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Teagasc Sheep Open Day

Teagasc, Animal & Grassland Research and Innovation Centre

Saturday 18th June, 2022

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Agriculture and Food Development Authority

SHEEP OPEN DAY 2022

18th June, 2022

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Table of Contents

SUSTAINABLE SYSTEMS

GENETICS & BREEDING

FLOCK HEALTH

HILL SHEEP

ECONOMICS AND OUTLOOK

ENVIRONMENT

UPLAND EIP PROJECTS

FORESTRY

HEALTH & SAFETY

BIA INNOVATOR

Foreword

It is my pleasure to welcome you all to Athenry today for our Teagasc Sheep openday. This booklet collates and summarises a significant body of knowledge on technical issues relating to sheep production and should prove a valuable reference for sheep producers.

The latest published sheep census statistics (Dec 2021) show that there were 36,163 flocks in Ireland, an increase of 1.6% from 2020. Sheep farming is a significant part of our agricultural industry with more than 1 in every 4 farms in Ireland involved in sheep production. The number of breeding ewes increased by 2.1% on 2020 figures to 2.7 million ewes.

Bearing this in mind, the objectives of the Teagasc sheep research programme are to increase the productivity, sustainability and competitiveness of Irish sheep production systems. Currently, the main research focus areas include production efficiency from grazed grass with and without the inclusion of companion forages, increasing genetic gain through selection of high genetic merit animals, understanding the anthelminthic resistance status of your flock and adopting best practice in terms of animal health, investigating methods of finishing store lambs, in particular hill lambs and investigating factors affecting methane output in sheep systems including animal type, genetic merit, feed intake and diet type.

The research centre at Teagasc Athenry has 138 ha of grazing land, which hosts 900 ewes (pedigree and non-pedigree), 300 male and female replacements, 80 mature rams, and 850 finishing lambs. There are six primary sheep research officers, one post-doctoral researcher, five technicians, four technologists and six Walsh Scholars across the entire research programme. The sheep research programme is actively involved with industry partners, particularly through our stakeholder committee and works in tandem with our knowledge transfer colleagues. In addition, there are multiple collaborative projects with national and international collaborators including Sheep Ireland, DAFM, UCD, UCC and NUIG.

The Teagasc BETTER farm sheep programme establishes focal points for the on-farm implementation, development and evaluation of technology that is relevant to the sheep sector. Currently the programme, which has both lowland and hill farms, has 13 participating flocks spread across the country and is built upon active collaboration between the participating farmer and Teagasc Research and Advisory staff.

In recent years outputs from the sheep programme have demonstrated the ability to increase lamb meat production from increasing stocking rate and weaning

rate within a grass based system, enhancing animal performance through the use of high genetic merit animals, factors affecting animal behaviour at lambing and ultimately lamb mortality, controlling and mitigating the progression of anthelminthic resistance and developing profitable lamb finishing systems. We are currently in a time of unprecedented challenges, from very high input prices to Brexit to climate change, but thankfully lamb prices are also at very high levels. Knowledge and technology have an important role to play in being resilient to these challenges. Continuous generation of new information is critically important and the incorporation and application of this information into on-farm production systems must be the on-going aim of all sheep farmers.

Lastly, I would like to thank you for joining us today and to all of the Staff and stakeholders who assisted with the organisation and delivery of today's event.

Professor Frank O'Mara

Director, Teagasc

Sheep Open day 2022 – Welcome

Philip Creighton[1] and Michael Gottstein[2]
[1]*Sheep Enterprise Leader, Teagasc, Athenry, Co Galway*
[2]*Head of Sheep Knowledge Transfer, Teagasc, Macroom, Co Cork.*

On behalf of everyone involved in organising this open day it is our pleasure to be able to welcome you to Athenry today. While the virtual events which we held over the last two years were enjoyable we are delighted that we can open the gates again and meet with you all in person. This open day presents an opportunity to review the latest research and technical advice from the Teagasc Sheep programme. Today we will be dealing with all the main areas important to Irish sheep production with a mix of technical presentations and interactive workshops and demonstrations.
On our first main stand we will be discussing **Sustainable Systems** looking at the role of white clover swards and other companion forages to enhance animal performance and deal with the economic and environmental challenges facing the sector
The theme of our next stand will be **Breeding for longevity** where we will present up to date information on maternal genetic index selection for sheep and how replacement strategies and management can impact ewe longevity and output
On stand three we will be dealing with **The parasite challenge** and the ever-increasing anthelmintic resistance issue facing the industry and the key actions we can take to slow the development of resistance.
And finally on stand four we will be covering **Hill Sheep** production , presenting results from the ongoing hill lamb finishing studies here in Athenry , as well as updates from the Teagasc BETTER farm sheep programme.
In addition, a series of workshops and interactive demonstrations will deal with topical issues relating to each of the main areas of sheep production with a special emphasis this year on the current challenges around Feed and Fertiliser costs and steps that can be taken to address this issue.
There will also be an opportunity to review the wider research programme and meet with Advisors, researchers, students and technical staff.
We are delighted to be able to host in person events again. Make use of the day, ask plenty of questions and consider the take home messages from the different papers and presentations and focus on implementing some of these messages on your own farms.
Finally a special word of thanks to all who have contributed to make today happen and to our sponsors FBD insurance.

SUSTAINABLE SYSTEMS

Sustainable sheep systems in Ireland

Fiona McGovern[1], Philip Creighton[1], Noirin McHugh[2] and Jonathan Herron[2]

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Take Home Messages

- Methane, a waste energy by-product from ruminant animal digestion accounts for 57% of agricultural greenhouse gas emissions (GHG)
- There are multiple management decisions we can take to reduce our farm emissions including maintaining soil fertility, improving grassland management, dietary efficiency and using animals of high genetic merit
- Research ongoing at Teagasc is identifying the impact of these management decisions to increase profitability and reduce farm gate GHG
- The onus is on each of us to make sustainable farming decisions including maintaining an appropriate work life balance which can often be forgotten.

Introduction

There are 10.47 million ruminant animals in the Republic of Ireland (CSO, 2020). These numbers can be further broken down into 6.66 million cattle and 3.81 million sheep of which 2.81 million are breeding ewes (CSO, 2020). Globally, the agri-food sector is facing the challenge of increasing food production while committing to reducing greenhouse gas emissions, improving water quality and maintaining or improving natural biodiversity levels, each in a sustainable manner. Sustainability is a term we hear quite frequently and can be defined as the ability to maintain at a certain rate or level thus upholding the balance of resources. There are three main dimensions to sustainability namely: environmental, economic and social. Therefore the decisions we make in our farming enterprises should encompass each of these pillars in order to be financially profitable, supportive of the environment and socially acceptable. This paper will focus predominantly on environmental sustainability in sheep systems however there are multiple papers throughout this booklet covering each pillar of sustainability. The Irish pasture-based system

of farming has many advantages however demanding national and international policy targets require system adaption and the acceptance that being sustainable is an integral part of our national agri-food system.

Greenhouse Gases

Ireland's agricultural industry currently contributes 37.1% of total national greenhouse gas (GHG) emissions in 2020. Within the agricultural industry, methane, produced via enteric fermentation, is the highest contributor at 57.5% (Figure 1).

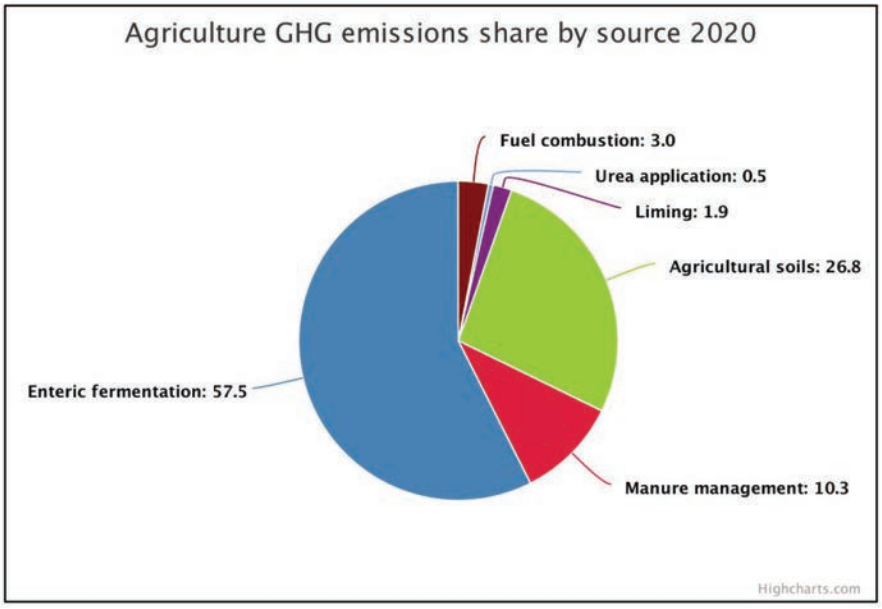

Figure 1. Agricultural greenhouse gas emissions by source in 2020 (EPA, 2022).

The Irish government have committed to climate neutrality by 2050 with significant progress by 2030. Consequently, there is a commitment to reducing total GHG emissions by 51% by 2030, relative to the 2018 emissions. This will put pressure on all sectors within Ireland to play a role in reducing emissions. Although methane emissions contribute over half of the agricultural industry's emissions there has been little research completed in pasture-based systems until recently, due to the complicated measurement process.

Although methane is the second biggest contributor to greenhouse gas in Ireland, nitrous oxide is also a main contributor from the agricultural industry, generating 93.4% of nitrous oxide emissions in 2020. In addition, agriculture accounts for 99.4% of the ammonia (NH_3) emissions in Ireland with 47.1% of the emissions associated with manure housing and storage, 30.1% with slurry spreading, and, on average, 12.3% and 10.6% with manure deposition at pasture and N fertiliser, respectively. Positively there has been a 7.2% decline in overall NH_3 emissions from Ireland in recent years.

