	€6	>€15	>€36
Hereford	<€29	<€51	€61	>€75	>€107
Limousin	<€125	<€148	€159	>€175	>€209
Simmental	<€59	<€82	€97	>€116	>€150

Research conducted by ICBF indicates that calves sired by beef bulls with higher genetic merit tend to exhibit superior carcass weight, better conformation, and a higher likelihood of meeting factory specifications compared to those sired by bulls with lower genetic merit (Table 2). Dairy steers showed little difference in calf purchase price (€43) between the bottom and top 10%; however, the differential in finishing value was €275/head and those in the top CBV bracket were finished 16 days earlier. Differences in finishing age for the Angus × dairy steers was more pronounced, with high CBV animals finished 54 days ahead of their low CBV counterparts. The CBV is relevant all through the animal's life. Therefore, beef finishers purchasing animals as calves, weanlings or store cattle, can utilise the CBV tool to assess the quality and efficiency of the animal.

Table 2. Calf price, finishing price and finishing age for A) dairy × dairy steers and B) Angus × dairy steers finished in 2023 by CBV decile.

A: Dairy steers finished in 2023

CBV Rank	Calf Price	Finishing Price	Finishing Age
Top 10%	€99	€1,538	817
2	€85	€1,471	823
3	€79	€1,455	826
4	€79	€1,439	826
5	€78	€1,415	824
6	€71	€1,409	828
7	€72	€1,392	827
8	€67	€1,371	829
9	€65	€1,338	832
Btm 10%	€56	€1,263	833
Difference Top & Bottom 10%	€43	€275	-16

B: AA X FR steers finished in 2023

CBV Rank	Calf Price	Finishing Price	Finishing Age
Top 10%	€249	€1,723	778
2	€235	€1,689	787
3	€230	€1,684	789
4	€231	€1,653	790
5	€229	€1,632	788
6	€223	€1,608	792
7	€218	€1,589	802
8	€211	€1,569	805
9	€208	€1,541	817
Btm 10%	€191	€1,450	831
Difference Top & Bottom 10%	€58	€273	-53

Quality versus quantity

There is no shortage of dairy-beef cattle to purchase. A distinct advantage now is that more calves are being genotyped at birth, parentage verified through the National Genotyping Programme (NGP). In NGP herds this year, over 93% of all calves born have been verified to a sire. This results in more accurate CBV values and buyers can be confident that the animal has been registered to the correct parents and their genetic merit potential has increased in accuracy. However, the overall 'quality' of dairy-beef animals, as measured by the CBV, has declined since 2015, and especially in the last two years (Figure 3). During this two-year period, more dairy herds are using beef sires and more dairy cows within herd are bred to beef sires. Trying to disentangle why the CBV values have declined is difficult and not all herds have witnessed a decline.

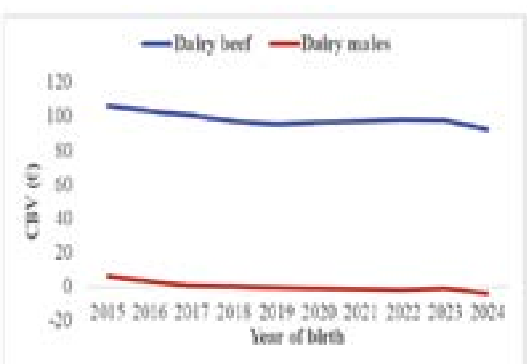


Figure 3. Trend in CBV for dairy × beef and dairy × dairy male animals

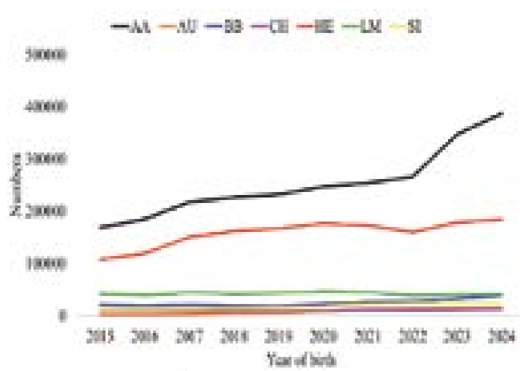


Figure 4. Numbers of beef sired progeny by breed: 2015-2024

For many years, Angus and Hereford were the top choices for beef breed sires among dairy farmers. This year, these traditional breeds make up over three-quarters of the market share with the continental breeds, mainly Limousin, Belgian Blue and Simmental, making up the remainder (Figure 4). Use of Angus has grown substantially, now comprising of 54% of the dairy-beef sired calves. This prompts the question: Are there sufficiently high beef merit bulls available to select on DBI for dairy farmers?

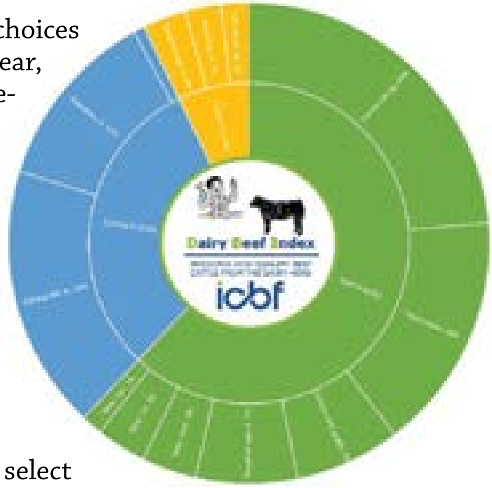


Figure 5. Dairy Beef Index (DBI) composition

The Dairy Beef Index (DBI)

The DBI is a genetic index used in dairy farming to select bulls that will produce calves suitable for beef production, while also maintaining desirable calving traits in their progeny. The index consists of three sub-indices: Calving, Beef and Carbon (Figure 5). Traits such as gestation, calving difficulty and mortality contribute to the Calving sub-index. Trends indicate that dairy farmers are increasingly prioritizing favourable calving traits and are making consistent advancements in this aspect annually. However, in the Beef sub-index, which encompasses traits like carcass weight, conformation and feed intake, progress appears to be less pronounced (Figure 6). Dairy farmers should select bulls with high beef sub-index values in the DBI in order to improve calf quality. The beef merit traits will be reflected in the CBV of the progeny.

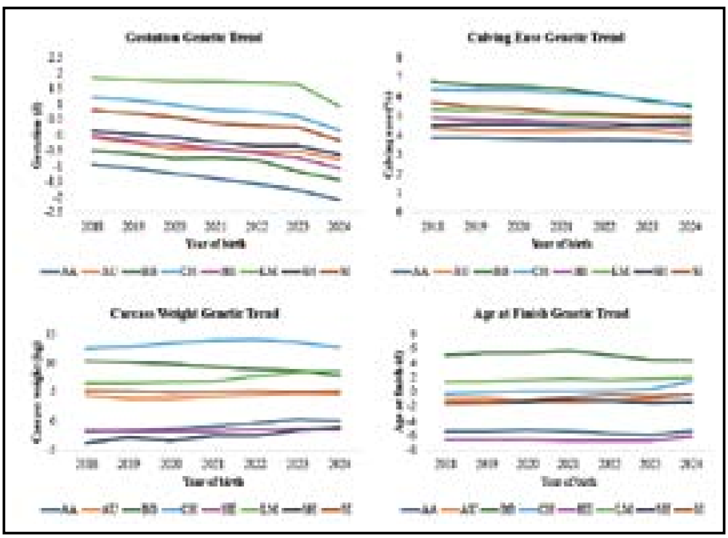


Figure 6. Genetic trend for calving traits (gestation and calving ease) and beef traits (carcass weight and age at finish) by year of birth and by breed.

The DBI was updated in January 2023 to incorporate revised economic values, new traits to the beef sub-index ('Age at Slaughter' and 'In-Spec' carcass) and the addition of a 'Carbon' sub-index. The Irish agricultural sector has been set a target of reducing greenhouse gas emissions by 25% (5.75 Mt CO_2e) by 2030. Genetics has been tasked with reducing this figure by 1.2 Mt of CO_2e and the new Carbon sub-index is imperative to achieving this target.

Key management strategies for reducing respiratory disease on dairy-beef farms

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Summary

- Bovine respiratory disease (BRD) is a common cause of reduced performance in dairy-beef calves.
- Calf health at the time of purchase can influence the likelihood of BRD development.
- Maintaining good housing air quality and adequately mitigating cold stress associated with low temperatures during the pre-weaning period will reduce the risk of BRD.
- Vaccination is an important tool in managing BRD but it needs to be integrated into a holistic calf management protocol.

Introduction

Bovine respiratory disease (BRD), also known as pneumonia, is one of the most prevalent diseases of dairy-beef calves, and is caused by a range of bacteria and viruses. It is the most common cause of calf mortality pre-weaning (34%), and remains a consistent cause of mortality in weanlings (41%) and adult cattle (19%) according to the All Island Disease Surveillance Report. Additionally, BRD increases calf-rearing costs, through expenditure on treatment and reduced animal performance. Research conducted in Teagasc Grange has shown that calves with lung lesions, which is an indicator of BRD, had a reduced live weight gain (0.12 kg/day). The number of calves that are affected by BRD will be influenced by a multitude of factors that can be broadly split into three main categories: 1) Calf immune competency, 2) Farm environment, and 3) Pathogens. Addressing all three of these areas is essential to a successful BRD management program.

Sourcing calves

The sourcing of dairy calves will have a major impact on all health issues in the pre-weaning period. Approximately 15% of the dairy beef calves acquired for a recent experiment in Teagasc Grange had lung lesions at the time of purchase. These calves were purchased from multiple farms with some farms having a greater proportion of calves with lung consolidation than others. Thus, it is clear that identifying source farm(s) that produce 'healthy' calves is the first step in managing BRD. Source farms with good colostrum management are more likely to produce calves without health issues. Calves with concurrent health issues such as scour or navel ill should not be purchased as these calves are likely to be immune compromised and so at a higher risk of developing BRD after purchase. Ideally sourcing calves from fewer farms is advised. Previous work conducted in Grange using novel diagnostics has identified a wide variety of BRD pathogens in purchased cattle. Limiting the number of herds from which calves are purchased should reduce the risk of introducing BRD pathogens to a group of calves.

Housing environment

Management of the housing environment in the pre-weaning period plays an important role in the respiratory health of dairy-beef calves. Air quality and thermal stress are the major factors that need to be managed in calf housing.

The rate of ventilation and the level of pollutants being produced determine air quality in calf housing. Key air pollutants include: ammonia, dust, and microbial air contamination. Ammonia is produced from the breakdown of urine by bacteria in soiled bedding. Ammonia is released from the bedding into the air and can irritate the respiratory tract of calves making them more vulnerable to infection. Regular removal of soiled bedding so that a deep wet pack does not form is recommended. This practice should reduce the production of ammonia within calf housing. Dust in calf housing can come from several sources including bedding and feed. Similar to ammonia, airborne dust can enter calves respiratory tract and cause inflammation, which may make calves more vulnerable to a BRD infection. Where possible, avoid generating dust with machines such as straw blowers. Microbial air contamination reflects the bacteria and viruses that are produced through the respiration of calves and other natural processes within the calf house. The most appropriate method to address microbial air contamination is through the provision of adequate ventilation.

Ventilation in calf housing can be provided through two means: 1) natural ventilation and 2) mechanical ventilation. Natural ventilation will rely on the 'wind effect' to drive fresh air into the calf house; the 'stack effect' does not occur in calf housing. To achieve adequate natural ventilation it is important that the calf housing has adequate inlets and outlets. Inlets should be located along both of the 'long' sides of the calf house. The building should be orientated perpendicular to the prevailing wind, and out of the wind shadow of other buildings. An outlet must also be provided at the apex of the calf house to allow for contaminated air to be removed. Mechanical ventilation may be useful in calf houses that cannot generate adequate natural ventilation due to design or location. Generally, these systems work by driving air into the building using an electrical fan and ducting. Through a combination of reducing the level of air pollutants and providing adequate ventilation, an environment that predisposes calves to BRD can be avoided.

Cold stress during the pre-weaning period has been associated with increased risk of BRD. This is due to immunosuppression associated with increased metabolic demand when ambient temperatures are low. Calves less than one-month-old have a thermo-neutral zone between 10oC and 20oC, thus in spring-time in Ireland they are exposed to temperatures that necessitate burning more energy to keep warm. As calves grow older the thermo-neutral zone widens. For this reason it is important to focus efforts on mitigation of cold stress on the youngest calves on the farm. As it is not practical to heat calf houses, management is centred on reducing factors that exacerbate cold stress, particularly draughts and moisture. Draughts at calf level will act to lower the effective temperature felt by calves and thus should be avoided. Draughts can be due to lack of appropriate inlet design or because doors are left open/ have gaps which air can pass through. Inlets that are completely open to the outside are likely to be too exposed. Instead, in calf housing inlet designs such as Yorkshire boarding (Figure 1) provide a good balance of adequate ventilation and protection from draughts. Diligent management of bedding can also protect younger calves from thermal stress. Wet bedding will result in increased thermal stress in calves. To avoid damp bedding, ensure that the calf pens have good drainage (1 in 20 slope) to a drain in the front of the pen. Water drinkers and automatic feeders also produce moisture and should be located where there is good drainage and such that they are not wetting the bedding.

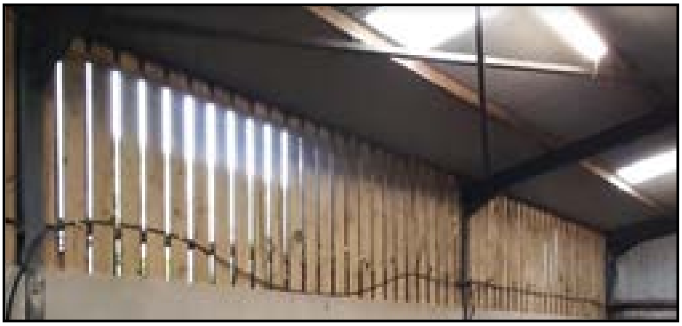

Figure 1. An example of Yorkshire boarding being used as an inlet in calf housing

Bedding can also provide thermal insulation for calves if it is regularly refreshed. When calves are able to nest in deep bedding (legs not visible, Figure 2) they are thermally insulated and at a reduced risk of BRD. Straw is the only bedding material that can provide the ability for calves to nest. Other materials such as woodchip do not provide this but can be used in older calves that are more thermally robust. High temperature can also result in immunosuppression and increase the risk of BRD occurrence, but this is less common in Ireland. However, ensuring that adequate ventilation is provided in calf housing should help to mitigate this risk.

Figure 2. A calf well nested in deep straw bedding, the calfs' legs are not visible

Vaccination

In Grange, dairy beef calves currently receive intranasal vaccines (Bovine respiratory syncytial virus (BRSV), Para influenza virus 3 (PI 3), Infectious bovine rhinotracheitis virus (IBR)) the day after arrival on farm. The initial vaccination is delayed by a day to improve immune response to the vaccine.