Life cycle assessment modelling – The Carbon footprint from sheep

Life cycle assessment (LCA) is an internationally recognized methodology used to determine the environmental impact of all stages embodied in the life of a product or production system. The agricultural sector has adopted LCA to take a holistic view of production systems, determine their environmental impact and assess the effect of management practices as a whole. Agricultural LCA can be used to calculate the environmental impact up to the point in which the animals leave the farm gate. By applying this boundary, LCA can identify the key emission sources and management practices that have the potential to reduce emissions. To realise the potential of available mitigation strategies and to ensure the agricultural sector meets the 22-30% reduction target outlined in the national climate action plan, it is vital to first determine the performance of an average production system. This sets a benchmark to which efficiency improvements can be compared. A LCA of an average lowland production system was therefore conducted. Data for flock performance and management practices was obtained from the Teagasc National Farm Survey. Based on the adoption of a range recommended management practices, an ambitious but realistic target production system can be established. This study investigated the effect of reducing concentrate feeding (103kg per ewe to 50 kg per ewe), substituting nitrate fertiliser with protected urea (90% nitrate based to 100% protected urea) , and the incorporation of white clover into swards (reducing the synthetic fertiliser requirement by 20%).

The GHG intensity of an average lowland system was calculated as 10.6 kg CO_2eq/kg live weight, lower than the global average of 11.3 kg CO_2eq/kg liveweight. Methane contributed 66% of total GHG emissions, predominantly sourced from enteric fermentation. Nitrous oxide from fertiliser application, managed manure and manure excreted during grazing contributed a further 21% of total GHG emissions. The remaining 13% of total GHG emissions was sourced from the production of concentrate feed, fertiliser and the consumption of fossil fuels (i.e. diesel). The combination of reducing reliance on concentrate feed, protected urea,

and the incorporation of white clover into swards was reported to mitigate total farm GHG emissions by 7.8%, reducing the GHG intensity of a lowland sheep system from an average of 10.6 kg CO_2-eq/kg live weight to 9.8 kg CO_2eq/kg live weight (Figure 1).

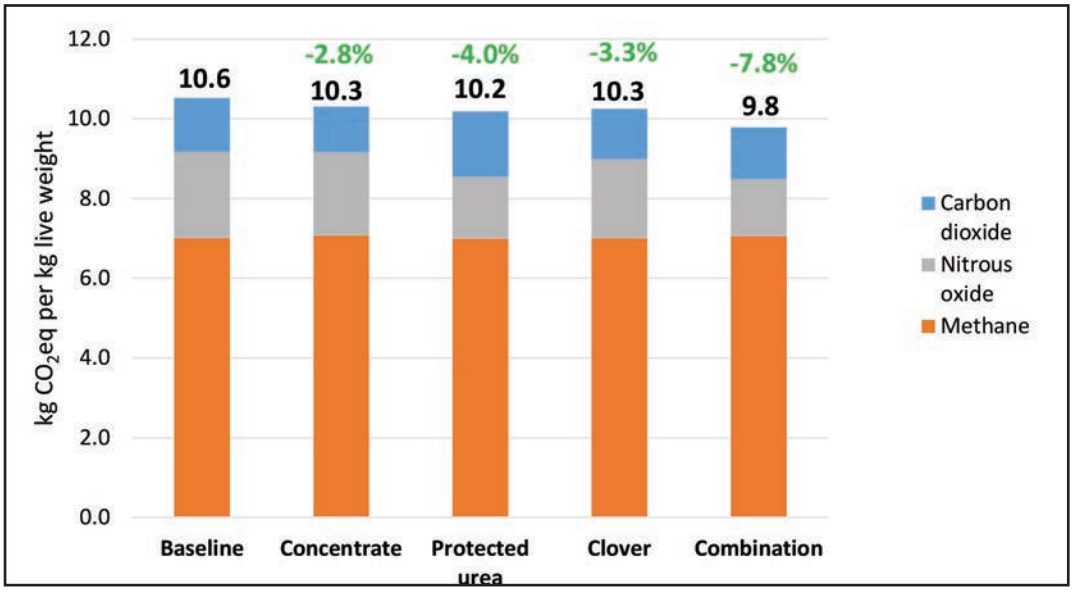

Figure 2. The greenhouse gas intensity (kg CO_2eq/kg liveweight) of an average lowland sheep system (Baseline) and the mitigation potential of reducing concentrate feeding, using protected urea and incorporation of clover into swards.

Measuring methane in sheep

To further enhance our LCA models and the contribution of sheep farming enterprises to our national greenhouse gas inventory it is critical that research is undertaken to determine baseline values of methane emissions from pasture based systems. Since late 2019, research has been ongoing at Teagasc Athenry, to determine the ranking of methane output from sheep varying in stage of production, age and consuming varying diet types. In ruminant animals methane is produced as a by-product of fermentation i.e. the digestion of forage material, through a process called methanogenesis whereby, methane producing bacteria convert excess carbon and hydrogen in the rumen to methane. This methane is then excreted from the animal as a waste product. Interestingly 89% of methane is excreted through eructation (burping). Portable accumulation chambers (PAC) are

a low cost, high throughput method of ranking animals based on their methane output and are currently being used to quantify methane output from sheep. To date over 7,000 records of methane output are available on over 2,500 animals representing various ages, breeds and stages of production across the Irish sheep population. Animals enter the PAC for a 50min period within which methane production is recorded at 0, 25 and 50min after animal entry. Using the PAC allows for animals to be measured while at pasture with a throughput of 72 animals per day being recorded. Importantly the PAC enable the ranking of animals however the methane output recorded cannot be taken as the absolute methane production of the animal. Research undertaken at Teagasc has compared the PAC to the 'gold' standard method of measuring methane, respiration chambers, with a strong relationship identified between both measuring techniques. Further work is however required to establish the absolute methane output from the Irish sheep population which will be acceptable for use in the national inventory.

Mitigation strategies

The onus is now on all of us, whether members of the agricultural industry or not, to review our day to day practices and management decisions in order to facilitate the national mitigation of greenhouse gases in line with government targets. From a sheep farming perspective there are a number of measures which can be taken from assessing and maintaining soil fertility, improving grassland management, to increasing flock productivity, reducing lambs days to slaughter and incorporating white clover into grazing swards. The Teagasc Signpost programme in conjunction with the Teagasc sheep research team have compiled a list of twelve actions which sheep farmers can do to play their part while also increasing their on-farm profitability and overall efficiency. These actions are further outlined later in this booklet (Kearney et al., 2022). Research carried out at Teagasc shows the potential for breeding a more sustainable animal with animals ranked as 5 star on the Sheep Ireland €uro-star indexes producing 7% less greenhouse gases per unit of output (i.e. carcass weight). Further research into the genetic influence over methane production in sheep has identified that methane production is heritable (i.e. the trait is under genetic control and can be passed from one generation to the next). From a sward perspective, when the methane output of animals grazing swards incorporating white clover, red clover or plantain was investigated it ranked on average 12% lower than those grazing perennial ryegrass only swards. Of the three companion forages offered alongside perennial ryegrass the inclusion of white clover has the largest impact with a 14% reduction in the ranking of methane output.

Conclusion

While we are at a crossroads whereby the management decisions we make will directly impact our national GHG emissions and contribute to overall governmental targets it is important to remember that the measures being outlined for sheep farmers will lead to economic benefits in addition to lowering farm gate GHG. Results from LCA modelling and research being carried out at Teagasc highlight the advantages of the Irish pasture based production system both environmentally and economically through the uptake of soil, grassland, animal and manure management practices.

Benefits and management of white clover swards for sheep

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Take Home Messages

- Incorporating white clover into sheep grazed swards can reduce lamb days to slaughter
- Grass - white clover swards require less chemical N compared to grass only swards
- Financial impact increased relative to current N cost
- Establishment planning and management are key to success

Introduction

Ireland's competitive advantage in sheepmeat production is based on the efficient production and utilisation of pasture. Challenges facing the agricultural sector are based on maintaining or improving current levels of production to maintain an economically viable sector but with an enhanced focus on environmental sustainability and a reduced dependence on chemical nitrogen (N) use. Perennial ryegrass is the most dominant forage grown in Ireland. It can produce high dry matter yields, especially in spring and autumn, reducing the seasonality of production. It does however require relatively high levels of chemical N to maximise its growth potential. The incorporation of white clover into pasture based production systems reduces the quantity of chemical N needed, and increases the N use efficiency of the farm system.

Grazing study

Ongoing grazing systems research at Teagasc Athenry is focusing on the impact of incorporating white clover into sheep grazed swards on the productivity of pasture based lamb production systems with special focus on the animal and the associated environmental and economic impacts. This study is evaluating the incorporation of white clover into sheep grazed swards at two-fertiliser N and stocking rate levels.

The two stocking rate levels are 11 or 13 ewes/ha with three pasture treatments at each stocking rate:

i) Grass-only receiving 145 kg N/ha per year (GO HN)
ii) Grass-white clover receiving 145 kg N/ha per year (GC HN)
iii Grass-white clover receiving 90 kg N/ha per year. (GC LN)

Key findings to date show that the inclusion of white clover in the sward relative to perennial ryegrass alone resulted in lambs reaching slaughter weight up to 10 days faster, although this was reduced to only 5 days for the 13 ewe/ha, low N group (Figure 1).

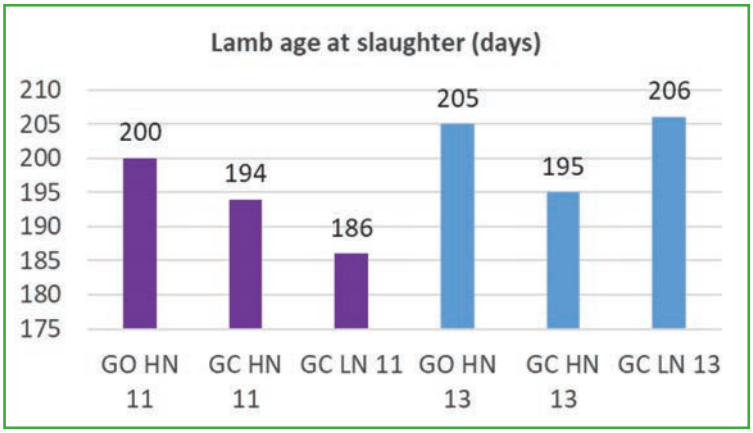


Figure 1. Lamb age at slaughter as influenced by sward type, stocking rate and nitrogen application rate

In terms of sward DM production on average across stocking rate treatments, the grass only swards have grown 13000kgDM/ha, grass clover swards at 145kg N/ha grew 13100kg DM/ha and the grass clover swards at 90kg N/ha grew 12700kg DM/ha. While little difference is evident on average between sward treatments there is a stocking rate effect on sward DM production (Figure 2). At the 11 ewes/ha stocking rate there is a marginal increase in sward DM production from the addition of white clover to the sward and positively the low N clover treatment is higher yielding than the grass only, high N treatment. At the higher stocking rate of 13 ewes/ha however the low N clover treatment is not able to match the grass only high N treatment and is unable to support the higher demands of this system. A consequence of this can be seen in the higher days to slaughter figure for lambs in the low N clover treatment at the 13 ewes/ha, in comparison to the 11 ewe/ha treatment (Figure 1).

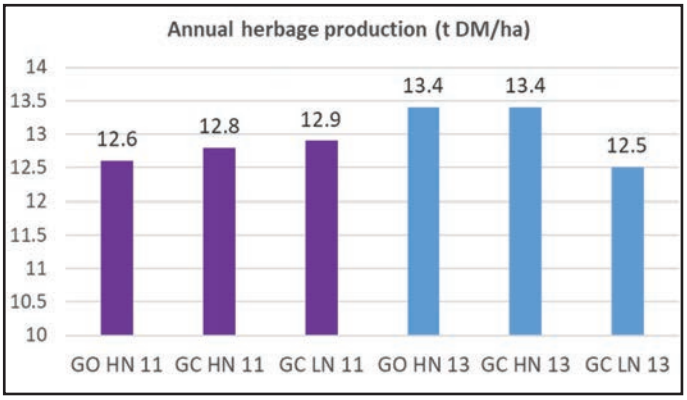
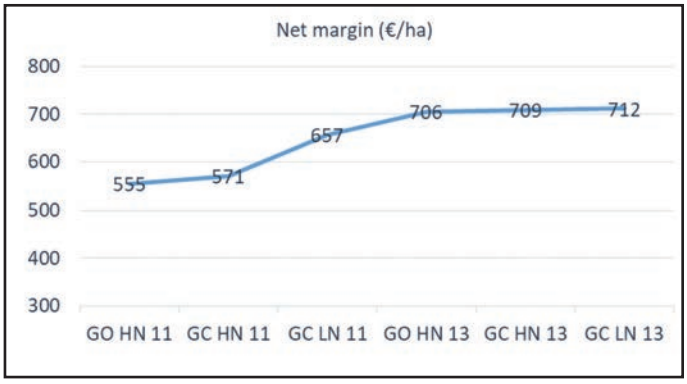


Figure 2. Sward DM production as influenced by sward type, stocking rate and nitrogen application rate

From a financial point of view the lower costs associated with the low N clover treatment in the 11 ewe/ha stocking rate has resulted in it being able to almost match the financial returns observed at the higher output, higher stocking rate 13 ewe/ha systems (Figure 3). Due to the lower DM production levels observed in the low N clover treatment at the 13 ewe/ha stocking rate (Figure 2) additional concentrate supplementation was required to finish lambs and so any savings on nitrogen fertiliser costs were absorbed by higher feed costs. As a result it can be concluded that while the lower stocking rate 11 ewe/ha treatment had a lower lamb output in this study the lower input costs resulting from a 40% reduction in chemical N fertiliser usage and the ability of the lambs to finish from a mainly forage based diet resulted in no loss of financial income. These calculations do not take into account the significant increases in both the cost of fertiliser and concentrate feeds in 2022, which would have an even bigger impact.



*Excluding direct payments and labour

Figure 3. Financial returns per hectare as influenced by sward type, stocking rate and nitrogen application rate

Management of white clover and factors to consider

White clover needs a higher soil temperature for growth than grass. Grass starts growing at soil temperatures of 5-6°C while clover needs a soil temperature of 8°C to start growing. As a result the contribution of clover to the sward in early spring is low. As we have a requirement for pasture to feed ewes in early spring, N fertiliser will still need to be applied at similar rates to those used in grass-only swards. In the summer when sward clover content is increasing N fertiliser application can be reduced or eliminated depending on stocking rate level and pasture demand. Some N fertiliser is required in autumn to ensure pasture availability for the autumn/winter period. Suggested N application rates for grass-clover swards with average annual white clover content of 15% or greater are shown in Table 1.

Table 1. Nitrogen fertiliser application strategies/rates by rotation for white clover in sheep swards (up to 2.0 L.U/ha)

Date (rotation)	N fertiliser application (kg N/ha)
Late Feb/Early March	20
April (2nd rotation)	20
May (3rd rotation)	12
June (4th rotation)	12
Late July/Early August	12
Early-Sept (7th rotation)	14
Total	**90**

Other companion forages

In addition to the ongoing study on the contribution of white clover to sheep grazing systems, work is also ongoing focused on the role that other companion forages such as Red clover, Plantain and Chicory could have on animal intake, performance and output. This work is part of the PhD studies of Teagasc Walsh Scholars Lisa McGrane and Sarah Woodmartin in collaboration with UCD. Detailed component work focusing on both the agronomy and nutritional aspects of these forages is the focus of this work. Separate papers on this work are also included in this booklet.

Acknowledgements

The authors would like to thank the technical and farm staff at Teagasc Athenry for their work throughout this study and also acknowledge the help and support of the staff of the Grassland Research Department Teagasc.

The effect of the addition of a companion forage to a perennial ryegrass sward on ewe and lamb performance

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Take Home Messages

- Lamb performance significantly improved when grazing swards including a companion forage
- Lambs finished between 15.8-28.6 days earlier than those grazing perennial ryegrass only
- Larger effect on post-weaning lamb performance than on pre-weaning lamb performance

Introduction

Ireland's competitive advantage in sheepmeat production is based on the efficient and cost effective production and utilisation of pasture. Perennial ryegrass is the most commonly sown grass variety, capable of producing high nutritive value dry matter yields, although can require relatively high inputs of chemical nitrogen. Numerous studies have shown improvements in both sward and animal performance when grazing more diverse sward types in comparison to perennial ryegrass monocultures. Incorporating legumes such as white or red clover into a sward can help reduce the chemical nitrogen requirement of the sward through biological nitrogen fixation. Deep-rooting herbs such as plantain and chicory are associated with good drought tolerance, have high mineral contents, and chicory has also been associated with a reduced parasite burden in ruminant livestock. The objective of this study was to assess the influence of binary mixtures of perennial ryegrass plus a companion forage on lamb performance at pasture. There were 23 ewes and their lambs grazing on each of the five sward mixtures compared namely, i) perennial ryegrass (PRG), ii) PRG and white clover (PRG+WC), iii) PRG and

red clover (PRG+RC), iv) PRG and plantain (PRG+Plan) and v) PRG and chicory (PRG+Chic) in each of the years 2018-2021. Lambs were weaned at 15 weeks of age and drafted at a live weight of 42kgs in June, which was increased by 1kg per month thereafter to produce a target carcass weight of 20 kg.

Lamb performance

As presented in table 1 below, lamb performance was improved with the inclusion of a companion forage to a perennial ryegrass sward particularly in the post-weaning period. Post-weaning lambs grazing all mixed sward types had a higher ADG than the PRG lambs, where as in the pre-weaning period PRG+RC lambs were the only group which performed better than the PRG lambs. The inclusion of a companion forage to a perennial ryegrass sward led to 17-31 g/day higher lifetime ADG, which resulted in lambs reaching the appropriate slaughter weight between 15.8 and 28.6 days ahead of those grazing perennial ryegrass only. Lambs which did not reach the required slaughter weight from pasture only were housed and finished on an intensive concentrate based diet. Reductions in days to slaughter resulted in significantly fewer lambs requiring housing for finishing. As a result, on average a lamb grazed on swards containing a companion forage received between 6.1 and 11.3 kg concentrates less than those grazing on perennial ryegrass only swards.

Table 1. The effect of sward type on lamb performance 2018-2021

	Sward Type					
	PRG	**PRG & WC**	**PRG & RC**	**PRG & Plan**	**PRG & Chic**	***P-value***
ADG Birth – Weaning (g day^{-1})	237^{a}	238^{a}	251^{b}	236^{a}	243^{ab}	<0.05
Weaning weight (kg)	29.5^{a}	29.5^{a}	31.1^{b}	29.7^{a}	30.2^{ab}	<0.05
ADG Weaning – Slaughter (g day^{-1})	133^{a}	155^{b}	162^{b}	158^{b}	176^{c}	<0.001
ADG Lifetime (g day^{-1})	182^{a}	204^{bc}	213^{b}	199^{c}	213^{b}	<0.001
Days to Slaughter	228.3^{a}	209.0^{bd}	199.7^{c}	212.5^{b}	200.1^{cd}	<0.001
Concentrates lamb drafted^{-1} (kg)	14.2^{a}	8.1^{b}	2.9^{e}	6.0^{c}	3.5^{d}	<0.001

^{a,b,c,d,e} Within rows, means with differing superscripts differ significantly.

As shown in table 2, there was no effect of sward type on lamb carcass weight, carcass conformation, fat score or kill out percentage.

Table 2. The effect of sward type on lamb slaughter data 2018-2021

	Sward Type					
	PRG	**PRG & WC**	**PRG & RC**	**PRG & Plan**	**PRG & Chic**	***P-value***
Carcass Weight (kg)	20.7	20.6	20.7	20.6	20.4	NS
Carcass Conformation	2.44	2.52	2.61	2.57	2.54	NS
Fat Score	2.97	2.94	2.86	2.81	2.81	NS
Dressing Proportion	0.45	0.45	0.44	0.45	0.44	NS

Carcass conformation was scored using the EUROP grid system (E=excellent and P=poor), and expressed where E=1, U=2, R=3, O=4, P=5, NS=Not significant.