There are several vaccines available against BRD on the Irish market. They can be broadly divided into two major categories: 1.) Intranasal, and 2.) Injectable. Typically, intranasal vaccines provide protection against viral pathogens (IBR, BRSV, PI-3, Bovine Coronavirus (BCoV)). Intranasal vaccines typically provide a more rapid onset protection (approximately 1 week after administration) but for a relatively shorter period (approximately 12 weeks). This can be useful in high-risk situations where protection is needed rapidly e.g. mixing of calves from several sources. Injectable vaccines may also provide protection against bacterial pathogens such as *Mannheimia haemolytica*; however, they often require multiple doses prior to onset of immunity meaning calves are not protected for several weeks. In Grange, injectable vaccines are used later in the pre-weaning period. They provide protection for calves during the stress of weaning as the protection from the intranasal vaccines begins to decline.

Vaccination against BRD pathogens is an important management practice; however, it does not guarantee protection against BRD. Vaccination failure may be seen in several situations. Maternally derived immunity (immunity from colostrum) can inhibit immune response to injectable vaccines. Therefore, it is advisable to use intranasal vaccines in younger calves. Calves that are vaccinated during a stress period (transport, weaning, disbudding) or during a period of concurrent illness (scour, joint ill, pneumonia) may not have the expected immune response to the vaccine and will still be vulnerable to infection. Bovine respiratory disease can be caused by pathogens, such as *Mycoplasma bovis,* against which there is currently no available vaccine. For this reason, it is important not to solely rely on vaccination as a management strategy for BRD. In herds using a vaccine where an outbreak occurs, it is advisable to take samples and identify the causative pathogen.

BRD detection

If BRD infections do occur it is important that they are detected early and treated appropriately. Early detection and treatment should reduce losses associated with poor animal performance and reduce the risk of disease spread when affected calves are quarantined. Regular monitoring of calves and further investigation of calves showing clinical signs such as coughing, nasal discharge, and rapid or unusual breathing is the key to detecting cases of BRD. In recent years, Teagasc Grange has screened incoming calves using lung scanning. This procedure is relatively simple using the same ultrasound scanner used for pregnancy diagnosis. This has allowed the detection and treatment of BRD prior to development of clinical signs, thus reducing the impact of BRD on animal performance. In the future, this is a service that may be provided by veterinary practitioners.

Conclusion

BRD is a challenge in dairy calf-to-beef rearing operations. Management of BRD risk is multifaceted. Consideration and planning is required to mitigate risk. Design a vaccination plan that provides cost-effective protection.

Managing parasites on dairy calf-to-beef farms

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Summary

- Growing cattle are exposed to a variety of different internal parasites, which negatively affect animal performance.
- Calf age criteria and health at purchase, hygiene and preventative treatment can be used to control cryptosporidium and coccidia.
- Calves are naïve to gut and lungworm, and control of these parasites depends on minimising exposure through grazing management and judicious use of wormers.
- The risk of fluke varies with weather and land-type. Liver fluke is generally a greater risk than rumen fluke.
- Parasites are becoming resistant to the drugs used to control them and beef farmers should ensure the products used are effective on their farm.

Introduction

Irish beef production is predominantly grass-based with animals at pasture for up to eight months of the year. However, one of the consequences of our production system is the continuous exposure of livestock to internal parasites. A variety of internal parasites can infect cattle, including cryptosporidium, coccidia, gut worms, lungworm and fluke (both rumen and liver fluke). Diseases caused by parasites depend on the type of livestock and time of year. Transmission of many of these parasites is also heavily influenced by weather conditions and so the risk varies from farm-to-farm and from year-to-year. This represents a

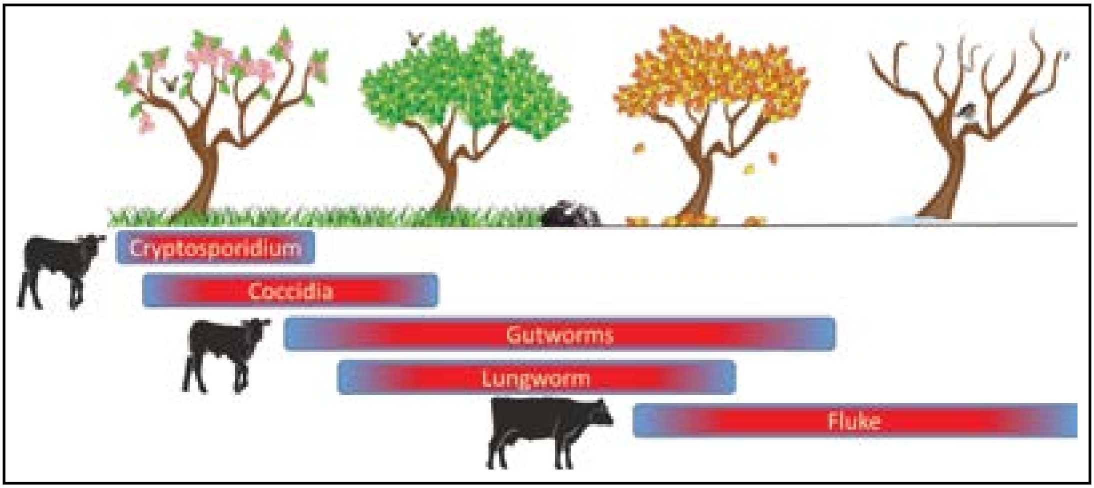

Figure 1. Seasonal and stock class risk for the major internal parasites of cattle

significant challenge in sustainable parasite control as it renders 'blueprints' or set protocols unsuitable. For the past 60 years, the control of parasites has been heavily dependent on the widespread availability of effective antiparasitic veterinary medicines. However, the development of anthelmintic resistance i.e. the ability of parasites to survive treatment with a drug that should kill them, is a major threat to the sustainability of our pasture-based production and steps must be taken to prolong the lifespan of the currently available antiparasitics. Therefore, sustainable parasite control should be an integral part of a tailored herd health plan, developed in conjunction with a veterinary practitioner. The major internal parasites of cattle, the type of livestock most at risk and the major seasonal risk is outlined in Figure 1.

Cryptosporidium and coccidia

The first parasites encountered by calves are usually cryptosporidium and coccidia. These parasites infect the intestinal tract of young animals. Cryptosporidium infects neonatal calves. Thus, dairy calf-to-beef farmers that do not have an issue with this parasite should only buy in calves older than two weeks of age. At Teagasc Grange, calves are 3-4 weeks old at purchase, which reduces the risk from this parasite. Cryptosporidium is transmitted by the faecal-oral route, either through direct contact with dung from infected animals, or through ingestion of contaminated food or water. Signs of disease include lethargy/weakness, profuse watery diarrhoea, dehydration, loss of appetite and weight loss. It seldom leads to calf deaths, although it can do so if calves are left untreated or if they are infected with multiple pathogens simultaneously. Sick calves should be housed in a clean, warm, dry environment and treated with fluids to offset the fluids lost. Infected calves shed many oocysts (eggs) into the environment and these eggs can survive for long periods and are difficult to eliminate. Therefore, unaffected calves should be separated from affected calves to prevent the spread of disease. It is important to bear in mind that Cryptosporidium can also infect humans, leading to gastroenteritis. Therefore, strict attention to hygiene is important when dealing with this parasite.

Coccidia is also a disease of young calves, usually from three weeks to approximately six months of age. Signs include diarrhoea, dehydration, straining, loss of condition, rough coat and reduced growth. In severe cases, the dung may contain blood and mucus and if left untreated can result in calf deaths. This parasite is also transmitted via the faecal-oral route. It is important to prevent coccidial disease and in this regard, strict hygiene and disinfection of calf pens are key. When disinfecting pens it is important to remove all organic matter and use a disinfectant effective against coccidia. Feed and water troughs should be kept clean and raised to prevent faecal contamination. Bedding should also be kept dry. There are a number of veterinary medicines with efficacy against coccidia, which may be used to prevent disease. Calves at Grange are treated during the high-risk period to prevent disease. Sick calves should be separated from unaffected calves and housed in a clean, warm, dry environment and oral rehydration administered.

Immunity to both cryptosporidium and coccidia develops reasonably rapidly, meaning these parasites are rarely associated with disease in older animals.

Gut worms

A large number of different gut worm species can infect cattle but the two economically important species are *Ostertagia ostertagi,* which is found in the abomasum (fourth stomach), and *Cooperia oncophera,* which is found in the small intestine. *Ostertagia* is generally considered more pathogenic but *Cooperia* is more prolific and is often the main contributor to worm eggs in dung, particularly in first-grazing season calves. At pasture, cattle consume infective gut worm larvae. When present in sufficient numbers, they can cause disease including scour and ill-thrift in naïve calves but more commonly they are associated with appetite suppression and sub-clinical disease resulting in reduced growth rates. Adult worms lay eggs that are passed out with the dung and hatch in the dung pat before the larvae migrate out onto pasture. The larvae can survive for long periods (many months) on pasture and so worms are generally a greater problem in the second half of the grazing season as the number of larvae on pasture accumulates. After their first-grazing season, artificially-reared cattle usually have sufficient immunity to prevent clinical disease. Leader-follower grazing systems, where older animals with greater immunity follow calves, reduce gut worm exposure in calves. Worm faecal egg counts are regularly monitored in the Grange calves and generally remain low. When required, control of gut worms is achieved by the administration of a broad-spectrum anthelmintic (wormer). Despite the large number of anthelmintic products on the market, there are only three classes of wormer licenced in Ireland for the control of gut worms in cattle. These classes are benzimidazole (white wormer, 1-BZ), levamisole (yellow wormer, 2-LV) and macrocyclic lactones (clear wormer, 3-ML). Anthelmintics from different classes have different modes of action. However, within the same class, all products share the same mode of action and therefore when resistance develops to one product within a class generally other products in the same class are affected. Recent Teagasc Grange research has demonstrated widespread anthelmintic resistance on dairy-beef farms. Dairy calf-to-beef farms were tested for anthelmintic resistance using the faecal egg count reduction test (FECRT). If the drug reduces the worm egg count by 95% or more then the wormer is effective. If the drug reduces the egg count by less than 95% then the worms are resistant. The results of the FECRT are shown in Table 1. It is important to always use a wormer known to be effective on the farm in question.

Table 1. Prevalence of anthelmintic resistance on dairy calf to beef farms in Ireland

Anthelmintic class	No of farms tested	Percentage of farms with resistance
Benzimidazole (1-BZ)	15	60%
Levamisole (2-LV)	11	18%
Macrocyclic lactone (3-ML) Ivermectin	16	100%
Macrocyclic lactone (3-ML) Moxidectin	11	73%

Lungworm

Lungworm, commonly known as ‘hoose’ is one of the most important parasitic diseases of calves. Similar to gut worms, infective larvae reside on pasture until they are picked up by grazing stock. Ingested parasites move from the gut to the lungs where they lay eggs that are coughed up and swallowed. The eggs hatch in the gut and larvae are passed out in the dung. Much like gut worms, infective larvae build up on pasture over the grazing season and so the greatest risk is generally later in the grazing season. The larvae are carried out of the dung pat by heavy rain or on the spores of a fungus. Immunity to lungworm develops over time and the greatest risk is usually in the first-grazing season, although very heavy infections can cause disease in older animals. Clinical signs of infection include coughing and difficulty breathing, particularly when animals are moved. If left untreated it can rapidly result in calf deaths. The wormers used to control lungworm are the same as those used for control of gut worms (1-BZ, 2-LV and 3-ML) although anthelmintic resistance in lungworm is believed to be rare. Due to outbreaks of lungworm in artificially-reared calves in Grange in previous years, in 2024 calves were vaccinated against lungworm disease with the first immunisation given at eight weeks and the second at 12 weeks of age. Calves will be monitored over the grazing season for signs of respiratory disease.

Fluke

Both liver and rumen fluke infect cattle in Ireland. These parasites share the same intermediate snail host, the mud snail, and hence are generally found on pastures in low-lying area with poor-draining soils. Fluke are not a major issue on the Grange farm. Of the two species of fluke, liver fluke is the more pathogenic resulting in failure to thrive, anaemia and scour. The Animal Health Ireland Beef HealthCheck Programme records liver pathology at the abattoir and can be a useful source of information on the liver fluke status of a herd. On 'flukey' farms, prevention of liver fluke disease relies on treatment over the winter housing period to ensure animals turned out in the spring are not shedding fluke eggs in combination with preventing cattle grazing high-risk areas (wet areas) in high-risk periods (autumn/winter). Liver fluke can be classified as early immature (<6 weeks), immature (6-12 weeks) or adult (>12 weeks) and different flukicides target fluke of different stages. Therefore, it is important to choose the correct product at the right time of year. Only triclabendazole targets all three stages of liver fluke; however, Teagasc research has identified liver fluke resistant to this drug, which warrants caution if relying on this flukicide. Immunity to liver fluke does not readily develop and animals remain at risk throughout their life.

In recent years, there has been an apparent increase in the prevalence of rumen fluke. Adult rumen fluke appear to be relatively well-tolerated by cattle, and the identification of rumen fluke eggs in dung does not warrant treatment. However, large numbers of larvae (which do not lay eggs) in the intestine has been associated with clinical disease. Only a single product, oxyclozanide, has efficacy against rumen fluke and so there is a need to use it wisely to guard against the development of resistance.

Conclusions

Internal parasites are a threat to the health and productivity of cattle. Good parasite control requires integration of preventative strategies such as grazing management with treatment when warranted. Anthelmintic resistance has now been detected in gut worms and liver fluke and it is important to know what products are effective on the farm. A parasite control plan, developed with a veterinary practitioner is key to sustainably controlling parasites in dairy calf-to-beef systems.

Acknowledgements

The cooperation of the dairy calf-to-beef farmers involved in the anthelmintic resistance study is gratefully acknowledged.

Tipperary dairy calf-to-beef demonstration farm

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Summary

- The Tipperary dairy calf-to-beef demonstration farm is a 95 hectare dairy-beef enterprise established in 2022 in Fethard, Co. Tipperary by Teagasc with the support of Dawn Meats and Shinagh Estates through a joint venture.
- The aim of the farm is to demonstrate the best technologies for profitable and sustainable production of beef calves from the dairy herd.
- The farm is focusing on key technologies such as;
- Dairy-beef integration to allow closer collaboration between a dairy and beef farmer in the breeding, management and transfer of calves.
- Efficient conversion of grazed grass and grass silage to beef.
- Optimising animal performance during all production stages to reduce finishing age through high-quality grass-based nutrition and excellent herd health.

Background

The recent expansion in the national dairy herd and increased uptake of sexed semen has resulted in a greater number of dairy-beef calves being born on Irish dairy farms each year. These calves represent a potential opportunity for Irish beef farmers to have a viable and sustainable enterprise if all of the critical links in the supply chain are managed and optimised. The dairy-beef supply chain currently includes the pedigree beef bull breeder, the dairy farmer, the beef farmer(s) and the beef processor. The critical points of this supply chain include the genetics of the sire selected by the dairy farmer, following best-practice in early-life management of the calf, the seamless transfer of a healthy calf from the dairy farmer to the beef farmer, and the efficiency and productivity of the animal while on the beef farm. The Tipperary dairy calf-to-beef demonstration farm based at Ballyvadin, Fethard, Co. Tipperary is a joint venture between Teagasc, Dawn Meats and Shinagh Estates Limited and is endeavoring to demonstrate the deployment of best technologies in profitable and sustainable beef production for beef farmers

Farm system

The Tipperary dairy calf-to-beef farm is 112 hectares (ha) of free-draining, clay loam soil and approximately 95 ha is used for the dairy-beef enterprise. This was sown with perennial ryegrass/white clover swards in 2022 and is being managed as a grass-clover system with moderate (~100 kg/ha) levels of artificial nitrogen fertiliser. The farm was stocked initially with 325 calves in 2023 and 335 in 2024 and these calves will be reared through to beef as steers and heifers. Achieving adequate carcass fat cover will dictate the finishing age, which in turn will determine the feed demand. The number of animals reared will be adjusted based on forage supply and demand. The target is to maximise production from grazed grass and high-quality (high dry matter digestibility) grass silage and finish all cattle to meet meat industry specifications.