Conclusions

The inclusion of any of the studied companion forages, white clover, red clover, plantain or chicory to a perennial ryegrass sward resulted in significant increases in lamb performance. The effects of these swards on ewe performance are discussed on page 24. The results of this study highlight the suitability of these binary sward mixtures for use in pasture based sheep production systems, and particularly for lamb grazing in the post-weaning period. The use of more diverse sward types has the potential to improve the efficiency and profitability of Irish sheep production, however appropriate sward management must be implemented.

Acknowledgements

The authors would like to thank the technical and farm staff at Teagasc Athenry for their contributions to this research. Funding from the Teagasc Walsh Scholarship programme is also gratefully acknowledged.

The effect of the addition of a companion forage to a perennial ryegrass sward on ewe performance

Lisa McGrane[1,2], Tommy M. Boland[2] and Philip Creighton[1]

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[2] *School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, Ireland*

Take Home Messages

- The addition of a companion forage had no significant impact on litter size or milk yield
- Ewe performance is similar when grazing swards including a companion forage compared to a perennial ryegrass only sward

Introduction

Grazed grass is the cheapest feedstuff available on Irish farms. Perennial ryegrass is the most commonly sown grass species on Irish farms however, in recent years there has been a large increase in interest in more diverse sward types with many reported benefits. At present there is ever growing interest in the use of clovers to reduce the inorganic nitrogen requirement of the sward, whilst the deep rooting herb components of the sward provide good drought tolerance and mineral uptake. Numerous studies have shown the potential for increased animal performance and output with the use of more diverse sward types. The objective of this study was to assess the influence of binary mixtures of perennial ryegrass plus a companion forage on ewe performance at pasture. Five sward mixtures were compared from years 2018-2021, namely, i) perennial ryegrass (PRG), ii) PRG and white clover (PRG+WC), iii) PRG and red clover (PRG+RC), iv) PRG and plantain (PRG+Plan) and v) PRG and chicory (PRG+Chic).

Ewe performance

Ewe performance was largely similar across all sward types. There were no differences in scanned litter size or milk yield as shown in table 1. Ewes grazing

PRG+RC and PRG+Plan however did have a greater litter weight than the PRG ewes, which is a combination of increased lamb birth weight in the PRG+Plan lambs and a numerical differences in litter size between the groups.

Table 1. The effect of sward type on ewe performance 2018-2021

	Sward Type					
	PRG	**PRG + WC**	**PRG + RC**	**PRG + Plan**	**PRG + Chic**	***P-value***
Scanned litter size (lambs ewe-1)	1.62	1.76	1.74	1.66	1.66	NS
Litter weight (kg ewe-1)	9.87[a]	10.03[ab]	10.57[bc]	10.77[c]	10.37[abc]	<0.01
Milk Yield (kg ewe-1 day-1)	1.97	2.04	2.06	1.65	2.17	NS

[a,b,c] Within rows, means with differing superscripts differ significantly, NS= Not significant.

As shown in tables 2 and 3 ewes across all sward types had similar body weights and BCS at mating, at scanning and at lambing. Ewes grazing PRG had a lower body weight compared to ewes grazing PRG+WC at 6 weeks post lambing and compared to PRG+WC and PRG+RC ewes at weaning, however there were no differences in ewe BCS at either of these time points. The next mating figures shown in tables 2 and 3 include only ewes retained from one production year to the next. At next mating ewes grazing PRG had a lower BCS than ewes grazing PRG+RC and PRG+Plan, and a lower body weight than the ewes grazing PRG+WC, PRG+RC and PRG+Plan. The differences in ewe body weight and BCS at the next mating measurement may be a result of improved lamb performance, where lower days to slaughter in the lambs leads to increased levels of herbage availability for the ewes approaching the mating season. Differences in ewe body weight and BCS shown in this study would not be considered to be large biological differences, however they do show that ewe performance can be at least maintained at a similar level to that of a PRG sward with the inclusion of a companion forage. In the current study, a leader follower grazing plan was implemented post weaning, with lambs grazing ahead of the ewes at all times. This system prioritises lamb performance during this period and also explains the lack of differences seen in ewe performance as lambs will selectively graze the forages more digestible components of the sward leaving very low sward forage contents available for the ewes.

Table 2. The effect of sward type on ewe body weight 2018-2021

	Sward Type					
	PRG	**PRG + WC**	**PRG + RC**	**PRG + Plan**	**PRG + Chic**	***P-value***
Mating weight (kg)	65.8	67.3	68.2	66.6	68.5	NS
Scanning weight (kg)	72.6	73.2	74.2	72.6	74.9	NS
Week 6 weight (kg)	66.1[a]	72.2[b]	68.1[a]	67.7[a]	68.9[ab]	<0.05
Weaning weight (kg)	62.0[a]	66.3[b]	67.0[b]	63.9[ab]	63.7[ab]	<0.05
Next mating weight (kg)	65.4[a]	69.1[b]	68.9[b]	68.3[b]	68.2[ab]	<0.05

[a,b] Within rows, means with differing superscripts differ significantly, NS= Not significant.

Table 3. The effect of sward type on ewe body condition score 2018-2021

	Sward Type					
	PRG	**PRG + WC**	**PRG + RC**	**PRG + Plan**	**PRG + Chic**	***P-value***
Mating BCS	3.13	3.08	3.12	3.17	3.14	NS
Scanning BCS	3.25	3.20	3.24	3.31	3.27	NS
Lambing BCS	3.07	3.01	3.01	3.02	3.06	NS
Week 6 BCS	2.70	2.93	2.80	2.80	2.75	NS
Weaning BCS	2.86	3.01	2.83	2.95	2.86	NS
Next mating BCS	2.98[a]	3.05[ab]	3.14[b]	3.13[b]	3.10[ab]	<0.05

[a,b] Within rows, means with differing superscripts differ significantly, BCS=body condition score, NS= Not significant.

Conclusions

Ewe performance remained largely similar or in some cases slightly improved with the inclusion of a companion forage, white clover, red clover, plantain or chicory to a perennial ryegrass sward. These results coupled with the improvements in lamb performance as shown in the corresponding lamb performance paper (pg 21) show the potential for use of these mixed sward types to increase lamb performance whilst at least maintaining ewe performance.

The effect of sward type on dry matter intake, digestibility and methane production in sheep

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Take Home Messages

- The inclusion of a companion forage in the diet increased dry matter intake (DMI) when compared to animals consuming a perennial ryegrass (PRG) only diet.
- When a companion forage was added to the diet methane (CH4) yield, (g CH4/kgDMI) ranked lower than the perennial ryegrass only diet in all scenarios.
- Methane production (gCH4/day) ranked 14% lower where white clover was included in the diet.

Introduction

Animal production from pasture-based systems is heavily influenced by DMI and the digestibility of the ingested feed. Perennial ryegrass is the most widely used forage in ruminant production systems across temperate regions due to its high digestibility and grazing tolerance. However, successful growth relies on high chemical fertilizer inputs making the sward less environmentally and economically viable as a feedstuff. The inclusion of companion forages alongside PRG in the grazed sward can increase the nutritive value and biodiversity of the sward, heighten an animal's motivation to eat and give the potential to produce greater dry matter yields from a lower chemical nitrogen input. Therefore, the objective of this study was to determine the effect of sward type on DMI, dry matter digestibility (DMD) and enteric CH_4 emissions in sheep.

Study Design

Twenty Belclare wether sheep were used to conduct this study whereby five dietary treatments were analysed over five feeding periods with four animals per treatment. Animals were housed in metabolism crates to facilitate intake and digestibility

measurements. The treatments investigated were PRG only or PRG plus white clover (PRG+WC), red clover (PRG+ RC), chicory (PRG+Chic) or plantain (PRG+ Plan). Diets were formulated at a ratio of 75% PRG and 25% of the respective forage on a dry matter (DM) basis. Herbage was harvested each morning and the specific allocations were offered to sheep as zero grazed herbage.

Results

There was a significant effect of dietary treatment on DMI whereby animals offered PRG plus a companion forage had higher DM intakes than animals offered PRG only. The DMD ranged from 793 g/kg DM (PRG and PRG+RC) to 804 g/kg DM (PRG+Chic), and was largely similar across treatments.

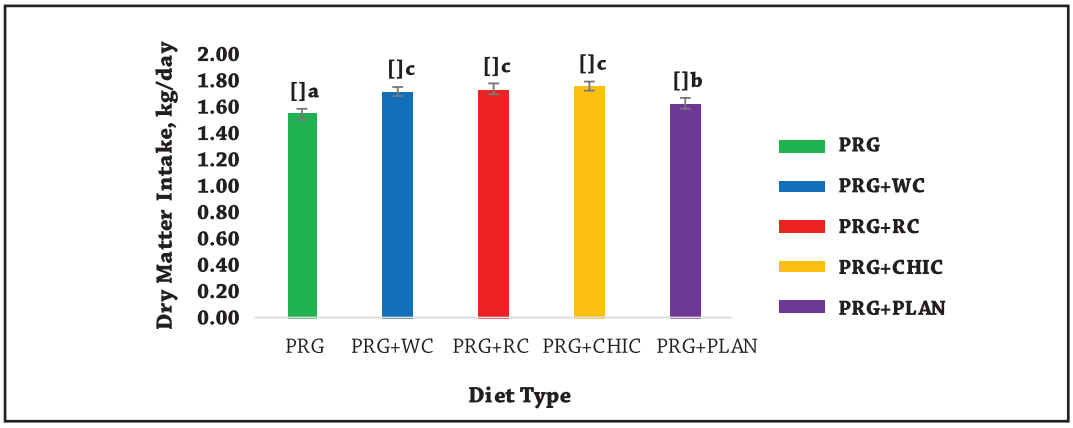

Figure 1. Average dry matter intakes by diet type

While DMI increased with the inclusion of a companion forage, CH_4 yield was reduced in all scenarios. Methane production ranked 14% lower than the PRG only diet with the inclusion of white clover in the diet.

Table 1. Methane production (g CH_4/day) and Methane yield (g CH_4/kg DMI) by diet type.

	PRG	PRG+WC	PRG+RC	PRG+Chic	PRG+Plan	SEM	P value
Methane Production (g CH_4/day)	21.90^{ab}	18.81^{c}	20.09^{bc}	22.29^{a}	21.15^{ab}	0.831	0.0001
Methane yield (gCH_4/kg DMI)	16.16^{a}	11.76^{c}	13.00^{b}	13.82^{b}	14.31^{b}	0.623	0.0001

Conclusions

Results indicate that sheep DMI is positively influenced by the inclusion of companion forages thus partially explaining their role in improving animal performance. There were small differences seen when DMD was investigated, unsurprising given the high proportion of PRG in each diet. The reduction in CH_4 yield among all animals offered a companion forage treatment requires further investigation albeit very positive in the development of potential enteric CH_4 emission mitigation strategies for ruminant animals.

Acknowledgements

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Over-sowing white clover in sheep swards

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Take Home Messages

- Full reseed is the most reliable method but over-sowing is a simple and low cost method
- Choose fields carefully - good fertility, high production potential, low weed content
- Sow as early in the year as possible (April onwards) to allow chance to establish
- Keep grazed at low grass covers to maximise light to base of sward

Benefits of white clover

White clover has the potential to reduce the amount of chemical nitrogen fertiliser required for grass production and also has been shown to improve lamb performance when included in grazing swards. While incorporating clover as part of a reseeding programme is the easiest way to introduce clover swards, over sowing into existing swards is another option to take advantage of the benefits of white clover.

Some of the key areas to focus on when oversowing white clover into sheep swards are:

Key areas to focus on

1. **Soil fertility:** Soil pH should be between 6.0 and 6.5, and soil P and K levels should be adequate (target index 3).
2. **Sward type:** For over-sowing to work, the clover seed has to come in contact with the soil. Therefore, over-sowing will work only where there is a reasonably open sward. For old dense swards and swards heavily infested with broad-leaved weeds, reseeding is a better option.
3. **Weed control:** Weeds, especially docks, should be controlled before over-sowing as once the clover is established the range of herbicides that can be used are more expensive and restrictive as a clover safe option must be selected.
4. **Preparation** Graze the sward you want to oversow tight <4cm or cut for silage to remove as much of the grass as possible.

5. **Sowing time and method:** The best time to over-sow is from April to July while soil temperatures are high to allow for good establishment. Moist soil conditions during and after over-sowing are crucial to success. Sow 6 to 7.5 kg seed per hectare (2.5 - 3kg/ac) of a small leaf clover variety. Small leaf clovers are more persistent under sheep grazing. Stitching the clover seed in with a drill/harrow works better with sheep grazed swards due to the denser nature of a sheep grazed sward compared to broadcasting into more open cattle swards.
6. **Post sowing.** Roll the seeds in if possible to ensure good seed soil contact. Reduce chemical nitrogen applications post sowing to give the clover seedlings a chance to compete with the existing grass sward. Graze frequently at low covers ~7cm (1000kg DM/ha) to allow as much light as possible into the base of the sward to allow for clover establishment and development.

Grass measuring and budgeting for sheep

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Take Home Messages

- Grass measurement and budgeting does not have to be complicated or expensive
- Sward sticks, rising plate meters and the quadrant and shears are common methods
- Measurement carried out on a regular basis can be used to aid management decisions

Introduction

To try and manage any business without knowing what the current and projected future basic inputs may be would not be accepted by the majority and sheep farming and grassland management should be no different. Once the basic building blocks of soil fertility, infrastructure and grazing management are in place the next step to getting more from grass is to develop grass measurement and budgeting skills.

Grass measurement to aid grazing management

Grass measurement and budgeting does not have to be complicated or expensive as is often the perception. There are a number of methods that can be used to measure grass supply on farms. The use of sward sticks, rising plate meters and the quadrant and shears method are all common. What method you use is irrelevant, the important thing is that some form of measurement is carried out on a regular basis which can be used to aid management decisions. Teagasc has developed an online grassland management decision support tool Pasturebase Ireland. Pasturebase Ireland enables the farmer to keep track of grass growth per paddock, the number of grazings per paddock and the quantity of grass being consumed at each grazing. This highlights poor performing paddocks and deficiencies in grazing management. This programme allows you to input grassland measurements and information on stock numbers. Using this information grassland management advice is generated based on your current grass supply and demand status to aid decision making on your farm. Table 1 shows an example of grassland management guidelines

	Kg grass DM/L.U	Days-ahead
M Apr	300	20
E May	250	15
M May	250	12.5
E June	200	10
Mid June	200	10
E July	200	15
Mid July	200	15
E Aug	250	17
M Aug	250	17
E Sept	250	20
M Sept	300	25
E Oct	350	30
M Oct	400	40

Table 1. Grass cover and days-ahead guidelines for sheep farms

developed through grazing trials on the Research Demonstration farm in Athenry that can be used to more accurately manage grass during the main grazing season to improve the management, utilisation and quality of swards offered.

A tool which can be used to aid the management and measurement of grass is the 'Grass wedge' concept. The idea of the grass wedge is that once a week the farm is walked and an assessment of the quantity of grass available on each paddock is made be it in terms of kg DM/ha or sward height. Paddocks are arranged from highest to lowest as shown in Figure 1 (overleaf). A line is then drawn from the point on the graph representing the target pre grazing yield down as far as the point on the graph representing the target post grazing yield. If paddocks are above the line you are in surplus or below the line in deficit. Where there is too much grass available the quality can deteriorate rapidly and on the other end of the scale if we continue to graze swards overly tight for a prolonged period in an effort to improve quality, growth rates can be reduced and we can run short of grass. The idea of the wedge is that we can recognise in advance what is coming down the line and take corrective action. Three words to remember when dealing with grassland systems are Monitor, Manage and Control. The use of the Grass wedge allows us to monitor what is happening allowing us to manage the system to control the desired outcome. Examples of actions which might be taken include removing heavy paddocks as baled silage to reduce supply or increasing fertiliser use where we see a period of deficit emerging.

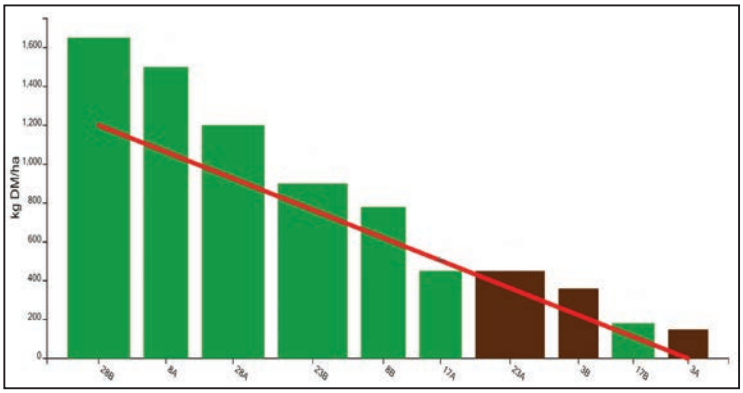

Figure 1. Example of grass wedge

Sheep Autumn Grassland Management Guidelines

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Take Home Messages

- To ensure adequate grass availability for ewes at lambing in March you should begin to close paddocks from mid to late October onwards.
- The first paddocks closed should be sheltered and close to the lambing area.
- A ewes feed requirement in mid pregnancy is approximately half that of a ewe in early lactation producing milk for two lambs.
- **Do not** re-graze closed paddocks

Autumn is the starting point of the grassland year. Management and decisions made in this period have a direct effect on the quality and availability of grass the following spring. To ensure adequate grass availability for ewes at lambing in March you should begin to close paddocks from mid to late October onwards. This is important so we can build cover while grass growth is still active. Very little grass will be grown during December and January. When grass growth starts to increase again in February and March it is the earlier closed fields that will respond quickest to the increasing temperatures and an early application of fertiliser

Where winter housing is not available or practical ewes can be managed in an extended grazing system on grass built up earlier in the autumn with grass allocated daily or every second day. Ewes could also be wintered on forage crops, away to winter grazing or with hay/silage and concentrate supplementation outdoors. The important thing is that the sheep are confined to a smaller area of the farm (less than 20%) allowing grass supplies to build on the majority of the area.

The temptation to re-graze closed fields in December/January will always be there, especially in years where autumn grass supply is good or where winter feed reserves are low or poor quality but this grass is worth much more in the spring to the freshly lambed ewe than in mid pregnancy. A ewes feed requirement in mid pregnancy is approximately half that of a ewe in early lactation producing milk for two lambs.

The first paddocks closed should be sheltered and close to the lambing area. Where autumn grass covers are high an electric fence can be used to reduce the area available for grazing at any one time to make ewes graze down to the desired post grazing height of around 4cm. It is important to clean swards out as tight as possible when closing as carrying higher residuals over winter will lead to a lot of dead material accumulating at the base of the sward which will depress grass growth in the spring and reduce quality.

Teagasc Sheep Autumn Closing Planner

The grazing season begins in autumn. Decisions taken in the autumn have a direct effect on spring grass availability. Use this planner to create a closing plan for your farm

Total area (ha) available

Date	Target % Area closed	Area requred to reach target (ha)	Field Names/Nos. to be closed to reach target
Late Oct	20		
Mid Nov	40		
Late Nov	60		
Mid Dec	80		

Based on early March lambing flock, 120 day rest period over winter

Guidelines

- The first paddocks closed should be sheltered and close to the lambing area
- Fields/paddocks should be grazed out tight to 3.5 – 4.0cm
- Use temporary electric fencing if required to reach post grazing targets without forcing sheep to graze to low heights for prolonged period
- **Do not** re-graze closed paddocks

Producing high feed-value grass silage

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Take Home Messages

- Silage DMD declines by 3.3 units for every 1-week delay in harvest
- Ensile within 36 hours after mowing targeting 25 to 30% dry matter concentration
- If using an additive select based on proven ability to increase animal performance
- Effective inoculants under a wide range of conditions, or formic acid under difficult conditions, increase animal performance.