Farm start-up (2022)

The farm enterprise commenced in the summer of 2022 and 235 spring-born cattle (3-6 months old) were purchased to stock the farm. These cattle were supplemented with concentrate at pasture (3 to 4 kg/head daily) from early autumn and this continued after they were housed indoors and offered high-quality grass silage *ad libitum*. From early-autumn 2023, cattle were weighed and assessed fortnightly for fat score, and 'finished' animals were drafted. Carcass performance data is shown in Table 1.

Table 1. Average carcass performance data of the 2022-born cattle

	Steers	Heifers
Number	123	112
Live weight (kg)	573	508
Carcass weight (kg)	290	251
Finishing age (months)	21.3	20.6
Carcass conformation score	O=	O=
Carcass fat score	3-	3=
Kill-out (%)	50.5	49.0
Average carcass price (€/kg)	€5.15	€5.23
Total concentrate fed in finishing phase (kg)	424	375

Spring 2023 animals

In spring 2023, the farm purchased 325 February-born and March-born calves with an average weight of 45 kg and an average age of 22 days, from six source dairy herds including our project partner, Shinagh dairy farm. These six source herds were then given a list of potential AI sires to use on their dairy herds with the commitment that the demonstration farm would then purchase these calves the following year, when they were three weeks old. The 325 calves comprised of Aberdeen Angus (AA), Aubrac (AU), Hereford (HE), Holstein-Friesian (FR), Limousin (LM) and Saler (SA) sires.

Spring 2024 animals

In spring 2024, the farm bought 335 calves at an average weight of 47 kg and average age of 21 days. These calves were purchased from eight source dairy farmers. The demonstration farm team are working closely with the source dairy farms to ensure the beef genetic merit of the calves continues to improve and a list (Table 2) of suitable AI sires was provided to the farmers to produce the calves for 2025.

Table 2. Sires used in 2024 on source dairy farms to produce calves for 2025

AI sire	Dairy Beef Index (DBI)	Beef sub-index	Calving sub-index	Calving difficulty (%)	Gestation (Days)	Carcass weight (kg)	Carcass conformation score	Age at Finish (days)
AA4089	172	102	61	2.46	-3.62	9.6	0.79	-18.14
AA4303	144	111	28	3.15	-1.04	13.5	0.93	-16.32
AA7803	169	124	42	2.69	-1.58	22.8	0.79	-14.96
AA8778	179	116	56	2.38	-3.21	15.4	0.98	-16.65
AA9607	185	135	43	2.76	-2.34	19.9	0.74	-21.57
AU4683	176	161	17	3.56	0.64	18.6	1.79	-9.4
AU8953	184	155	32	2.98	-0.79	21.4	2.15	-1.25
CH4321	141	190	-37	5.41	2.11	42.2	2.26	0.41
HE6841	131	103	24	3.02	0.47	8.30	0.75	-18.27
HE8511	133	112	14	4.60	-2.19	12.8	0.79	-17.86
HE9777	152	119	26	3.53	-1.5	12.2	0.80	-19.65
LM2014	163	171	2	3.22	2.83	28.4	2.43	-0.67
LM7077	139	164	-15	4.23	2.87	28.8	2.61	0.52
SA4604	144	121	29	3.04	0.16	20.1	1.04	4.29
Average	158	135	23	3.36	-0.51	19.57	1.35	-10.68

Calf purchase

All calves are sourced from the eight dairy herds, which use the AI sires recommended by the Demonstration farm team. The calves, born between 1 February and 5 April, are vaccinated to protect against pneumonia at least five days before transfer. They are at least two weeks old when purchased. All calves are moved on one day each week and arrive on the farm at midday to facilitate orderly management. Calves are paid for based on their Commercial Beef Value (CBV), weight and sex.

Financial performance

Tipperary dairy calf to beef farm is operated as a standalone company (Ballyvadin Beef Farm Ltd), which will produce an annual set of audited accounts. The farm has no BISS payment and has full labour cost but no land cost included in the budget (Table 3). Currently, approximately 10 ha of the farm is sown to spring barley and this will be reviewed as the farm reaches its stocking rate limit. This year, 2024, will be the first year the farm will reach full output with 335 calves and 320 yearling cattle on 95 ha. The initial target is to produce a carcass weight of 275 kg (average of steers and heifers) and to increase this over time using appropriate genetics. Approximately 3.5 cattle/ha will be produced annually, or 965 kg beef/ha, which will require an annual pasture growth of 13 tonne dry matter (DM)/ha utilising 10.5 tonne DM/ha.

Farm labour/management

Tipperary dairy calf-to-beef farm is managed and operated by Jack Spillane and Stephen Baskin who works half-time on the farm. Their primary focus is the management of the health and performance of over 650 cattle and the management of the pasture to ensure high animal performance and high grass utilisation. The key performance indicators for the farm include grass utilised, animal performance from pasture and grass silage, animal health and mortality and finishing age of the cattle. A farm management team meet fortnightly to support and advise Jack in the operation of the farm. This team includes Donal Murphy, a director of Shinagh Estates, John McNamara from Shinagh dairy farm, Mathew Murphy from Dawn Meats, and Chloe Millar and Padraig French from Teagasc.

Table 3. Tipperary dairy calf-to-beef farm budget 2024

	Total €	€/head	€/kg carcass
Projected output			
Cattle sales	404,141	1291	4.70
Total sales	418,441		
Projected costs			
Concentrate	74,400	225	0.82
Labour/management	71,844	218	0.79
Contractor	45,180	137	0.50
Calf purchase	44,200	134	0.489
Depreciation	35,333	107	0.39
Fertiliser	22,505	68	0.25
Milk replacer	20,706	63	0.223
Veterinary	13,200	40	0.15
Other variable & fixed costs	40,750	123	0.45
Total costs	368,118	1116	4.06
Projected Margin	**50,323**	**161**	**0.59**

Teagasc DairyBeef500 Campaign

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Summary

- Compared to 2022, profitability of DairyBeef500 monitor farms increased by 3% in 2023, to €542/hectare (ha).
- Carcass weights decreased by 9.6 kg and 12.1 kg for dairy × dairy and beef × dairy steers, respectively, between 2022 and 2023.
- Finishing age reduced by 0.5 months for dairy steers, and 0.4 months for dairy-beef steers, between 2022 and 2023.
- Stocking rate remains the primary driver of profit on DairyBeef500 monitor farms. Exceeding €500/ha net profit is difficult for farms stocked under 170 kg organic nitrogen/ha.

Introduction

The Teagasc DairyBeef500 campaign began in 2021 and will run for an initial 5-year period. The campaign centres on a cohort of monitor farms located nationwide, which incorporate best practice in an effort to increase profitability in a sustainable manner. Additionally, the campaign organises a New Entrant Dairy Calf-to-Beef, five-day training course, which is in its second year. Thirty-eight students will have completed the course by the end of 2024. To maximise dissemination from the campaign, the DairyBeef500 team assist local Teagasc B&T advisors organise dedicated dairy-beef discussion groups and host open days in association with media outlets.

Profitability

The 15 DairyBeef500 monitor farms complete Teagasc E-Profit Monitors annually. Despite the very challenging weather conditions which prevailed in 2023, profitability on the farms increased by 3% relative to 2022. The average net margin, excluding all subsidies, was €542/hectare (ha) in 2023 compared to €517/ha in 2022. During 2023 beef prices increased by 4% from €4.77/kg to €4.96/kg carcass weight. The excessive rainfall in 2023 resulted in delayed turnout to grass in spring and earlier housing in autumn. The shorter grazing season meant that animal weight gain from grazed grass was reduced, and extra quantities of concentrates and silage were required instead. On a number of the monitor farms, the increased beef price in 2023 was offset by a lower carcass weight. The net profit ranged from €47/ha (one of the new entrants) to €1459/ha (one of the established farms operating a high-output bull finishing system).

Gross output across the programme farms averaged €3330/ha resulting in an average gross margin across the group of €1341/ha. Variable costs ranged from €1030/ha to €2798/ha with an average of €1990/ha for 2023, which is an increase of 4% compared to 2022 (Table 1).

Feed and milk replacer expenditure increased by 7% despite the cost of inputs dropping from the inflated prices of 2022. Fertiliser expenditure decreased by 19% as result of fertiliser price dropping from historic highs seen in 2022. Contractor costs increased by 20% in 2023, mainly due to increased volumes of silage being harvested and extra slurry spreading costs resulting from prolonged housing periods.

Table 1. Mean variable costs (€/ha) on DairyBeef500 monitor farms: 2023 vs. 2022

Variable cost	2023	2022	% Change
Feed/milk/calf ration/forage	1187	1112	+7%
Fertiliser	288	354	-19%
Vet	128	125	+2.4%
Contractor	173	144	+20%
Other	214	178	+20%
Total	1990	1913	+4%

Fixed costs across the programme farms averaged €799/ha in 2023, an increase of 3% (Table 2). From 2022 to 2023, no major increases in individual fixed costs were recorded on programme farms. A number of large-scale investments such as buildings and machinery were put on-hold due to rapid increase in cost of materials. It is expected that these delayed investments will recommence in 2024 and beyond, resulting in an increase in fixed costs to in excess of €1,000/ha on many of the farms.

Table 2. Mean fixed costs (€/ha) on DairyBeef500 monitor farms: 2023 vs. 2022

Fixed cost	2023	2022	% Change
Machinery running	137	136	n/a
Depreciation	162	153	+6%
Repairs/Maintenance	114	120	-5%
Land lease	125	121	+3%
Others	261	244	+7%
Total	799	774	+3%

Assessing the effect of stocking rate on the profitability of DairyBeef 500 farmers

The current target net margin for the DairyBeef 500 program is €500/ha, excluding direct payments. Many factors such as calf price and beef price at the date of sale will have a direct impact on the gross output and profitability of this enterprise; however, the main factor within the farmers' control affecting profitability of these systems is the stocking rate operated at farm level.

An analysis of the stocking rate of all DairyBeef 500 program farmers in 2023, showed that in order to meet the program target net margin, in general, stocking rate needed to at a minimum of 2.1 livestock units per hectare (LU/ha), equivalent to 167 kg organic nitrogen/ha. At this stocking rate, 70% of program farmers met the profit target, whereas only 15% of farmers below this stocking rate met it. Stocking rates on program farms ranged from 1.7 to 3.0 LU/ha or 136 kg to 230 kg organic nitrogen/ha. Decreasing stocking rate by 10% from 2.2 LU/ha will reduce gross output per hectare by ~€267/ha, and further stocking rate reductions will have a greater impact as outlined in Table 3.

Table 3. Sensitivity analysis of stocking rate (livestock units (LU)/ha)) reduction on DairyBeef500 monitor farm output and profitability

Stocking rate reduction (%)	Stocking rate (LU/ha)	Gross output/ha	Net margin/ ha reduction
0	2.20		
10	2.00	-€267	-€107
25	1.65	-€745	-€298

Challenges to dairy calf to beef enterprises going forward

To achieve net margins of >€500/ha, stocking rates of over 170 kg organic nitrogen/ha appear to be necessary. This means that these farms require a nitrogen derogation; however, some producers are concerned about the future status of Ireland's nitrogen derogation. If farm stocking rates are required to be less than 170 kg organic nitrogen/ha, the opportunity to obtain a net margin of €500/ha is reduced unless calf purchase price reduces, beef price increases and/or input costs reduce substantially. Given the new nitrogen allowances for cattle rearing systems, it will be necessary to achieve younger finishing ages to support high stocking rates, as the revised allowances for cattle >12 months have increased.

Grass

Grazed grass is the cheapest animal feed for beef production in Ireland. The cost per kg of live weight gain from grazed grass is approximately one-fifth of that from an indoor silage and concentrate diet. Consequently, on DairyBeef 500 farms, the aim is to maximise weight gain from grazed pasture over an extended grazing season. The length of the grazing season has a big impact on the level of live weight gained from grass. In 2023, thirteen out of the fourteen farmers had cattle out by mid-February; however, weather conditions deteriorated in March, and many farms needed to rehouse cattle until early-April. In the autumn, all farms housed their cattle earlier than planned due to poor grazing conditions. The unfavourable weather in 2023 had a big impact on animal performance and costs, as cattle were indoors for longer.

Based on the group report from PastureBase Ireland, the monitor farms with over 20 grass measurements grew 10.6 t grass dry matter/ha in 2023. To support this level of grass production farmers used 161 kg N/ha across the year. Soil fertility across the farms has increased since the inception of the programme with a big emphasis on correcting soil pH in the last 12 months. Nevertheless, all farms still have at least 20% of the farm sub-optimal for soil fertility. Almost three-quarters of programme farms have incorporated white clover into their swards through reseeding and over-sowing and 40% of farms have established red clover silage swards to reduce N inputs and increase silage production and feed value.

Carcass performance on DairyBeef 500 farms

In dairy-beef systems, ensuring high levels of individual animal performance from arrival on-farm until finishing is key to maximising carcass output. Obtaining maximum carcass weight at a reduced age is one of the main drivers of profitability, while it will also reduce the carbon footprint of beef produced. Irish agriculture is obliged to reduce greenhouse gas

Table 4. Dairy and beef × dairy steer finishing performance on DairyBeef 500 farms

Year	Carcass weight (kg)	Number	Conformation score	Finishing age (months)	Price (€/kg)	Carcass value (€)
Dairy × dairy steers						
2023	298.0	863	O-	24.0	4.84	1441
2022	307.6	764	O-	24.5	4.63	1425
Difference	**-9.6**	**+99**	**N/A**	**-0.5**	**+0.21**	**+16**
Beef × dairy steers						
2023	299.3	243	O=	22.7	5.05	1511
2022	311.4	248	O=	23.1	4.84	1507
Difference	**-12.1**	**-5**	**N/A**	**-0.4**	**+0.21**	**+3.7**

emissions by 25% by 2030, as set out in the Climate Action Plan. One of the many strategies to achieve this target is the reduction in the finishing age of animals on beef farms, by up to three months by 2030 relative to 2018. Finishing performance for steers, heifers and bulls were analysed for 2022 and 2023 across all DairyBeef 500 farms. Variance was found between farms and between years.

Average carcass weight for dairy-sired steers declined by 9.6 kg between 2022 and 2023 (Table 4). Finishing age also reduced by 15 days to 24 months. Carcass conformation score did not change. Beef-sired steers followed a similar trend to dairy-sired steers, with a 12.1 kg lighter carcass, a 12-day reduction in finishing age and similar a carcass conformation score for 2023 compared to 2022.