Introduction

The herbage from 1.2 million hectares is ensiled annually. Silage production is one of the most important tasks undertaken on-farm annually. Many sheep farmers feed silage for up to 4 months, which was ensiled on one day. Consequently, one day's work can have long-term consequences. Digestibility (DMD) is the main factor influencing silage feed value. For high feed-value silage, the DMD should be greater than 75%. Increasing silage DMD presents the producer with 2 options next winter. Either maintain concentrate feed level and increase animal performance or maintain animal performance and reduce concentrate supplementation.

Factors affecting digestibility

Most factors that affect silage DMD are within the control of the producer, namely:

1) *Harvest date*: Silage DMD declines by 3.3 units, on average, for each 1 week delay in the date of harvest and is similar for first and second harvests. The decline in DMD is due to stem elongation and the accumulation of dead material at the base of the sward. When deciding when to harvest walk the swards, look at the top of the canopy for seed head development and the base for accumulation of dead leaf. Mowing too close to ground level results in ensiling low-digestibility stem and risks soil contamination, both of which reduce DMD. In broken

weather do not delay harvesting for a protracted period with the hope of getting a wilt – it may not happen. A delay of 1 week requires an additional 1.2 kg/day concentrate daily for finishing beef cattle, and 8 kg extra concentrate during late pregnancy for ewes

2) *Crop lodging:* Lodging of the grass accelerates the rate of decline in herbage DMD as harvest date is delayed. This accelerated decline is due to the accumulation of dead leaf, and stem at the base of the sward. In severely lodged crops DMD may decline by as much as 6 to 9 units per week delay in harvest.
3) *Sward type:* Old permanent pastures, that contain a reasonable proportion of perennial ryegrass and are harvested at the correct stage of growth, can consistently produce a high feed-value silage, similar to that from perennial ryegrass swards.
4) *Heading date:* Comparisons of intermediate- and late-heading varieties have shown that to produce silage with the same DMD, herbage from late-heading varieties (heading date 12 June) must be ensiled no more than 8 days later than intermediate-heading (heading date 19 May) varieties despite the 24-day difference in heading date. If both intermediate- and late-heading varieties were harvested at 50% ear emergence, the silage from the late-heading varieties would have 7 units lower DMD.

Wilting

Wilting herbage pre ensiling reduces effluent production, improves ensilability, reduces weight of material for transport during ensiling and feed out, and reduces straw requirement for bedding. A rapid wilt is desirable. The rate of water loss during wilting is primarily related to solar radiation and swath density. Herbage in auto-swaths (two swaths placed into one) has a much higher density than herbage that is tedded out. Studies have shown that to increase herbage DM from 16% to 25% required 65, 30 and 14 hours, respectively, for herbage in auto-swaths, single swaths or tedded out (to cover the total ground area), immediately post mowing. Prolonged wilting reduces DMD - by up to 2 percentage units per 24-hour wilting period in extreme cases. Tedders and rakes must be set correctly to avoid causing soil contamination as this reduces DMD.

Animal performance effects

From the mean of 11 comparisons with dairy cows it was concluded that rapid wilting prior to ensiling increased milk fat+protein yield by 6%, but at a cost of increasing silage intake by 16%.

Ensiling in showery weather

Often ground conditions are good but occasional showers are not conducive to wilting. In these conditions some producers fear that herbage will be difficult to ensile and are tempted to delay harvest, thus reducing DMD, in the expectation of better weather. Results from a study where grass was ensiled at 19.0% or 13.7% dry matter (following water application) showed that dry matter percentage had no effect on silage fermentation or on the silage intake or performance of lactating dairy cows. Therefore if the grass is ready to ensile when dry, it is also ready when wet.

Chop length

Whilst chop length has no effect on the performance of beef cattle or dairy cows, chop length affects the intake characteristics of silage when offered to sheep. Studies have reported precision chopped silage increases lamb birth weight and ewe weight at lambing relative to single chopped silage.

Silage additives

Animal performance is the most important measure of the efficacy of a silage additive since producers are paid for animal product, and not for the measured preservation quality of the silage. It is important to apply additives at the correct rate. For example, if the dry matter concentration of the herbage is increased from 18 to 25%, the fresh weight of grass will be reduced by 40%. So this must be reflected in the rate of application.

There have been many comparisons of additives with respect to animal performance. A review of the published studies shows that:

1) effective inoculants, used under a wide range of ensiling conditions, increased the performance of dairy cows and finishing beef cattle.
2) effective inoculants can substantially improve animal performance without necessarily altering fermentation quality.
3) formic acid applied under difficult ensiling conditions improves animal performance
4) molasses, sulphuric acid and enzyme-based additives improved silage fermentation, but had no significant effect on animal performance.

Nutrition during late pregnancy – the key factor influencing flock profitability

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Take Home Messages

- Each 5 percentage point increase in silage DMD increases ewe weight post lambing by 6.5 kg and lamb birth weight by 0.25 kg
- Plan to increase next year's silage DMD by at least 5% units
- Purchase concentrate on ingredient composition and not solely on price
- Excess concentrate supplementation is unlikely to yield an economic response.

Introduction

Nutritional management during late pregnancy impacts: colostrum quality and quantity, ease of lambing, lamb survival, lamb birth weight, formation of the ewe-lamb bond. All of these factors impact lamb performance from birth to sale, flock productivity and labour requirement during the lambing period – the key factors influencing flock profitability and job satisfaction.

Silage feed value

The main factor influencing silage feed value is digestibility (DMD). The effects of the DMD of silage offered to ewes whilst housed on ewe and lamb performance are presented in Table 1. Increasing DMD increased silage intake. When concentrate supplementation was initiated (approximately 6 weeks prelambing) the intake of medium DMD silage remained relatively unchanged up to lambing whilst that of the high DMD silage declined as concentrate feed level increased. Concentrate displaced high DMD silage in the diet. Studies at Athenry have shown that increasing silage DMD increases ME intake by up to 53% during late pregnancy.
The ewes offered the high DMD silage were 10 kg heavier and had a higher body condition score (BCS) at lambing. At pasture, between lambing and weaning the ewes that had been offered the high DMD silage lost 0.5 units BCS (sacrificed body reserves in favour of milk production) whilst those offered the medium

DMD silage gained 0.2 units BCS (partitioned energy intake to replenish their own body reserves rather than to milk production). The lambs from ewes offered the high DMD silage were: 0.5 kg heavier at birth, 1.9 kg heavier at weaning and 17 days younger at slaughter. A reduction of 17 days at slaughter is equivalent to the response expected from feeding 19 kg concentrate per lamb from birth to slaughter. As each ewe in the study reared 1.75 lambs, this would equate to 33 kg concentrate/ewe - equivalent to ~ €15/ewe.

Table 1. The effects of grass silage feed value and concentrate feed level on ewe performance

	Silage DMD			
	79		70	
Concentrate per ewe in late pregnancy (kg)	15	25	15	25
Ewe weight post lambing (kg)	71.7	73.6	61.8	64.1
Ewe condition score- at lambing	4.0	4.0	2.8	3.0
Lamb weaning weight (kg)	33.9	33.4	32.5	31.1

Concentrate supplementation

Whilst increasing concentrate intake to ewes offered the medium DMD silage yielded a small improvement in BCS at lambing it had no impact on lamb performance (Table 1). Thus, feeding excess concentrate in late pregnancy does not improve lamb performance and will result in a negative return on concentrate expenditure.

The effects of silage feed value on the concentrate requirement of twin-bearing ewes in late pregnancy are shown in Table 2. It is assumed that ewes have access to fresh silage 24 hours daily. Concentrate requirement is influenced primarily by silage DMD (but also by chop length). The concentrate requirements per ewe can be reduced by 5 kg for single-bearing ewes, and increased by 8 kg for ewes carrying triplets.

Concentrate composition

An Athenry study evaluated two concentrates which were formulated to have the same ME and crude protein concentrations and used either soyabean meal or a mixture of by-products (rapeseed, maize distillers and maize gluten) as the main protein source. The concentrates were offered to ewes during late pregnancy. Lambs born to ewes that were offered the soyabean-based concentrate were 0.3 kg and 0.9 kg heavier at birth and weaning, respectively, than lambs born to ewes offered the

concentrate containing by-products as the protein source. The increase in weaning weight of 0.9 kg (extra cost ~€0.60/ewe) is similar to the response obtained from offering each lamb 6 kg of creep concentrate until weaning (cost ~ €6/ewe per set of twins).

Lambs from ewes that were offered 16 kg of the soya based concentrate were the same weight at weaning as lambs from ewes offered 28 kg of the concentrate containing the by-products. Purchase concentrate based on ingredient composition rather than solely on price. A reduction in concentrate price of €20/t equates to a saving equivalent to only €0.50/ewe.

Pregnancy nutrition plan

To optimise the use of concentrate, ewes should be grouped according to predicted litter size (based on ultrasonic scanning) and expected lambing date (change raddle colour every 7-10 days during the joining season). Analyse you silage and base supplementation level on data presented in Table 2. Supplementation should be stepped up weekly over the weeks immediately prior to lambing to coincide with ewe requirements.

Table 2. Effects of silage DMD on concentrate requirements (kg) of twin-bearing ewes during late pregnancy.

	Silage DMD (%)		
	79	72	64
Precision chop	8	17	25
Big bale/Single chop	12	24	35

EuroSheep – an EU thematic network to improve flock profitability

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Take Home Messages

- EU - 85% self sufficient in sheep meat
  - second largest importer of sheep meat world wide
- Major issue is lack of profitability due to flock nutrition and health issues
- Many scientific and practical solutions already exist at local level but are not widely transferred
- EuroSheep uses the multi-actor approach, bringing together all stakeholders involved in sheep production in member countries and across Europe
- EuroSheep is developing a knowledge reservoir of technical and practical solutions developed by producers, researchers and other stakeholders

Introduction

Sheep meat and milk production are very important farm enterprises in Europe and play a key social, economic and environmental role in many "less-favoured areas". The number of sheep producers in the EU has declined since 2000. Currently there are 85 million sheep in Europe. There are more sheep in Europe than in Australia and New Zealand combined. Ewe productivity is low in many regions, including Ireland where it has not improved during the last 30 to 40 years.

The EU is the second largest importer of sheep meat worldwide as it is only 85% self-sufficient in sheep meat. The average EU per capita consumption of sheep meat is 2.1kg. There is an opportunity to increase production without having to export excess sheep meat. An increase in ewe productivity of 0.1 lambs reared per ewe joined would increase EU self-sufficiency in sheep meat to 92%. As well as sheep meat production there are a significant number of dairy sheep in Europe producing milk, cheese, yoghurt, etc.

EuroSheep – provides solutions to producers problems

EuroSheep was established with the objective of increasing the profitability of sheep production across the EU by focusing on flock health management and nutrition management. EuroSheep is a 3 year thematic network, funded by the EU, which was set up to continue the dynamic of knowledge sharing between stakeholders in the European sheep sector which was initiated by SheepNet. The eight main sheep countries in Europe are involved namely; Ireland, France, Greece, Hungary, Italy, Spain, Turkey and UK.

Through a multi-stakeholder approach, EuroSheep brings together all the stakeholders involved in the sheep sector e.g. farmers, advisors, veterinarians, teachers, researchers, processors etc. EuroSheep articulates national and transnational workshops to structure and facilitate knowledge exchange both nationally and internationally.

Initially EuroSheep identified the needs of farmers in terms of nutrition and health management of their flocks. It was noted that producers in the different countries had similar needs/issues but were ranked differently in order of importance.

EuroSheep is developing a reservoir of scientific knowledge, technical solutions and 'tips and tricks' that address the needs identified by producers in each country. Many solutions may already exist to specific needs, either in the same region or another country. Each country has the opportunity to select relevant solutions and information from the EuroSheep knowledge reservoir, and evaluate them. As required EuroSheep will adapt relevant solutions to suit local conditions/regions and assess their sustainability (economic, environmental and social). EuroSheep has a dissemination plan for the transfer of knowledge and practical solutions to improve flock management, nutrition and health. Areas lacking in knowledge are currently being identified for the creation of factsheets, based on a review of the literature, and to target future research priorities.

To date, Eurosheep has produced 91 solutions (many of which are evaluated in on-farm situations) and 25 fact sheets. Currently 'tips and tricks' are being gathered to aid solution implementation, improve labour efficiency and farm profitability.

Examples of solutions to producers needs on flock health and nutrition include rotational grazing systems, inclusion and management of chicory in forage systems, guidelines on post-weaning management, sward measurement and management, mixed grazing of cattle and sheep to limit parasite infestation, flock biosecurity, reducing anthelmintic resistance, better control of orf, and appraisal of udder morphology to prevent mastitis. All of these solutions, and more as they become available, can be accessed on the Eurosheep platform (www.eurosheep.network) in 7 languages. The EuroSheep website also contains all the solutions that were established by SheepNet, focusing on flock productivity.

https://eurosheep.network/
https://www.facebook.com/EuroSheep/
https://twitter.com/eurosheepeu
https://www.instagram.com/eurosheepeu/
https://www.youtube.com/channel/UC_M6xVTb4A2wb__evWU0SRA

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Sm@rt: Sm@ll Ruminant Technology – Precision Livestock Farming and Digital Technology for Small Ruminants

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Take Home Messages

- Precision livestock farming (PLF) technologies exist that are relevant to sheep producers but are not widely adopted
- Sm@rt uses the multi-actor approach, bringing together all stakeholders involved in sheep production in member countries and across Europe
- Sm@rt's objective is to increase the awareness of PLF tools, demonstrating their potential to improve productivity, labour efficiency and possible return on investment

Introduction

Small ruminant (sheep and goat) farming is important to the rural economy of many countries in the EU and worldwide, especially in areas that are unsuitable for other farming systems. The small ruminant population in the EU is approximately 98 million animals, of which 87% are sheep. There are more sheep in Europe than the combined total of Australia and New Zealand.

Approximately 7% of the people working on EU farms are involved in sheep production. Available labour to manage flocks is declining thus there will be more animals managed by individuals. Use of digital technologies, particularly precision livestock farming (PLF) technologies could reduce labour requirement and improve enterprise efficiency on sheep and goat farms.
Precision Livestock Farming technologies are widely adopted in other farm enterprises e.g. dairy cows, using an individual animal approach to monitor performance. Precision livestock farming technologies are also used in group housing systems (e.g. pigs) using cameras and sensors for monitoring activity, that can provide early detection of health issues. However, because of the value of small ruminants and the extensive environments where they are managed, the development and uptake of innovative PLF tools to improve farm efficiency is a lot lower than other livestock sectors.

Sm@RT

Sm@rt was established with the objective to increase the awareness of those working in the sheep and goats sectors of newly available PLF tools, demonstrating their potential to improve productivity, labour efficiency and possible return on investment. Sm@RT brings together a network of researchers from 8 countries namely Ireland, Estonia, France, Hungary, Israel, Italy, Norway and UK. The network will engage with a wide range of sheep and goat farming systems.
Sm@rt uses a variety of methods to facilitate productive knowledge exchange within the European small ruminant community, working with a wide range of stakeholders including those operating well-equipped demonstration farms ('digifarms') and innovative commercial farms. Sm@RT aims to use a step-by-step approach to ensure that the relevant people are involved at the right stages to facilitate and enable discussion and the exchange of ideas in a trusting environment. By drawing upon the valuable input and knowledge of farmers, and passing it on to their peers, the hope is that it will increase uptake of PLF tools across the industry. It is intended to use these discussions to motivate IT companies to develop further practical, cost effective, digital solutions for the sheep and goat sectors.
Initially, Sm@rt identified by survey in each partner country, the main challenges and needs of farmers and stakeholders' for PLF tools and digital technologies based on 5 themes; feeding/grazing, health/welfare, reproduction, flock/herd management and fattening/milking. Subsequently Sm@rt has identified available technologies to address the main needs and challenges of stakeholders under the five themes. For example, 16 feeding/grazing, 24 health/welfare/reproduction, 11 flock/herd management and 10 fattening/finishing PLF technologies/tools were

presented at our last transnational workshop. Videos of some of these technologies in operation are available for viewing on the Sm@rt YouTube Channel (https://www.youtube.com/channel/UCafSFzvQvNLRdcucJEWONCQ/videos).

Website: www.H2020-Smart.eu
Facebook: https://www.facebook.com/H2020Smart/
YouTube: https://www.youtube.com/channel/UCafSFzvQvNLRdcucJEWONCQ
Twitter: https://twitter.com/h2020smart
Instagram: https://www.instagram.com/h2020smart/

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Green Sheep – for low carbon and sustainable sheep production

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Take Home Messages

- Greenhouse gas (GHG) emissions are responsible for global warming and 37% of GHG emissions in Ireland are associated with agriculture
- GHG emissions on sheep farms can be reduced by implementing a suite of mitigation strategies (e.g. improving flock nutrition and health management, different feed formulations, switch to protected urea chemical fertilizer and improved grassland management practices). Many of these strategies also have economic benefits
- The LIFE Green Sheep project was established with the objective of reducing sheep milk and meat carbon footprint by 12% while maintaining or improving other sustainability dimensions
- There are 5 partner countries involved in Green Sheep, namely Ireland, France, Italy, Romania and Spain

Introduction

Greenhouse gases (GHG), because of their molecular structure trap heat or longwave radiation released in the atmosphere and re-emit it back to the earth resulting in the phenomenon known as the 'greenhouse' effect and is responsible for global warming. Twenty four percent of global GHG emissions are derived from the agriculture, forestry and other land use sector. The livestock sectors play an important role in climate change contributing a significant proportion of GHG emissions. In Ireland, 37% of GHG emissions are associated with agriculture. Sheep meat and milk production are very important farm enterprises across Europe and play a key social,

economic and environmental role in many "less-favoured areas". From a global livestock perspective, small ruminants are responsible for 7.4% and 1% of global and European GHG emissions, respectively. The main GHG's emitted on livestock farms tend to are methane, nitrous oxide and carbon dioxide respectively.
Greenhouse gas GHG emissions can be reduced by producers using a suite of mitigation strategies. These include improving flock nutrition and health management, different feed formulations, switch to protected urea chemical fertilizer and improved grassland management practices. Such practices can differently or indirectly reduce GHG emissions. Additionally, grasslands has the potential to sequester carbon and increase the store of carbon in our soils. This is of particular relevance to Ireland as sheep farming is pasture based on primarily permanent grassland and often occurs on extensive grazing areas that are either difficult to access or are not suitable for other farm enterprises. In addition to meat production and carbon sequestration, appropriately managed sheep farms have the potential to deliver a number of additional ecosystem services including biodiversity and landscape management services.

Green Sheep

LIFE Green Sheep was established with the objective of reducing sheep milk and meat carbon footprint by 12% while maintaining or improving other dimensions of sustainability (Economic and social dimensions). The Green Sheep project will promote low carbon farming systems and associated practices to ensure technical, economic, environmental and social sustainability on sheep farms, thus improving interactions between climate change and livestock production. There are 5 partner countries involved in Green Sheep, namely Ireland, France, Italy, Romania and Spain.

Green Sheep will:

1) Develop a common European framework for estimating GHG emission on sheep farms
2) Raise awareness and train stakeholders in the tools for assessing environmental and sustainability performances
3) Undertake a large assessment of GHG emissions in sheep farming and create national and European observatories of environmental and sustainability performance by assessing GHG emissions on 1,355 demonstrative farms throughout Europe
4) Monitor 282 innovative low-carbon farms across partner countries who implement mitigation action plans to reduce their carbon foot print and absolute GHG emissions

5) Develop national action plans aimed at reducing GHG emissions in sheep farming while maintaining or improving other sustainability dimensions.