Mirroring the performance of steers, average carcass weight for heifers was 5.3 kg lighter in 2023 than in 2022 (Table 5). However, this reduction in weight was not associated with a younger age. In fact, average finishing age of heifers was one month older in 2023. Furthermore, carcass conformation reduced by one grade from O+ in 2022 to O= in 2023.

Table 5. Beef × dairy heifer finishing performance on DairyBeef 500 farms

Year	Carcass weight (kg)	Number	Conformation score	Finishing age (months)	Price (€/kg)	Carcass value (€)
2023	252.4	107.0	O=	21.5	5.20	1312
2022	257.7	205.0	O+	20.5	4.84	1247
Difference	**-5.3**	**-98**	**-1 grade**	**+1.0**	**+0.36**	**+65**

Bull carcass weight had the biggest drop, whereby on average they were 24.5 kg lighter in 2023 than in 2022 (Table 6). Again, similar to heifers, this reduction in weight was not associated with a younger finishing age, rather an increase in age of 20 days. Carcass conformation remained the same, with an average grade of O= recorded in both years.

Table 6. Dairy × dairy bull finishing performance on DairyBeef 500 farms

Year	Carcass weight (kg)	Number	Conformation score	Finishing age (months)	Price (€/kg)	Carcass value (€)
2023	289.4	308	O=	21.5	4.70	1360
2022	313.9	267	O=	20.8	4.60	1443
Difference	**-24.5**	**+41**	**N/A**	**+0.7**	**+0.1**	**-84**

Summary

The overall performance of cattle on the DairyBeef500 monitor farms dropped in 2023. This can be attributed to poor weather conditions leading to late turnout to pasture in spring and early housing in autumn. With a number of the farmers at a stocking rate close to 170 kg organic nitrogen, changes to the nitrogen excretion rates on males >12 months will mean a reduction in output from these farms, otherwise these farms will require a nitrates derogation.

TECHNOLOGY VILLAGE

Advisory, Education and Opportunities

Update from the Signpost demonstration cattle farmers

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Summary

- The Signpost cattle farmers have adopted many of the climate mitigation technologies recommended by Teagasc, but there is still scope to reduce greenhouse gas (GHG) and ammonia emissions on these farms.
- Nitrogen fertiliser use has decreased by 22% on the Signpost farms and 48% of it is now applied as NBPT-Urea (Protected Urea).
- Signpost cattle farms are finishing bulls, steers and heifers at 17.7, 23.8 and 22.5 months, respectively.
- It is advised that all cattle farmers sign up for the Signpost Advisory Programme to identify ways to reduce gaseous emissions.

Background

The Signpost Programme is designed to support and enable beef farmers to farm more sustainably. The demonstration farmers are the early-adopters of key technologies to reduce greenhouse gas (GHG) emissions. They are following the "12 Steps to Reduce Gaseous Emissions" which includes technologies such as reducing reliance on chemical nitrogen (N) fertiliser, increasing the length of the grazing season, improving animal health, improving animal breeding performance, and reducing animal age at first-calving and age at finishing. This paper aims to benchmark the uptake of these recommended climate mitigation practices for the beef farms participating in the programme. These Signpost beef farmers were not selected to be representative of the "typical beef farmer" and operate at a higher level of productivity and profitability relative to the average National Farm Survey beef farmers. The Signpost beef demonstration farmers are part of the Future Beef Suckler Programme or the Dairy Beef 500 programme.

Farm performance

There was a high level of technical performance on the Signpost cattle farms in 2023 with an average beef live weight output of 689 kg/hectare (ha) on the suckler beef farms and 1303 kg/ha on the dairy-beef farms (Table 1). Average chemical N fertiliser use across the suckler beef and dairy-beef farms was 85 kg N/ha and average concentrates fed per livestock unit (LU) was 708 kg. This level of concentrate feeding was 27% greater than 2022, with the increase attributed to the inclement weather conditions that prevailed, particularly in the second half of the year. Beef live weight output/ha decreased in 2023 compared to 2022, particularly on the dairy-beef farms where stocking rate declined from 2.62 to 2.44 LU/ha. The challenging weather conditions in 2023 led to poor grazing conditions, reduced cattle growth rates and difficulty in finishing animals. On average, Family Farm Income was €516/ha during 2023, which is a slight decrease from 2022 (€587/ha).

Table 1. Performance of Signpost cattle farms over three years

	2021	2022	2023
Number of farms	28	28	28
Physical			
Hectares (ha) farmed	55.6	58.0	58.0
Livestock units (LU) farmed	100.3	101.7	98.8
Stocking rate LU/ha			
Suckler beef farms (LU/ha)	1.92	1.96	1.91
Dairy-beef farms (LU/ha)	2.28	2.62	2.44
Family Farm Income (€/ha)	631	587	516
Beef output			
Suckler beef output (kg live weight/LU)	343	360	355
Dairy-beef output (kg live weight/LU)	574	563	537
Suckler beef output (kg live weight/ha)	665	707	689
Dairy-beef output (kg live weight/ha)	1322	1504	1303

Teagasc 12 Steps to Reduce Gaseous Emissions

Teagasc have identified 12 key steps to reducing gaseous emissions on cattle farms. Significant progress has been made by Signpost Cattle farmers to adopt key technologies to reduce emissions (Table 2).

Steps 1-6

Steps 1 to 6 relate to reducing chemical N fertiliser use and a change in chemical N fertiliser type to NBPT-Urea (Protected Urea). These are two of the key factors influencing GHG emissions. Nitrogen fertiliser use on the Signpost cattle farms has decreased by 22% since commencing the programme in 2021. This was achieved by:

- Optimising soil fertility: On Signpost cattle farms, 25% of all soils sampled were optimum for pH, phosphorus (P) and potassium (K). This compares with a national average of 13%.
- Applying lime to correct low soil pH, which will release N from the soil: the Signpost farms were extensively soil sampled in late 2021 and early 2022. The farmers have used the results to target lime applications during both 2022 and 2023. On average in 2023, 33.8 tonnes of lime was spread per farm, equivalent to 0.58 tonnes per hectare farmed.
- Better use of slurry: the adoption of low emission slurry spreading (LESS) on Signpost farms has been significant. In 2023, over 80% of the slurry produced was spread using LESS. Furthermore, 58% of all slurry was spread during the spring, optimising its N value.
- Using clover: Signpost cattle farms will be 'clover-scored' in 2024; however, evidence from farm visits and discussions with the farmers indicates an increase in white clover, red clover and multi-species swards on these farms.
- Almost half of the fertiliser N applied on Signpost cattle farms was applied as NBPT-Urea (protected urea), a substantial increase compared to just 14% in 2021. The national average for beef farmers in 2022 was 4% (National Farm Survey Sustainability Report 2022).

Table 2. Adoption of the "12 Steps to Reduce Gaseous Emissions" on Signpost cattle farms over three years

	2021	2022	2023	Target
Number of farms	28	28	28	
Reducing chemical nitrogen (N) (Steps 1-6)				
Soil samples with optimum fertility (%)	17%	-	20%	90
Lime usage (tonnes/farm)	29.6	41.3	33.8	pH 6.2+
Slurry spread using LESS (%)	36	71	81	100
Chemical N fertiliser application (kg/ha)	109	94	85	Reduce by 25%
Total chemical N as protected urea (%)	14	36	48	>85
Production efficiency (Steps 7-10)				
Length of the grazing season (days)	239	223	229	250
Replacement Index (€)	106	-	118	111
Calves per cow per year	0.92	0.92	0.96	0.95
Heifers calved at 22 to 26 months (%)	71	64	82	100
Animal age at finishing (months)				
Bulls	16.6	16.4	17.7	16
Heifers	23.3	21.8	22.5	22
Steers	24.0	23.9	23.8	24

Steps 6-10

Steps 6 to 10 focus on increased efficiency, output and reduced age at finishing. Signpost cattle farms have a relatively long grazing season. Cattle were at grass for 229 days in 2023, despite the difficult grazing conditions experienced on many farms. Replacement Index for suckler cows increased by €12 since 2021 - the target is an increase of €5 per year. Eighty-two percent of the heifers calved at 22 to 26 months in 2023, up from 71% in 2021. The aforementioned difficult grazing conditions in 2023 had an adverse effect on animal growth performance at pasture, which may have contributed to an increase in age at finishing. The average age at finishing over the 3 years of the project was 16.9, 22.5 and 23.9 months for bulls, heifers and steers, respectively. The building blocks of improved animal breeding, grassland management and herd health management are all being implemented to allow further progress in this area.

Steps 11-12

Step 11 refers to the better management of existing hedgerows and planting of trees on Signpost cattle farms with benefits to biodiversity accruing on these farms as well as increasing carbon sequestration potential. Step 12 refers to looking after the health of our soils, which includes actions such as, avoiding soil compaction, use of clover/multi-species swards, extended grazing, improving hedgerows and planting trees/hedgerows.

Gaseous emissions on Signpost cattle farms

Total GHG emissions for the Signpost cattle farms is 365 tonnes CO_2 equivalents (CO_2-eq) per farm, corresponding to an emissions per ha of 6.1 tonnes CO_2-eq. The national average for cattle farms was 4.4 tonnes CO_2-eq per ha in 2022 (NFS Sustainability Report 2022); however these farms have a comparatively lower stocking rate. Total emissions on the Signpost cattle farms decreased by 2% since the start of the programme in 2021. The key drivers of the change in emissions on the Signpost cattle farms are:

Chemical N fertiliser use

There was a change in the total quantity of N fertiliser applied and in the 'composition' of fertilisers used (Table 3). Total fertiliser N use decreased by 22% from 2021 to 2023. In 2021, 69% of the chemical N was applied as calcium ammonium nitrate (CAN) and associated compounds, with this reducing to just 34% in 2023. A reduction in CAN and chemical N in compounds contributes to a reduction in GHG emissions. The quantity of straight urea used in 2023 decreased by 7 percentage units, compared to 2022. Although this decrease in urea application has minimal impact on GHG emissions, it does further decrease ammonia emissions. The quantity of NBPT-Urea (protected urea) used more than tripled between 2021 and 2023, corresponding to 47% of total chemical N applied as NBPT-Urea (protected urea) in 2023. An increase in NBPT-Urea (protected urea) is positive in terms of reducing both GHG and ammonia emissions.

Table 3. The percentage of chemical nitrogen (N) fertilisers used on Signpost cattle farms in 2021, 2022 and 2023

	2021	**2022**	**2023**
Calcium ammonium nitrate (CAN) (%)	26	8	6
Urea (%)	18	26	19
NBPT-Urea (Protected Urea) (%)	13	35	47
Nitrogen and phosphorus mixtures (%)	0	1	2
Nitrogen, phosphorus & potassium (NPK) mixtures (%)	43	31	26

Lime use

Average lime usage increased from 29.6 to 33.8 tonnes per farm between 2021 and 2023. Despite an initial increase in GHG emissions associated with the application of lime, this increase in lime use is positive, as optimum soil pH will ultimately permit lower N fertiliser application rates and increased N and P use efficiency.

Change in livestock numbers

There was a slight decrease in livestock numbers (2.9%) on the Signpost cattle farms from 2021 to 2023. Livestock numbers contribute to over 70% of the total emissions associated with cattle farming; therefore, any change in livestock numbers, however small, can contribute to a change in GHG emissions.

Conclusion

Considerable progress has been made on the Signpost cattle farms to implement the technologies for reducing GHG and ammonia emissions. There is still potential to reduce total GHG emissions on the Signpost farms. This can be achieved by further reducing chemical N use, and increasing the proportion of chemical N applied as protected urea. Other areas for improvement include reducing cattle age at finishing and reducing heifer age at first-calving. The Signpost farms show what is possible in terms of the use of climate mitigation technologies, and Teagasc believes that they can point the way forward for all farmers.

The economic performance and the role for diversification on cattle farms in Ireland

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Summary

- Irish beef farms have a competitive advantage within Europe based on cash costs of production, with costs as a percent of output below the EU average.
- Despite this, economic viability levels remain challenging in the drystock sectors.
- Given the economic competitiveness issues identified within Ireland, it is interesting to examine alternative diversification opportunities.
- Cattle farms with average levels of economic performance have the capacity to increase their economic returns by supplying perennial ryegrass-red clover silage for an anaerobic digestion (AD) plant.

Introduction

Farm incomes are generally low on cattle farms in Ireland with farm subsidies accounting for the majority of farm income. Cattle farmers have contended with a number of economic challenges in recent years. In this paper, Teagasc National Farm Survey (NFS) data is used to describe recent trends in farm income and competitiveness, and to explore the potential of anaerobic digestion (AD) feedstock supply as a potential diversification opportunity.

Farm income

Family Farm Income (FFI) represents the return to family farm labour, capital and land and is the principal measure of farm income used in the Teagasc NFS. In calculating farm income statistics, we distinguish between two main cattle systems, namely, 'Cattle Rearing' and 'Cattle Other' (Note: both of these systems exclude small farms of a standard output of less than €8,000). The Cattle Rearing system includes farms concerned mainly with suckler cow farming and there are approximately 26,000 farms in this system. The Cattle Other system comprises of farms involved in the purchase of cattle (various ages) and the sale of store cattle in the marts or finished cattle to the factories, with approximately 28,000 farms in this system. Some farms in both of the Cattle systems maintain a sheep or crop enterprise in addition to their main cattle enterprise.

In 2022, the average FFI on the Cattle Rearing system was €8,324 per farm. The average FFI on the Cattle Other system was €18,554 per farm. For 2023, we have estimated a 23% increase in FI on Cattle Rearing farms and no change on the Cattle Other farms.

In late April 2024, the average price for an R3 steer was approximately €5.45 per kg, which is approximately one per cent below the average for the same time in 2023. However, the annual average beef price in 2024 is forecast to be approximately two to three per cent higher relative to 2023. Beef prices declined by about 13 per cent from May to October 2023 and a more optimistic outlook is forecast for 2024. Despite some increases in Q1 2024, the total prime beef production in Ireland is forecast to be down for 2024 relative to 2023. An increase in cow beef production (mainly cull dairy cows) is expected to offset the decline in prime beef production. The costs of production for beef are forecast to be slightly lower in 2024, mainly due to lower fertiliser prices. However, as a result of the prolonged winter, the positive effect of the decline in feed price is being offset by a rise in feed use and a depletion of fodder reserves. In 2024, it is forecast that margins and incomes on Cattle Other farms will be slightly higher relative to 2023 with more uncertainty for Cattle Rearing farms due to the timing of cattle sales and the impact of weather conditions.

Economic viability comparison across farming systems

The latest available data on economic viability of farming systems in Ireland is reported based on the Teagasc National Farm Survey (NFS) for 2022. A farm business is defined as being economically viable if Family Farm Income is sufficient to remunerate family labour at the minimum wage in 2022 (which is assumed in this instance to be €20,129 per labour unit), and provide a 5% return on the capital invested in non-land assets, i.e. machinery and livestock.

Farms that are found not to be economically viable, but have an off-farm income source within the household (i.e. either the farmer or spouse are employed off-farm) are considered to be economically sustainable. Farm households are considered to be economically vulnerable if they are operating non-viable farm businesses and neither the farmer or spouse have an off-farm job.

The viability of Irish farms varies across system. Figure 1 illustrates the wide differential between the viability of dairy and tillage farms, on average, compared to their drystock counterparts. In 2022, 93% of dairy farms were found to be viable, while only 4% of dairy farms were considered vulnerable. The situation on drystock farms remains more challenging, particularly on Cattle Rearing farms where only 13% were deemed viable in 2022. The proportion of Cattle Rearing farms considered sustainable in 2022 was 52%, and 35% of Cattle Rearing farms were classified as vulnerable in 2022. Just over one-third (34%) of Cattle Other farms were classified as viable in 2022, whilst Cattle Other farms deemed to be sustainable was 34%, with a further 31% vulnerable.

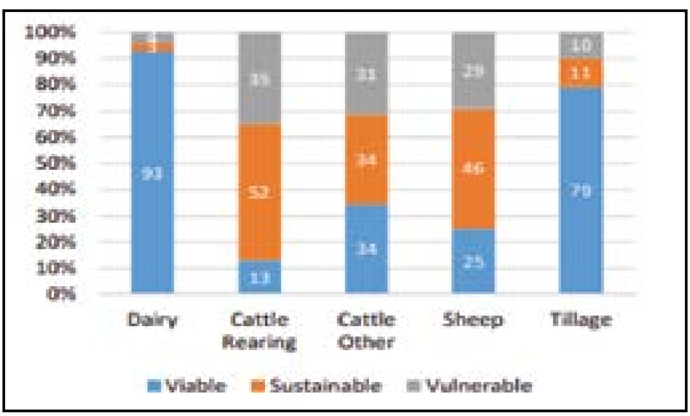

Figure 1. Economic viability of farming by farm system, 2022

Competitiveness of cattle farms in Ireland

In evaluating the competitiveness of Irish cattle farms, data analysis was confined to the specialist cattle farms, based on the principal type of farming, based on a gross output, as defined by the Farm Accountancy Data Network (FADN). The competitive position of Irish farms was compared against all farms within the FADN dataset, and the EU-27 average, based on the most recent data from 2021.

A number of cost and return-based indicators of competitiveness were examined for beef systems: costs as a percentage of output, margin over costs per hectare and margin over costs per livestock unit (LU). Overall, these results for beef rearing and fattening enterprises show that Irish producers had a competitive advantage with cash costs as a percent of output below the European Union (EU) average (Figure 2). Based on the main beef producers within EU-27, namely, France and Germany, (and Ireland), the cash cost to output ratio (including coupled and decoupled payments) was lowest in Ireland (63% of output) and highest in Germany (70% of output). However, it is important to note that when total economic costs, which includes an opportunity cost for owned resources (land, labour and capital), were considered Ireland's competitive position worsens.

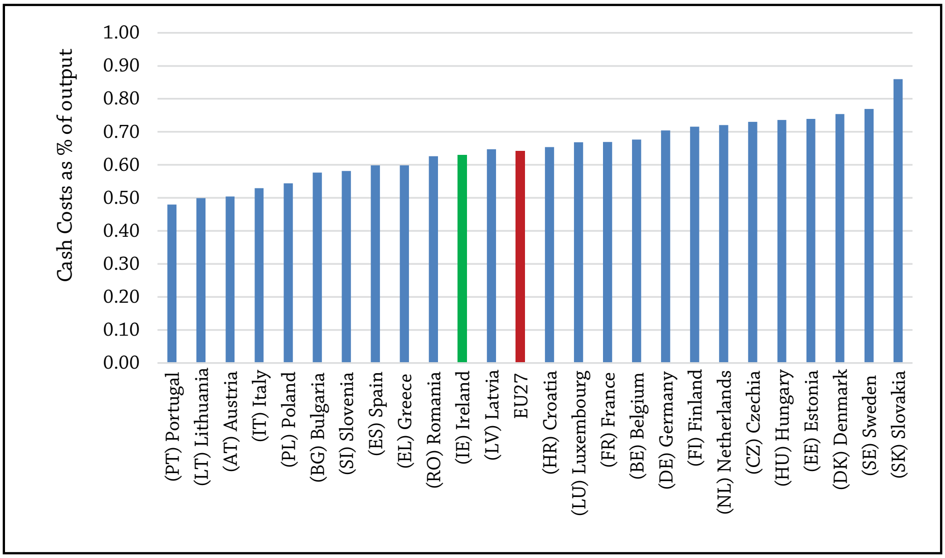

Figure 2. Costs as a percentage of total output (incl. subsidies) for European specialist cattle farms in 2021

Source: Author's estimate based on EC FADN data, 2022.

Anaerobic digestion (AD) feedstock supply as a diversification opportunity

Given the economic competitiveness issues identified for cattle farms within Ireland, in terms of comparative economic viability measurements, it is interesting to examine alternative diversification opportunities. In particular, various EU and Irish policy documents identify a role for bioenergy as a means to reduce greenhouse gas (GHG) emissions from agriculture and energy production. Furthermore, Ireland's Climate Action Plan increased the target for AD to 5.7 terawatt-hours (TWh) biomethane, recognising the role AD can play in reducing emissions and creating a circular bioeconomy.

The SEAI funded FLEET project (Farm Level Economic, Environmental and Transport Modelling of Feedstock Solutions) acknowledged that the economic case for the production of silage for AD in Ireland can only be established by analysis of the potential costs and returns at farm level relative to existing enterprises. The FLEET project used farm-level survey data from the Teagasc NFS for a perennial ryegrass sward (PRG), coupled with farm management data for a modelled crop of perennial ryegrass and red clover (PRG-RC) sward. Feedstock costs and returns are derived using a Discounted Cash Flow (DCF) analysis based on the production of silage for an off-farm AD facility.

Results show that production of silage as an AD feedstock using a PRG-RC sward can be more profitable than some existing farm enterprises within the Teagasc NFS. Cattle and sheep farms with average levels of economic performance have the capacity to increase their economic returns by supplying silage for an AD plant. Conversely, the average specialist dairy farms generated economic returns that far exceeded the returns that would be available from growing silage for AD purposes.

Conclusion

Overall, the analysis shows that economic viability continues to be an issue within the drystock sector in Ireland, and particularly for Cattle Rearing farms with these farms predominantly containing a single suckling enterprise.

Whilst Irish producers have a competitive advantage in terms of cash costs when compared with other European countries, this advantage deteriorates when all opportunity costs are applied to all owned factors of production.

Given the economic competitiveness issues identified within Ireland, it is interesting to examine alternative diversification opportunities. Results show that cattle farms with average levels of economic performance have the capacity to increase their economic returns by supplying PRG-RC silage for an AD plant.

Acknowledgements

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Feedstocks from agriculture for anaerobic digestion

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Summary

- Biogas is produced via a biological process called anaerobic digestion.
- Biomethane refers to biogas that has been upgraded by removing carbon dioxide. It can displace fossil gas.
- Agriculture will be an important source of feedstocks for biomethane production in Ireland.
- Anaerobic digestion (AD) plants vary in size according feedstock availability, processing capacity and intended application.
- A biomethane industry presents substantial opportunities for greenhouse gas (GHG) emissions reduction in agriculture.

Introduction

Anaerobic digestion (AD) is a process that can be used to generate renewable energy in the form of biogas. Anaerobic means without oxygen and digestion refers to the breakdown of organic matter by different groups of microorganisms. The process takes place in a sealed tank or digester, which is free from oxygen. The digester is heated to stimulate microbial activity. This results in the production of biogas, which consists of approximately 60% methane (CH_4) and 40% carbon dioxide (CO_2). Biogas can be combusted for heat purposes or for combined heat and power production. Biogas can also be upgraded to biomethane by removing CO_2. Biomethane can displace fossil gas in many sectors that are difficult to decarbonise. The digested material that remains after AD is digestate. The nutrients from the materials added to the digester (i.e. the feedstocks) are retained in the digestate and it is a valuable fertiliser.

In 2022, the Department of Environment, Climate, and Communications (DECC) published a target of producing 5.7 Terawatt-hours (TWh) of biomethane by 2030. This is equivalent to 10% of our current demand for fossil gas. The National Biomethane Strategy is due to be published in the second quarter of 2024. According to the draft that was published in January 2024, the Strategy will be “agri-led and farmer-centric”, with a focus on the supply of suitable feedstocks. The Strategy will set out the opportunity, economics, key actions, and roadmap to developing an indigenous biomethane industry in Ireland.

Feedstocks for anaerobic digestion

Anaerobic digesters use different types of organic feedstock, including agricultural crops (grass silage, energy crops, maize silage etc.), agricultural residues (livestock manure and crop residues), industrial residues from food and beverage industry, biowaste and municipal organic waste, and sewage sludge. The feedstocks used for biogas production are selected based on their availability and suitability. Availability refers to the ease of access to feedstock for biogas plant operators, ensuring a steady, renewable supply in sufficient quantities. Suitability is defined by a number of characteristics and parameters. These include the content of easily digestible organic matter, CH_4 potential, particle size, dry matter content, pH, carbon to nitrogen (C:N) ratio, and the content of macro- and micro-elements. As the microorganisms inside the digester need to be supplied with some basic 'ingredients' necessary for their metabolism, it is common practice to mix more than one feedstock (co-digestion). The aim is to achieve a balanced substrate composition and a synergic effect of improved process stability and higher methane yield. The biomethane yield from selected feedstocks is presented in Table 1.

Table 1. Biomethane yield from selected feedstocks.

Feedstock	Dry matter (%)	Methane yield (l CH4/kg fresh)
Pig slurry	3-8	6–22
Cattle slurry	6-12	8–25
Poultry manure	10-30	21–84
Maize silage	30-40	68–170
Grass	20-30	55–128
Organic waste	10-40	26–180
Abattoir residues	35	173–216

Animal manures and slurries: Manures and slurries from a variety of animals are used as feedstocks for biogas. They differ in dry matter content, e.g. solid farmyard manure (10–30% dry matter) or liquid slurry (below 10% dry matter). Their composition also differs according to the species of origin and the quality of the animal feed. Manures and slurries have several advantages as a feedstock for AD. They are rich in various nutrients necessary for the growth of anaerobic microorganisms. They have a high buffering capacity and can stabilise the AD process in the case of a significant pH decrease inside the digester. They have a natural content of anaerobic microorganisms, and are readily available and cheap. Solid manure and slurries also have some limitations as a feedstock for AD. Animal slurries have a low dry matter content, which gives a low CH_4 yield per unit volume of digested feedstock, and biomass transport costs are high. Due to their low CH_4 yield, animal manures are generally dependent on co-digestion with feedstocks with a high methane yield.

Crops: Many varieties of crops, both whole plants and parts of plants, are suitable as feedstocks for AD. These include maize, various grasses, various cereals, beets. Woody crops are not used for AD, as anaerobic microorganisms cannot effectively decompose biomass containing a high percentage of lignin. The use of crops for AD requires some steps prior to digestion, including storage/ensiling and pre-processing. The cultivation of crops that require a high input of fertiliser reduces the environmental sustainability of their use for biogas. Research is ongoing in Teagasc to examine the potential of using legumes in binary mixes with grasses to produce grass silage with reduced inputs of chemical fertilisers. Many European countries, including Denmark and Germany, are limiting the share of energy crops used in biogas plants. This is largely due to a push to move biogas production away from crops that can be used for food.

Scale of production

Anaerobic digestion plants vary in size depending on factors such as feedstock availability, processing capacity, and intended application. They can range from small-scale facilities suitable for local waste management to large industrial operations designed to process significant volumes of organic waste. The biogas flow rate refers to the volume of biogas produced per unit of time. It is typically measured in cubic meters per hour (m^3/h).

- Small-scale anaerobic digesters can have capacities ranging from a few cubic meters to a few hundred cubic meters and are often used by farms, households, or small communities to manage organic waste and produce biogas for cooking or heating purposes.
- Medium-scale anaerobic digestion plants typically have capacities ranging from a few hundred cubic meters to several thousand cubic meters and are commonly used by agricultural operations, food processing facilities, and wastewater treatment plants to treat organic waste and generate biogas for electricity or heat production.
- Large-scale anaerobic digestion plants can have capacities exceeding several thousand cubic meters and are typically used by municipal waste management authorities, industrial complexes and energy companies to process large volumes of organic waste from urban areas, agriculture, and industry, and to produce biogas for injection into natural gas pipelines or for use as transportation fuel.

For AD plants on-farms, the smallest systems are termed micro-scale. This describes plants that produce electricity via combined heat and power plants with an electrical capacity ranging from 15 kW to 100 kW. These types of systems are typically suitable for farms with upwards of 100 dairy cows, based on the amount of slurry that is available. These plants can offset a farm's energy consumption. In Northern Ireland, the average AD plant has an electrical output of around 500 kW. The development of the AD industry in Northern Ireland was largely driven by the Northern Ireland Renewables Obligation support scheme for renewable electricity. A Renewables Obligation Certificate (ROC) was a green certificate issued to an accredited generator for eligible renewable electricity generated within the United Kingdom. There are approximately 80 AD facilities in Northern Ireland. To support an AD plant with a 500kW output, a herd size of 500 cows and crop area of 240 hectares of maize is required. Cows are often farmed on a zero-grazing system, which means that slurry is available all-year round for the AD plant.

Biomethane

In Europe, the AD industry developed with small and medium AD facilities generating biogas for local heat/power. As the growth of the biogas industry has slowed in Europe over the past decade, biomethane production has grown considerably. Each year, an increasing number of EU countries are shifting incentives from biogas production to biomethane production, resulting in sustained rapid growth of the biomethane industry. In many countries, the business case has moved to farmers becoming suppliers of feedstock for large-scale AD facilities. The draft Biomethane Strategy document includes three scenarios for the deployment of biomethane infrastructure in Ireland. The scenarios include several assumptions, including the scale of plants developed.

Scenario 1 focused on the development of a larger number of smaller AD facilities (10-20 GWh). Such facilities would require 25,000 tonnes of feedstock. The main downfall of smaller developments is that they require a higher price for their gas, which, without specific financial support, would leave them less viable. Scenario 2 looked to assess what level of biomethane would develop in the absence of any further policy. This would favour large-scale facilities (40-60 GWh), which would require up to 60,000 tonnes of feedstock. Scenario 3 considered what is seen to be the most economic and cost-efficient pathway for developing a biomethane industry. A smaller number of larger plants is preferred. In this scenario, the average sized plant developed is 40 GWh per annum. This is similar to the European average of 35 GWh. Larger plants benefit from economies of scale and can offer lower off-take prices than smaller plants.

Outlook

In 2022, Gas Networks Ireland issued a Request for Information (RFI) to potential biomethane producers. The purpose of this RFI was to support the identification of new and feasible biomethane production projects and prepare for increased biomethane connections and injection. The RFI yielded 176 responses, which total 14.8 TWh of biomethane production by the end of 2030. The response exceeds the ambition stated in the Climate Action Plan of 5.7 TWh by more than two and a half times. Scaling up to 5.7 TWh will require investment in up to 150 new medium-sized biomethane production units. According to the responses, about 80% of feedstock are set to be sourced from agricultural sources. In particular, the counties of Monaghan and Cavan rank highly owing to a range of agricultural practices, particularly intensive pig and poultry farms, in these locations, which represent very good prospective feedstock. The counties with the highest biomethane production responses in the RFI are shown in Table 2.

Table 2. Biomethane production response – top five counties

County	GWh
Cavan	2,791
Kildare	2,572
Limerick	2,118
Cork	1,442
Monaghan	1,068

Conclusions

Although a significant proportion of the greenhouse gas emissions reduction from biomethane is expected to support the energy sector, fostering a biomethane industry also presents substantial opportunities for agriculture and enhances the prospects of meeting sector-specific targets. The potential benefits of biomethane for agriculture encompass opportunities for livestock farmers to diversify, decreased emissions from animal manures, and the substitution of chemical fertilisers with bio-based fertilisers. Effective collaboration among farmers, biomethane producers, and policymakers, akin to the cooperative model, is essential for leveraging the environmental and economic advantages of biomethane within the agriculture sector.

Organic beef farming systems

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Summary

- Organic agriculture is defined by the International Federation of Organic Agriculture Movements as ‘a production system that sustains the health of soils, ecosystems and people’.
- Currently 225,000 hectares (5% of total farmed area) are farmed organically in Ireland with an ambition to increase this to 450,000 ha (10%) by 2030.
- Beef farmers who are considering converting to organic farming should review their current production system and speak to other organic farmers and organics advisors/consultants.
- Teagasc have recently commenced a new research project - “Growing Resilient Organic Farming Systems” (GROFarmS) - funded by the Department of Agriculture, Food and the Marine (DAFM) to provide timely research to underpin the rapid expansion of the area farmed organically in Ireland.

Introduction

Organic agriculture is defined by the International Federation of Organic Agriculture Movements (IFOAM) as ‘a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved.’

IFOAM defines four principles of organic farming:

Health: organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

Ecology: organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

Fairness: organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

Care: organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Organic farming in Ireland

Currently 225,000 hectares (5% of total farmed area) are farmed organically in Ireland. The Climate Action Plan (2024) has set ambitious targets to increase this to 450,000 ha (10%) by 2030. This ambition is currently being incentivised through financial support from government in the form of an enhanced Organic Farming Scheme that opened to applicants in autumn 2023. This scheme has resulted in a doubling of farmers farming organically.

The largest organic sector in Ireland is beef cattle production. According to the Department of Agriculture, Food and the Marine (DAFM), there are now over 5,000 organic farms in Ireland in 2024 with approximately half of these being cattle farms. There are an estimated 20,000 organically-farmed suckler cows in Ireland with 12,500 cattle finished for organic beef production. This highlights that a major issue for the organic beef sector is the high 'leakage' rate between organic suckler cow systems and finished beef output, estimated at 30%.

Is organic farming an option for me?

Clearly, the incentives provided by the organic farming scheme are proving attractive to many farmers. Indeed, indications are that there are a large number of additional farmers who are considering conversion.

The following are some key factors for farmers who are considering converting to organic farming.

1. What is my current production system?

In many cases, beef farmers operate relatively extensive production systems such that conversion to organic farming may be relatively seamless. Aspects to consider include:

- Is the current stocking rate below two livestock units per ha?
- Can animal housing be modified to incorporate a bedded lying area?
- Is the use of artificial fertilisers low (or even zero)?

2. Review and consult

It is important to get acquainted with the adjustments required by talking to other organic farmers and contacting a local organics advisor. Teagasc have recently enhanced their organic advisory team to support the additional farmer inquiries and conversions to organic farming. It is essential for those considering conversion to become familiar with the organic standards. These standards have been developed to provide organic producers with consistent, clear rules as to how organic food should be produced. A two-year conversion period is required before a farm is given organic status.

3. Choose an organic certification body and register as an organic producer

In Ireland, there are two organic certification bodies: the Irish Organic Association and the Organic Trust. They are approved by DAFM under European Union law. Organic certification bodies (OCBs) provide certification services to organic producers and processors via inspection and certification programmes, which ensure the compliance of their licensees with the regulatory requirements for organic production. Additionally, licensing of their organic symbols for certified operators assures shoppers of the integrity of organic products.

Certification bodies will send an information pack on request. The pack is tailored to the producers needs and contains information on the application and conversion process, an application form and a guide to the Organic Standards. Once the application and conversion plan are received and assessed, an initial inspection will be arranged and you are registered as an organic operator. The OCBs carry out annual inspections of every organic enterprise.

Conversion to organic farming

When the initial inspection has been carried out, the application approved and the 'in-conversion licence' granted, a period of conversion begins. Normally two years in duration, this period of conversion allows time for the land and producer to adjust to organic methods. In certain cases, the conversion period may be extended or reduced by the inspection body subject to approval by DAFM. The time periods required above are initiated by the farmer submitting his/her farming enterprise to inspection and certification by one of the certification bodies.

During the conversion period, the enterprise must adhere to all the organic standards concerning animal welfare, artificial fertilisers, pesticides and chemicals. The changes proposed in the conversion plan must be implemented during this period. After the required conversion period expires, the inspection body may issue organic status to the farmer (unless conversion period is being extended), which allows the farmer to sell his/her produce as organic. There may be a financial cost associated with conversion. These costs vary widely according to individual circumstances but would be influenced by some of the following factors:

- Is the output reduction due to changes in production practices,
- Is the capital investments in land, machinery, livestock housing etc.,
- Is the certification and inspection costs, and
- Is the inability to command premium prices during the conversion phase.

To help alleviate these costs, the Organic Farming Scheme includes a 'participation payment' of €2000 in the first year following conversion and €1400 in subsequent years of the contract.

Impact on national greenhouse gas emissions

The increase in the area of land farmed organically has implications for national greenhouse (GHG) emissions. This will largely be mediated through: reduced use of inorganic fertilisers, particularly nitrogen (N); lower stocking rates on livestock farms and thus fewer livestock nationally; and a change in finishing age of beef cattle relative to conventionally-farmed beef cattle. Typically, the finishing age of beef cattle on organic farms is older than for conventional farms. In the Teagasc Marginal Abatement Cost Curve (MACC), it is assumed that reductions in finishing age across the 'conventionally' farmed bovine population are marginally offset by an increase in beef cattle produced on organic farms. However, given that organic beef farms tend to be lower stocked than conventional farms, the overall impact on the national population is expected to be relatively modest. These effects together are anticipated to abate 300,000 t of CO_2eq annually.

Teagasc organic research

As part of the DAFM research call in 2023, Teagasc were awarded funding for a major organic farming research project. The "Growing Resilient Organic Farming Systems" (GROFarmS) project aims to provide timely research to underpin the rapid expansion of the area farmed organically in Ireland and the ambitious targets to grow the sector further. GROFarmS addresses three primary research areas:

1. to evaluate and further develop organic knowledge transfer interventions in order to demonstrate technically-efficient systems of production to build the knowledge and confidence of farmers in organic production,
2. to undertake scientific research on organic beef (and lamb) finishing systems in order to develop efficient technology blueprints which will support farmers to finish animals organically,
3. to measure the sustainability of organic farming systems in Ireland.

Central to this project is the demonstration of best-practice for organic beef systems in order to expedite technology transfer to the organic farming sector. In the case of beef systems, Teagasc is currently converting the 100-acre Kildavin farm at Teagasc Johnstown Castle in Co. Wexford to a fully certified organic status. This farm will be developed as an organic finishing beef research and demonstration farm. The research undertaken will assess a range of beef finishing options to develop clear guidelines for efficient and profitable organic-beef finishing systems. Complementary research studies will be conducted at Teagasc Grange Research Centre to identify optimal finishing diets. Results from these cattle experiments will subsequently inform farm systems experiments in Johnstown Castle. The research conducted in these trials will provide the basis for further investigation into organic production systems by supporting cross cutting studies in product quality and environmental impact assessments.

GROFarmS
Growing Resilient Organic Farming Systems

Teagasc is your education and training provider for the agricultural and land-based sectors

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Summary

- Graduates of Teagasc certificate and advanced certificate courses meet the training qualification to become a ''trained farmer.''
- Teagasc introduced four apprenticeship programmes in 2023, with certification by QQI.
- The Adult Green Cert programme is offered at Teagasc Regional Education Centres and Agricultural Colleges on a part-time basis.
- The Distance Education Green Cert course has been developed to meet the training requirements of graduates from other non-agricultural award programmes who are interested in farming.
- The Higher Education Links Scheme enables holders of Further Education awards to apply for a quota of higher education courses.
- The Knowledge Transfer Walsh Scholarship Programme is designed to equip participants with the skills and knowledge to be effective in building the capacity of farmers to adopt new practices and technologies.
- Teagasc provides specialist training to the food processing and retail sector in the areas of food safety and quality systems, food legislation, food innovation and new product development.
- Teagasc Education is integrating measures to address the climate change challenge across its activities.

Introduction

Teagasc is the primary provider of accredited further (vocational) education for the agricultural and land-based sectors. Teagasc has a major input into higher education and postgraduate education delivery through its extensive partnerships. Teagasc introduced four new apprenticeship programmes in 2023 and welcomes applications for courses starting in September 2024. Teagasc also has a substantial involvement in providing short courses and continuous professional development across the agricultural, land-based and food sectors.

Become a "Trained Farmer"

National policy has prioritised 'young trained farmers' for various farm schemes and incentives. Graduates of Teagasc training courses meet the training qualification to become a 'young trained farmer'. Measures and schemes include:

- Complementary Income Support for Young Farmers scheme
- National Reserve Scheme – Young Farmer Category
- Young Farmer Capital Investment Scheme under the Targeted Agricultural Modernisation Schemes (TAMS)
- Registered Farm Partnerships/ Collaborative Farming Grant Scheme

- Stamp Duty Exemption on Transfers of Land to Young Trained Farmers
- Capital Acquisitions Tax Relief
- Stock Relief on Income Tax for Certain Young Trained Farmers

It is expected that future CAP reform will have additional benefits for young trained farmers. Note: educational requirements for schemes are subject to change and applicants are required to meet terms and conditions when applying for various schemes.

New apprenticeship programmes

Teagasc introduced four apprenticeship programmes in 2023. These programmes lead to QQI awards at Level 6 and Level 7, as follows:

- Sportsturf Technician (NFQ Level 6 Higher Certificate), 2 year duration
- Horticulturist (NFQ Level 6 Higher Certificate), 2 year duration
- Farm Technician (NFQ Level 6 Higher Certificate), 2 year duration
- Farm Manager (NFQ Level 7 Ordinary Bachelor Degree)

Teagasc plans to introduce an apprenticeship programme (Ordinary Level 7 Bachelor Degree) for the equine industry in 2024. This programme will train Assistant Stud Farm Managers to work in the industry. Further updates on apprenticeship training will be published on the Teagasc website.

Careers in the agricultural and land-based sectors

To remain competitive, new entrants to farming, horse production, forestry and horticulture will have to master fresh challenges to progress in the industry. Training with Teagasc will empower you and give you the skills you require to prosper in your chosen career. Courses include:

QQI Level 5 Certificate Courses

- Certificate in Agriculture / Horticulture / Horsemanship/ Forestry

QQI Level 6 Advanced Certificate Courses

- Specific Purpose Certificate in Farming (Teagasc "Green Cert")
- Advanced Certificate in Agriculture (Dairy Herd Management)
- Advanced Certificate in Agriculture (Drystock Management)
- Advanced Certificate in Agriculture (Agricultural Mechanisation)
- Advanced Certificate in Agriculture (Crops & Machinery Management)
- Advanced Certificate in Horsemanship
- Advanced Certificate in Equine Breeding (Stud Management)
- Advanced Certificate in Forestry
- Advanced Certificate in Pig Management
- Advanced Certificate in Poultry Management

Adult Green Cert programmes

The Adult Green Cert programme is offered at Teagasc Regional Education Centres and Agricultural Colleges for students who wish to complete the course on a part-time basis. This course, accredited by QQI, is 2-to-2.5 years in duration. The qualifications gained are the Level 5 Certificate in Agriculture 5M20454 and the Level 6 Specific Purpose in Farming 6S20487. To enter this programme, applicants must be 23 years of age or older when starting.

Enquires should be made locally to Teagasc colleges and centres. Subsequently applications are made online through the Teagasc public website: www.teagasc.ie/agriculture-courses/

Distance education

The Distance Education Green Cert course has been developed to meet the training requirements of graduates from other non-agricultural award programmes who are interested in farming. The course extends over a minimum of 15 to 18 months. The qualifications gained are the Level 5 Certificate in Agriculture 5M20454 and Level 6 Specific Purpose Certificate in Farming 6S20487. Applicants must be a holder of a Level 6 or higher major award in a non-agricultural discipline. Applicants must also have continuous access to a commercial farm in the Republic of Ireland (home-farm or approved nominated farm) to develop proficiency in farm tasks and complete farm-based assignment and projects. They must have access to all farm details, including financial details, on the nominated farm, and are expected to spend time weekly on this farm and be involved in its operation and management. Applications are made online through the Teagasc public website: www.teagasc.ie/agriculture-courses/

Higher education opportunities

The Higher Education Links Scheme enables holders of further education awards to apply for a quota of higher education courses. Specific further education courses are linked with specific higher education courses. Applicants for a higher education course, covered by the Scheme, are made through the standard CAO form. Applicants should check details of the higher education Links scheme with the relevant Technological Institute/University. Graduates of Teagasc further education may be eligible for advanced entry to Teagasc linked higher education courses subject to conditions and criteria of the partner higher education institution.

Teagasc higher education partnerships

Teagasc has a longstanding and substantial involvement in higher education provision. There is a wide range of higher-level programmes for the agricultural and land-based sectors available through the Central Applications Office (CAO). Many of these courses are conducted jointly between Teagasc and higher education institutions which allows students access to the best core competencies of each of the partner institutions. Direct recruitment to the courses is through the CAO system with a number of places reserved for mature students and holders of designated further education awards. There are also a number of advanced entry routes which allow Teagasc students to progress from further education into second year of certain higher level programmes. Places are limited and students make applications directly to higher level institutions. Additional information can be obtained on relevant technical university websites.

Walsh Scholarship programme

The Knowledge Transfer Walsh Scholarship Programme is designed to equip participants with the skills and knowledge to be effective in building the capacity of farmers to adopt new practices and technologies. Students complete a knowledge transfer-focused research project during their scholarship with Teagasc, while studying for a higher degree. For more information, visit www.teagasc.ie

Lifelong learning & continuous professional development

Teagasc offer a wide range of courses for adults and agri-food sector employees. Please contact your Teagasc Education Officer or your Teagasc Advisory Region or college for advice on courses in your region. Courses are provided subject to demand, and staff resources. Some of the courses include: Farm Safety, Crop Nutrition Management, Discussion Groups, Dairy Production, Grass10 Grazing Management, Forestry, Business, Organic Farming, and Welfare of Animals during Transport.

Teagasc food industry training

Teagasc provides specialist training to the food processing and retail sector in the areas of food safety and quality systems, food legislation, food innovation and new product development. These training programmes are delivered from Teagasc Centres in Ashtown, Dublin and Moorepark, Cork, as well as from other locations around the country or in-company. They address specific industry needs and skills gaps and are developed in consultation with industry. Our training programmes operate to best quality assurance standards. In addition, businesses can avail of assistance from consultants either at Teagasc locations or in-company to address the individual company development needs or for problem solving.

Education addressing the climate challenge

Teagasc Education is integrating measures to address the climate change challenge across its activities. For example, college farms are participating in the Signpost Farms programme; we have dedicated Sustainable Farming in the Environment modules at level 6 with sustainability to the forefront of all husbandry modules; and we use climate-smart technologies and methods in teaching and learning, including, Low Emission Slurry Spreading, Protected Urea, Biodiversity (planting hedgerows, coppicing/laying), genetics, energy audits and multi-species swards. These kind of measures are also used in the management of college farms, for both livestock and tillage enterprises.

Locations, information, open days

Teagasc Education Officers run part-time and distance education courses from Teagasc offices throughout the country. For more details, visit your local Teagasc office or log on to www.teagasc.ie/education/local-education-centres/

Teagasc agricultural and horticultural colleges and Teagasc partner/private colleges hold college open days each autumn and spring for potential applicants and their families. Further information can be obtained from the college of your choice or by visiting www.teagasc.ie/education

College of Amenity Horticulture, Botanic Gardens	john.mulhern@teagasc.ie
Gurteen Agricultural College	jparry@gurteencollege.ie
Ballyhaise Agricultural College	john.kelly@teagasc.ie
Kildalton Agricultural & Horticultural College	tim.ashmore@teagasc.ie
Mountbellew Agricultural College	edna.curley@mountbellewagri.com
Clonakilty Agricultural College	keith.kennedy@teagasc.ie
Pallaskenry Agricultural College	derek.odonoghue@pallaskenry.com

What's it like to do a Teagasc Part-Time or Distance Education Green Cert course?

Brian Morrissey, Carmel Finlay and Tara Fitzsimons
Teagasc, Curriculum Development & Standards Unit, Grange, Dunsany, Co. Meath

Summary

- There are many benefits to completing a Teagasc Part-Time or Distance Education Green Cert.
- A "Green Cert" is an educational award that qualifies the holder as a "trained farmer" for the purposes of Department of Agriculture, Food and the Marine (DAFM) schemes.
- The Adult Green Cert programme is offered at Teagasc Regional Education Centres and Agricultural Colleges on a Part-Time basis.
- The Distance Education Green Cert Programme (for award holders) has been developed to meet the training requirements of graduates from other non-agricultural award programmes who are interested in farming.
- The course content for both the Part-Time and Distance Education Green Certificates is the same, with the latter involving online or blended learning.
- Graduates of these courses are eligible to progress to the Teagasc Higher Education Farm Technician Apprenticeship or apply for entry to linked courses through the Higher Education Links Scheme.
- On the Teagasc website at https://www.teagasc.ie/education/contacts/ you can find information on Part-Time or Distance Education courses in your local Teagasc education centre or your nearest college.

Introduction

There are many benefits to completing a Teagasc Part-Time or Distance Education Green Cert, such as achieving "trained farmer" status. But what does this actually mean, and what is involved in undertaking this kind of training?

Benefits of training with Teagasc

Teagasc is the leading provider of accredited further education and training for the agricultural and land-based sectors. When you take a course with Teagasc, you receive specialist skills training and gain an in-depth understanding of progressive farming, crop and livestock production systems. Teagasc courses are creative, diverse and lots of fun. During the course, you will meet and work with students from similar backgrounds and develop friendships and networks, which will last long after graduation.

On successful completion of your course, you will receive internationally recognised awards. Your QQI qualification will prepare you for your future career in farming, and if you want, it will allow progression into higher education while potentially increase your employment opportunities. In addition, graduating from an accredited Teagasc course qualifies you as a "trained farmer." This is important because national policy has prioritised "young trained farmers" for various farm schemes and incentives.

What is a "Green Cert" award?

A "Green Cert" is an educational award that qualifies the holder as a "trained farmer" for the purposes of DAFM (Department of Agriculture, Food and the Marine, www.dafm.ie) schemes. Being the holder of a "Green Cert" is also one of the Revenue conditions of stamp duty exemption on the transfer of land (www.revenue.ie). Teagasc provides full-time, part-time, and distance education and training towards many land-based educational awards in agriculture, horticulture, forestry, equine and other subjects. Teagasc offers the Distance Education Green Cert for Non-Agricultural Award Holders and the Part-Time Green Cert courses.

Taking the first steps

There are a number of steps you can take when planning your education pathway.

1. Consider your long-term career plan
2. Identify your education and training requirements
3. Review which courses would meet these needs
4. Decide on the course or courses you want to take
5. Talk to Teagasc staff

You can do a lot more research on your education pathway on the Teagasc public website (www.teagasc.ie/education), and you can apply for most Teagasc courses through the online application system you will find there.

Deciding for a Part-Time or Distance Education course

Once you've decided on a course, you can go and find out more about the course and make an application. Here is some information on the Teagasc Part-Time and Distance Education Green Cert programmes.

The Teagasc Adult Green Cert programmes

The Adult Green Cert programme is offered at Teagasc Regional Education Centres and Agricultural Colleges for students who want to complete the course on a part-time basis. This course, accredited by QQI, is 2-to-2.5 years in duration. The qualifications gained are the Level 5 Certificate in Agriculture 5M20454 and the Level 6 Specific Purpose in Farming 6S20487. To enter this programme, applicants must be 23 years of age or older when starting this programme. Enquires should be made locally to Teagasc colleges and centres. Subsequently applications are made online through the Teagasc public website at www.teagasc.ie/agriculture-courses/

Distance Education

The Distance Education Green Cert Programme (for award holders) has been developed to meet the training requirements of graduates from other non-agricultural award programmes who are interested in farming. The course extends over a minimum of 15–18 months. The qualifications gained are the Level 5 Certificate in Agriculture 5M20454 and Level 6 Specific Purpose Certificate in Farming 6S20487. Applicants must be a holder of a Level 6 or higher major award in a non- agricultural discipline. Applicants must also have continuous access to a commercial farm in the Republic of Ireland (home-farm or approved nominated farm) to develop proficiency in farm tasks and complete farm based assignment and projects. They must have access to all farm details, including financial details, on the nominated farm and are expected to spend time weekly on this farm and be involved in its operation and management. Applications are made online through the Teagasc public website: www.teagasc.ie/agriculture-courses/

What happens next?

So what happens next? Your course application will be processed and if you are offered a place, you can pay the fee. You will receive information about your course, when it will begin, what the requirements are etc. Then you will receive more information about your course, and have an induction session where you will begin your training. Starting a new course can be a challenge, but there are many people you can ask for help, such as your course co-ordinator. Your Learner Handbook will describe your responsibilities as a learner, and the services, supports, and facilities that are available to you.

What is the pattern then?

Then what is the pattern your course will follow? Your course will settle down into a pattern of course work across all subjects, both theory and practical skills, quizzes, practical skills demonstration and practicing, self-directed learning, and Practical Learning Period (PLP). You will also complete different kinds of assessment (examinations, projects, diaries, assignments etc.), and repeat assessments (if required). Towards the end of your course, the course co-ordinator will submit your final assessment results and assessment evidence for External Authentication. All going well, this will be followed by certification of successful learners by QQI, and graduation and receipt of certificates.

What will you study?

The course content for both the Part-Time and Distance Education Green Certificates is the same. The Part-Time Green Certificate course involves classroom and practical instruction. The Distance Education Green Certificate involves classroom and practical instruction and remote or blended learning. The list below gives a sample of what the learner will study on Teagasc Part-time and Distance Education Green Cert programmes:

- Work Practice (home farm) - Level 5
- Principles of Agriculture - Level 5
- Farm Safety and Farm Assurance - Level 5
- Soils and the Environment - Level 5
- Farm Business and Technology - Level 5

- Safe Use of Pesticide Products - Level 5
- Personal Development module* - Level 5
- Electives [choice of electives is at the discretion of the college/ centre] - Level 5
- Work Practice (Home Farm) - Level 6
- Farm Performance Measurement - Level 6
- Farm Management and Business Planning - Level 6
- Sustainable Farming in the Environment - Level 6
- Applied Livestock Breeding & Grassland Management or Crop Production Management - Level 6

Progression

Graduates of these courses are eligible to progress to the Teagasc Higher Education Farm Technician Apprenticeship or apply for entry to linked courses at Institutes of Technology through the Higher Education Links Scheme.

Location and contact details

On the Teagasc website at https://www.teagasc.ie/education/contacts/ you can find information on Part-Time or Distance Education courses in your local Teagasc education centre or your nearest college.

Farm transfer and succession planning

James McDonnell
Teagasc, Farm Management and Rural Development Department, Oak Park, Carlow

Summary

- Farm transfer and succession are matters for every farm family.
- Planning for succession is one of the most important aspects in the life of the farm business.
- Planning for, and carrying out, succession can be a complex process.
- Use the 'Five Steps' outlined as a guide.
- Open communication within the family is one of the most important factors contributing to a successful succession and inheritance process.
- Use all the available supports.

Introduction

The subject "Transferring the family farm" is one that every farm family should plan for during the life of the farm. People in general do not like to talk about succession and inheritance. It is a sensitive subject area as farmers may feel it marks the end of their farming career. If the goal is for the farm business to continue functioning (well) beyond the tenure of the current owner/operator, then talking about and planning for succession is vitally important to ensure a smooth transition and viable future. It is important to understand that within farm transfer, there are two processes: succession and inheritance.

- Succession is defined as the gradual transfer of management of the farm business from one generation to the next.
- Inheritance is defined as the legal transfer of the farm assets from one generation to the next.

Planning for both these processes in an open, collaborative way is critical to avoid extreme conflict and breakdown within the family unit.

Succession planning

Succession is very important for the farm business, but it can be difficult and complex. The farmer and spouse are faced with trying to maintain a viable farm business for the next generation, treat all of their children fairly (not necessarily equally) and provide financial security for their own retirement. Fortunately, succession also incentivises the next generation to expand or change the farm in order to generate sufficient income for additional family members, and it provides the necessary resources, labour and skills to carry the plan through.

It is important to note that succession is not a single event but a process, which occurs over time. Planning early for succession allows for many of the main issues to be addressed and resolved before transition starts.

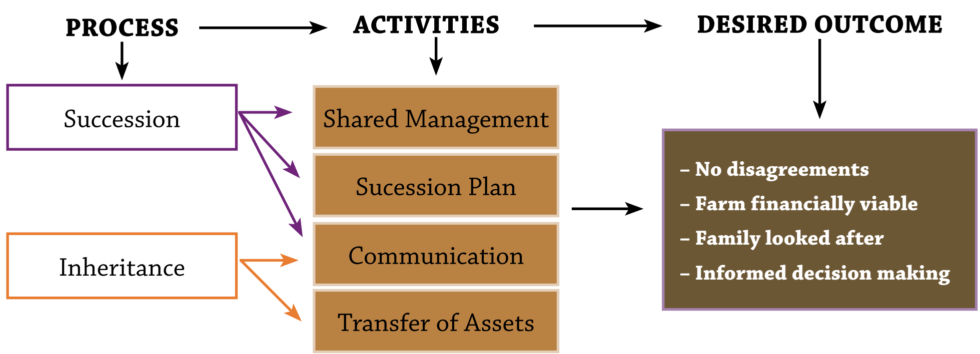
Five steps to successful farm succession

Step 1- Make a Will

Making your Will is quite a significant legal task to undertake. This legal document sets out how you wish your assets to be shared out on your death. When you die, your affairs need to be settled up. There are likely to be bills that need to be paid and property to be distributed. A Will is the simple mechanism that allows you to decide what happens to your assets with minimum fuss and delay. If you die without making a Will, then law (Intestate) will determine what happens to your assets. The 1965 Succession Act is the relevant legislation that now decides on how your assets are distributed. Irrespective of your age, state of health or financial status, it is imperative that you have a legally recognised valid will. Completing the Will allows you to use it like an insurance policy should you die prior to completing your succession plan.

Step 2- Communication within the family

The goal in involving all family members in planning is to build consensus over the plan and proposed outcomes for the farm. A key starting point to this is establishing the needs, expectations and fears of all family members with regard to the farm business.



Step 3- Review the cost and timing of completing the plan

Getting good taxation advice is a key ingredient in creating a successful succession plan. It is important to complete a taxation calculation, prior to any handover taking place. If there is a potentially large tax bill, then it might be possible to mitigate against this by adjusting the plan or time-lines of the transfer.

With good advance planning and preparation, the issue of taxes should not have a major negative impact on the farm business transfer. As part of a farm transfer, there are three significant tax triggering events occurring;

1. The transfer of assets (land, entitlements, machinery, livestock) between the parties involved in the transfer,
2. The finishing up of the business in the hands of one person,
3. The starting up of the business in the hands of the new farmer.

The Department of Agriculture Food and the Marine (DAFM) have a grant available that can be used to cover some of the costs in relation to getting advice in relation to farm succession. This grant is called the Succession Planning Advice Grant.

Step 4- Implement the succession plan

Implementing the plan will involve a number of tasks, such as completing the legal transfer of assets, getting valuations of assets for making tax returns, changing the ownership of the herd number and making contact with the DAFM so that any schemes the farm is involved in can be taken over by the new farmer. For some, it may involve setting up a farm partnership. So allow plenty of time to get this work done as there are many deadlines with DAFM schemes. It would be wise to consult with your advisor regularly during the process.

Step 5- Update and review your will

Once the plan is completed, the will needs to be reviewed in case there are any unintended consequences. The new farmer should now also complete a will as they now have significant assets in their name.

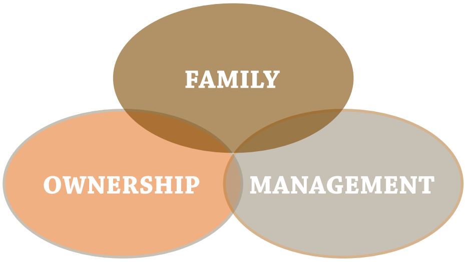
Communication

Effective communication is the key ingredient to successful succession planning. It allows for family members to share concerns, decide on options available and what actions to take. It also allows for effective planning and helps prevent disputes, misunderstandings and unnecessary anger.

Typically, when it comes to discussions around succession and inheritance, farmers are "passive" communicators. This means that there are many assumptions around who is getting the farm and the plans for the future, but these are not always explicitly communicated to the people involved.

When communicating on succession and inheritance, it is important to discuss and clarify the three key aspects of how family, ownership and management will play out, overlap and change over time/at different points in the future. When planning any discussion on succession, the following should be considered:

1. Who should be involved in the discussion?
2. What needs to be discussed?
3. When and where to meet?
4. What life stages are the children at?



Conclusions

Farm succession is a very complex area. Farm families should use all the available supports available. Follow the five key steps outlined above. A poorly thought-out plan could be costly from a taxation perspective and result in poor family relationships. Communication is a key part to effective succession planning. It is important to have the discussion early and with all family members. This should help prevent disagreements and ensure that all family members have had the opportunity to discuss their needs, fears and requirements as to how the farm business will continue.

For further information, log onto the farm succession page on www.teagasc.ie at the following link https://www.teagasc.ie/rural-economy/farm-management/succession--inheritance/

Transferring the Family Farm Clinics

A farm succession plan is essential for the future viability of your farm business!

Our upcoming Transferring the Family Farm clinics are designed to help farm families through the process of and all aspects that need to be considered when transferring the family farm.

Tuesday, 1 October | 10am
Fitzgerald's Woodlands House Hotel & Spa, Adare, Co. Limerick

Wednesday, 2 October | 10am
Corrin Mart Conference Centre, Fermoy, Co Cork

Thursday, 3 October | 10am
Riverside Park Hotel & Leisure Club, Enniscorthy, Co. Wexford

Tuesday, 8 October | 10am
Inishowen Gateway Hotel, Buncrana, Co. Donegal

Wednesday, 9 October | 10am
Knockranny House Hotel, Westport, Co. Mayo

Thursday, 10 October | 10am
Abbeyleix Manor Hotel, Abbeyleix, Co. Laois

Scan the QR code to book a place!

or visit

www.teagasc.ie/farmtransfer

teagasc

Best practice for health and safety on beef farms

John McNamara[1], Francis Bligh[2] and MJ Kelly[3]

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[3] Teagasc, Grange Animal & Grassland Research and Innovation Centre, Dunsany, Co. Meath

Summary

- Farm accidents and ill health cause tragedy, suffering and long-term disability. They can also jeopardise a person's capacity to farm effectively and hence jeopardise farm income. Therefore, it is in everyone's best interest to give practical safety and health management foremost attention.
- In 2023, sixteen fatal accidents occurred associated with farming and one in the 'forestry and logging' sector. An estimated 4,500 serious accidents take place each year.
- Farming is an occupation with a high level of ill health. This suggests that farmers need to give more attention to their health, including having a regular medical check-up.
- Considerable grant aid support for farm safety improvements is currently available through the Targeted Agricultural Modernisation Scheme (TAMS 3). Beef farmers need to consider how to make optimum use of this scheme.
- Farmers need to comply with legal requirements for safety, health and welfare in addition to those pertaining to agricultural vehicles and trailers used in public roads and with the Sustainable Use of Pesticides Directive.

Introduction

Farming is one of the most dangerous work sectors in Ireland. Typically, about 20 workplace deaths occur in the agriculture sector annually. In 2022, 14 farm deaths occurred, accounting for 50% of all workplace deaths. In 2023, the number of farm deaths was 16 with one in the 'forestry and logging' sector. Childhood deaths are particularly tragic. Seventeen children lost their lives between 2013 and 2023. Farm accidents causing serious injury, estimated by Teagasc National Farm Survey (NFS) occur at high level of about 4,500 per year. Drystock farms account for 26% of total accidents. An accident can lead to a permanent disability and hinder a person's capacity to farm effectively. Farmers as an occupational group have been identified as having high levels of preventable ill health. Ill health affects quality of life and a person's capacity to farm effectively. More awareness of health promoting practices is needed among the farming community.

Legal duty to complete a Risk Assessment

All workplaces, including farms, have a legal duty under Safety, Health and Welfare at Work (SHWW) legislation to conduct a Risk Assessment to ensure that work is carried out safely. The 'green covered' Risk Assessment Document is available to accompany the Farm Safety Code of Practice. It is a legal requirement to complete this document annually, and when major changes occur to farming systems. The requirement to conduct a Risk Assessment replaced the requirement to prepare a Safety Statement for farms with three or less employees, which make up about 95% of farms nationally

Looking after health and wellbeing

Being tired or 'below par' leads to poor decision-making and work becoming a grind. A recent study of Irish farmers, conducted by Dublin City University, found that almost one in four farmers (24%) reported burnout and half (50%) had sleep issues.

Workload

Workload is a key driver of lifestyle. Work, rest and leisure must be in about equal proportions to have a healthy lifestyle in the longer term. In addition, getting a regular break away from work is crucial. Research shows that many farmers work excessively long hours and seldom take a break from the farm. It is important to review where your farm work-time is going and to plan changes if you are not able to make time for rest. Farmers who work off-farm should review their total workload.

Sleep

Are you getting enough sleep? Sleep is essential for the physical and mental wellbeing required to carry out your everyday tasks effectively and safely. You should be aiming to get at least seven-to-eight hours of sleep per night. Make sure you have a routine that works for you and stick to it.

Diet

Diet and weight control is vital for health. Findings from an Irish study indicate that these are areas needing attention to prevent cardiovascular disease and cancers. This same study showed that 62% of participants were overweight or obese. Regarding the diet of farmers, it was reported that 60% consumed fried food more than once weekly and 17% consumed processed meats most days. Fruit and vegetable consumption was low, with 94% eating less than five portions, while consumption of sugary/ salty snacks between meals was high (60%). The HSE Healthy Eating Guidelines provide excellent guidance on making dietary changes.

Exercise

Irish research has shown that farmers achieve more than the internationally recommended 10,000 steps per day but that they also have a high sitting time of over eight hours per day. A study by a cardiology team at the University of Galway has shown that farmers do not get enough moderate-to-vigorous-intensity physical activity (MVPA) – the kind of exercise that provides cardiovascular disease protection. At least 30 minutes of moderate-intensity activity five days per week (or 150 minutes per week) is recommended. Moderate-intensity activities include brisk walking, cycling or swimming – activities that cause your breathing to quicken, but you are not out of breath, although you may sweat a little.

Health and farming

Physical health, mental health, farming practices, farm safety and lifestyle are all inter-connected. For instance, farmers in poor health are more likely to suffer accidents. Disability associated with poor health or the results of an injury leads to reduced farm income. Controlling the workload, taking breaks, adequate exercise, diet and weight control are all associated with positive mental health. The challenge lies in making the changes to reap the benefits. Connect with some person or group who can assist in making positive changes. Before embarking on major changes, always consult your GP for a check-up and advice.

Positive mental health and wellbeing

We can all go through low points from time-to-time time in our lives and it is common to experience symptoms related to stress, anxiety and depression. It is important to recognise the symptoms of these conditions in oneself and to seek support. Teagasc has a leaflet available entitled “Positive Mental Health in Farming” while the H.S.A and the Farm Safety Partnership have published a booklet called: “Farmers’ Health and Wellbeing – A guide to staying healthy while farming”. There are a number of organisations that promote positive mental wellbeing in Ireland. These include Mental Health Ireland, Samaritans Ireland and Embrace Farm, who support Farm Families after a farm accident or ill health.

Preventing accidents with cattle

On Irish farms, livestock deaths make up 19% of all deaths and 42% of farm accidents. Cows or heifer accidents account for 33% of livestock-related deaths, with bulls (18%), horses (8%), bullocks and other cattle (41%) accounting for the remainder. The notable trend is that the percentage of cow/heifer incidents causing death has increased dramatically in the last decade so additional precautions with this livestock group are required. Farmers are advised to keep a bull’s temperament under constant review, have a ring-and-chain fitted, keep a bull in view at all times and always have a means of escape or refuge. Breeding cattle for docility should always be considered.

The behaviour of animals when handled can differ greatly, ranging from fractious to docile. Unfamiliarity to environment, facility or procedures performed while the animal is restrained in the crush facility, can often lead to agitation. A recent study at Teagasc Grange, funded by the DAFM ‘BeSafe’ project, found that cattle behaviours to external stimuli change over time, as the animals get more familiar with their surroundings. The study showed that animal origin, breed and frequency of handling all impact on behaviour in some form.

Preventing machinery accidents

Vehicle and machinery-related deaths account for 53% of all farm deaths. For vehicles, being struck (25%) is the most frequent cause of death followed by being crushed or trapped by the vehicle (24%), fall from vehicle (12%) and being pierced by a vehicle part (2%). With machinery, being crushed (23%), struck (18%) or collapse (18%) are the most frequent causes of death followed by power drive entanglement (14%). The fatality data shows that most accidents occur due to being crushed or struck, so safety vigilance is especially needed when in proximity to moving vehicles/ machines. Entanglement deaths and serious injuries are particularly gruesome and occur most frequently with machines used in a stationary position, such as a vacuum tanker or slurry agitator where contact can occur between the person and the power take-off (PTO). Quads (ATV's) are useful machines on farms for travel but they have a high risk of death and serious injury if miss-used.

All-terrain vehicle (ATV) safety

Using an all-terrain vehicle (ATV) can very easily, and suddenly, cause a serious or fatal injury on impact. When an ATV turns over it can crush the chest area with its weight or cause an impact injury. Between 2013 and 2022 there have been 10 farm fatalities involving quads; two individuals were under-18 and six were over-65 years of age (HSA). Many more have been left with life-changing injuries. In terms of legal requirements, under Regulation: S.I. No. 619 of 2021, *all operators using an ATV/quad for work must have undergone an ATV training course provided by a registered provider to a QQI standard or equivalent before using it. The law also places a requirement on the operator to carry out a risk assessment of ATV operation and to wear personal protective equipment (including a helmet).* There is an increasing trend towards people considering a slightly larger Utility Vehicle (UTV) with a cab or roll over protection that will carry two people.

Agricultural vehicle standards for public roads

Revised standards for use of agricultural vehicles on public roads are in place. In addition to the vehicle, the standards include both trailers and attached machines. The purpose of the standards is to enhance the safety of road users. A booklet on the revised standard can be downloaded from the RSA website at: http://www.rsa.ie/en/RSA/Your-Vehicle/Vehicle-Standards/Agricultural-Vehicles/

Key requirements of the new legislation include:

- Braking: More powerful braking systems will be required for agricultural vehicles operating at speeds in excess of 40 km/h. Most correctly maintained tractors, which have come into use in the past 30 years, already meet these requirements.
- Lighting and visibility: Agricultural vehicles will need to be equipped with appropriate lighting systems, flashing amber beacons and reflective markings.
- Weights, dimensions and coupling: New national weight limits have been introduced. These will enable tractor and trailer combinations which are un-plated to continue in use at limits which are safe for such vehicles. Plated tractors and trailer combinations can operate at higher weight limits of up to 24 and 34 tonnes for tandem and triaxle agricultural trailers, respectively, that meet certain additional requirements.

Preventing deaths with slurry

Farm deaths associated with slurry and water account for 10% of farm deaths with the majority of these being drowning. Particular care is needed when slurry access points are open and physical guarding needs to be put in place. Slurry gases are a lethal hazard on cattle farms. Hydrogen sulphide is released when slurry is agitated and in calm weather can be present at lethal levels. The key mitigating controls are to pick a windy day for agitating, evacuate all persons and stock from housing and open all doors and outlets. A range of other gases, including methane, ammonia and carbon dioxide, are produced from slurry due to fermentation in semi-emptied tanks. Never enter a slurry tank as lack of oxygen or the presence of poison gases could be fatal. Also, never have an ignition source near a slurry tank due to the methane explosion risk.

Construction health and safety on farms

Farm maintenance, building, construction and demolition work are high-risk activities undertaken from time-to-time on farms. Every year fatal and serious injuries occur on farms including when construction work is in progress. Thirteen farm construction related deaths occurred on farms where farmers between 2013 and 2022. The major triggers for farm construction fatalities include: falls from heights, collapse of objects (e.g. a wall), and loss of control of vehicles. To ensure work is planned, managed and adequately supervised it is a legal requirement to make key appointments prior to construction work starting. This includes selecting and appointing a person/s (in writing) to take on the responsibility of safety management of the project. Such appointments protect farmers (clients) against possible prosecution in the event of an accident on a construction project. By making appointments a farmer passes on the responsibilities of the safety management of the project to the Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) and this will reduce the likelihood of accidents on projects. A booklet, "How to Make Construction Appointments for Your Farm" has been issued to all farmers by H.S.A and DAFM in association with the Farm Safety and Construction Safety Partnerships to the H.S.A.

To learn more on Construction Safety, visit the H.S.A website https://www.hsa.ie/eng/publications_and_forms/publications/agriculture_and_forestry/how_to_make_construction_appointments_for_your_farm_-_guidance.pdf

FBD Insurance, H.S.A. and Teagasc have prepared a booklet "Build in Safety – An Advisory Booklet for Farmers", outlining how to comply with SHWW Construction Regulations, which is an important reference source.

Targeted Agricultural Modernisation Scheme (TAMS 3)

Grant aid is available through the various TAMS Schemes. Full details of each scheme are available on the Department of Agriculture Food and the Marine (DAFM) web site at http://www. agriculture.gov.ie/farmerschemespayments/tams/. The principle areas where funding is available include: slurry aeration and access manholes; electrical installations and lighting; livestock handling facilities, safety rails and sliding doors. It is mandatory that all applicants will have completed, within the five years prior to the submission of their claim for payment, the half-day Farm Safety Code of Practice course (given by Teagasc or other trained persons) or the FETAC Level 6 Advanced Certificate in Agriculture (Green Cert). The claim for payment will not be processed until evidence of completion of the course is provided. It is recommended to discuss a TAMS application before submission with an advisor, to optimise the benefit.

Accelerated Capital Allowance scheme

An Accelerated Capital Allowance programme for farm safety and disability adaptation equipment is in place. Normal capital allowances are available at 12.5% per annum (p.a.) over eight years for agricultural equipment generally. This scheme allows for accelerated capital allowances of 50% per annum over two years for certain eligible equipment. This eligible equipment includes; chemical storage cabinets, anti-backing gates, big-bag lifters, quick hitch mechanisms for rear and front three-point linkage to enable hitching of implements without need to descend from tractor, as well as adaptive equipment to assist farmers with disabilities. Full details of the scheme are available on the DAFM web site at https://www.gov.ie/en/publication/4133b-farm-safety/?referrer=http://www.gov.ie /farmsafety/

Safety of children on farms

The safety of children and young persons must be paramount on farms. The following precautions need to be considered when children are present on a farm:

- Provide a safe and secure play area for children away from all work activities. Where children are not in a secure play area a high level of adult supervision is needed.
- Children should not be allowed to access heights.
- Action should be taken to keep children away from dangerous areas such as slurry tanks. All open water tanks, wells and slurry tanks should be fenced off.
- Give children clear instruction on farm safety issues.
- Children to be carried in the tractor cab (aged 7 or older) need to wear a seat belt.

The renowned safety booklet for children "Stay Safe with Jesse" is a key reference.

Sustainable Use of Pesticides Directive

The purpose of the EU Sustainable Use Directive is to put a legislative system in place to ensure that farm pesticides are used responsibly, safely and effectively, while safeguarding the environment. Professional pesticide users (PU) must be registered with DAFM and have a PU Number. Famers are classified as professional pesticide users. In order to register, a farmer must have completed a training course provided by an approved training provider. A list of training agencies is provided on the DAFM web site at http://www.pcs.agriculture.gov.ie/sud/. In the event of a DAFM inspection, a farmer will be required to produce evidence of having completed appropriate training. All boom sprayers greater than 3 m boom width must be tested. The interval between tests must not exceed five years until 2025. A list of approved sprayer testers is available on the DAFM website.

Further Information

New and current information can be downloaded at the following web sites:

1. **https://www.teagasc.ie/rural-economy/farm-management/farm-health--safety/**
2. **H.S.A.: http://www.hsa.ie/**

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