All information from the project will be available on:
Facebook page (https://www.facebook.com/life.green.sheep)
Website (www.teagasc.ie/animals/sheep/research/life-green-sheep)

The effect of ewe prolificacy potential and stocking rate on greenhouse gas emissions

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Take Home Messages

- Increasing ewe prolificacy can reduce GHG emissions per kg carcass weight
- Increasing stocking rate through fertiliser increased emissions per ha and per kg carcass weight
- Aim to increase number of lambs weaned per ewe and reduce reliance on farm inputs i.e. fertiliser and concentrate.

Introduction

Intensification through increased stocking rate and ewe prolificacy potential (lambs per ewe) has been highlighted as a strategy to increase productivity and profitability of sheep systems. However there is limited research investigating the effect of intensification on GHG emissions from sheep production systems. Furthermore, to our knowledge no study has assessed the effect of ewe prolificacy on the environmental impact of production systems. The objective of this study was to determine the effect of ewe prolificacy, stocking rate, and their interaction on GHG emissions from lowland sheep systems.

Methods

Data was obtained from an experiment conducted at Teagasc Athenry between 2012 and 2015. A total of six mid-season lowland sheep system were modelled. Two ewe prolificacy potentials; medium, 1.5 lambs weaned per ewe; and high, 1.8 lambs weaned per ewe were investigated (Table 1). Medium prolificacy (MP)

and high prolificacy (HP) ewes were Suffolk-sired ewes and Belclare-sired ewes, respectively. All ewes were mated to Charollais during a 6-week breeding season (October/November) and lambed first time at two years. Three stocking rates; low, 10 ewes per ha (LS); medium, 12 ewes per ha (MS); and high, 14 ewes per ha (HS) were investigated. The increase in stocking rate was achieved through fertiliser application (Table 1).

Table 1. Description of the six production systems simulated

System	MPLS	MPMS	MPHS	HPLS	HPMS	HPHS
Farm area (ha)	20	20	20	20	20	20
Stocking rate (ewes/ha)	10	12	14	10	12	14
Weaning rate (lambs/ewe)	1.5	1.5	1.5	1.8	1.8	1.8
Nitrogen use (kg N/ha)	113	145	181	113	145	181
Lamb carcass weight	19.5	19.5	19.7	19.9	19.7	19.8
Total carcass sold (kg/ha)	273	327	393	341	403	474
Drafted by 1st October	75%	55%	47%	63%	68%	50%
Concentrate consumed per ha	456	613	813	552	664	888

Ewes were housing following the completion of the last grazing rotation; early December, late December, and mid-January for the HS, MS, and the LS, respectively. Ewes were turned out to pasture post lambing (March). Lambs were weaned from ewes at 14 weeks. Lambs were drafted between June and January when they reached live weight needed to achieve the target carcass weight of 20 kg. A proportion of ewe lambs were retained and reared as replacements. The Teagasc Sheep LCA model was used to calculate total GHG emissions of the six production systems. The LCA operated over one full production year. A cradle-to-farm gate system boundary was adopted, accounting for emissions up to the point animals leave the farming systems. This includes the production of farm inputs. Total GHG emissions were scaled per ha and per kg carcass weight (lamb and cull ewe).

Results

When scaled to area, systems weaning 1.8 lambs per ewe emitted 9-12% more GHG emissions than systems weaning 1.5 lambs per ha due to more animals in the system (Figure 1). In contrast, increasing weaning rate from 1.5 to 1.8 lambs per ewe reduced GHG per kg carcass weight by 10-12%. The reduction per kg carcass weight was due to the greater quantity of live weight produced by high prolificacy

ewes diluting ewe related emissions. Systems stocked at 14 ewes per ha emitted on average 43% more GHG emissions per ha than systems stocked at 10 years per ha. The increase was attributed to greater number of animals in the system as well as increase in days to slaughter. Increasing stocking rate also increased GHG emissions per kg carcass weight, indicating that emission associated with increasing stocking rate surpassed the increase in productivity per ha.

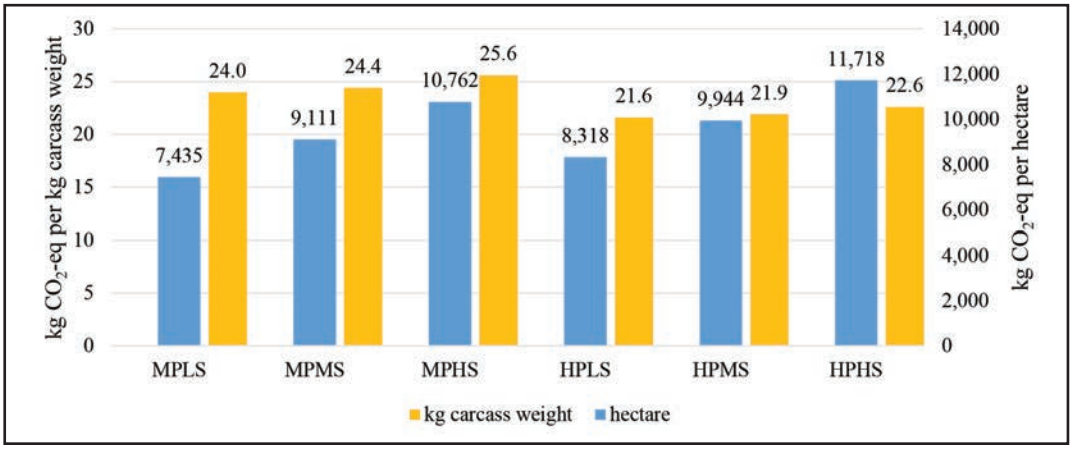

Figure 1. Global warming potential (kg CO_2equivalent) per hectare and kg carcass weight for the six production systems

Conclusion

Improving the prolificacy potential of ewes has potential to reduce the GHG intensity of sheep meat by increasing live weight sold per ewe. Achieving higher stocking rate through synthetic fertiliser use increased GHG emissions per ha and per kg carcass weight. Further research needed to reduce reliance on farm inputs while maintaining production.

Measuring methane in Irish sheep production systems

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Take Home Messages

- Methane is produced following digestion of forage by the ruminant animal
- Teagasc have compared three techniques for measuring methane in sheep
- Portable accumulation chamber (PAC) measurements have a strong relationship to the 'gold standard' method, respiration chambers
- PAC allow for the ranking of methane output in grazing sheep with good accuracy and repeatability
- Large numbers of animals (>2,500) have been measured to date with the ultimate aim of generating genetic breeding values for methane

Introduction

A question often posed is why are we measuring methane output in sheep? Methane is actually a waste by-product from the digestion and fermentation of feed in the ruminant animal whereby excess hydrogen and carbon dioxide are converted to methane and excreted from the animal via eructation and flatulence. Worldwide agricultural methane emissions account for over 38% of total methane emissions. Therefore in addition to methane being produced as an energy waste in the animal, it is one of the world's most potent greenhouse gases. Our aim is to quantify the baseline methane output of sheep in pasture based systems across various breeds, ages and stages of production. This information will allow us to determine measures we can take to improve on-farm efficiency, to determine the genetic influence over the trait with the ultimate aim of generating breeding values for methane. While striving for lower methane emitting animals is merited, the importance of maintaining production levels and overall farm profitability is equally as important. Therefore, both goals must align. The objective of this paper is to review the research undertaken in Teagasc to date to determine the optimal technology to measure methane in sheep on a large number of animals under grazing conditions.

Measuring methane

Respiration Chambers

Figure 1. Respiration chamber

Respiration chambers are classed as the 'gold standard' method of measuring methane emissions from ruminants. They are capable of measuring an individual animal's methane emissions over an extended period of time and are able to provide continuous and accurate data on air composition within the chamber. The key advantage of this method is the ability to measure both ruminal and hindgut fermentation, thus giving an accurate measurement of an animal's methane over a period of 2 to 4 days. Methane emissions are calculated by measuring the total air flow and the difference between inlet and outlet flow.
The disadvantages associated with this technique includes that it is a labour intensive method but they are also expensive to construct and maintain and only allow small numbers of animals to be measured at a time. There is also an argument that respiration chambers do not give an accurate representation of an animal's behaviour in their normal conditions as the environment is artificial.

SF_6 Technique

Figure 2. SF_6 tracer technique

The SF_6 tracer technique allows for CH_4 measurements to be collected from individual grazing animals and is based on a known SF_6 gas release rate from a permeation tube, into the rumen, with samples of exhaled breath continuously collected into an evacuated canister. The tubes are orally dosed into each sheep 6 to 7 days before measurement begins. Each animal is fitted with a halter, with an inlet attached, thus allowing for air to be sampled from the nose. Capillary-tube flow rate restrictors are commonly used to achieve a constant rate of sample collection. Methane measurements are generally conducted over 5 to 6 consecutive days. The advantages of this measurement technique is that methane is measured at grazing. However, the

main disadvantage is that the technique is labour intensive and only allows small groups of animals to be measured at a time.

Portable Accumulation Chambers (PAC)

Portable accumulation chambers enable methane measurements to be recorded from sheep at a lower cost than the previously mentioned measurement techniques whilst also allowing for a high throughput of animals. Portable accumulation chambers are made of polycarbonate sheets with an internal volume of approximately 827L or 0.8 m^3. As the PAC is a spot sampling method, animals are removed from feed approximately one hour prior to measuring. Sheep placed in the chambers normally stand throughout the measurement period and are able to have visual contact with the animal in the nearby chambers thus allowing the animals to stay calm throughout. Methane and CO_2 production as well as O_2 consumption are also measured during a 50 minute measurement time.

Figure 3. PAC

Results to date

In a comparison study methane output was measured from 60 ewe lambs, averaging 47 kg using both the PAC and respiration chamber. Mean CH_4 output was 16.92 g/day (PAC) and 29.57 g/day (respiration chamber). A moderate to strong relationship (correlation of 0.55) was found between CH_4 output measured in both the PAC and respiration chamber which means that the animals are likely to rank (high or low CH_4 emitters) the same using both measurement techniques. Preliminary results on comparing the PAC to the SF_6 tracer technique show that CH_4 output from 60 dry ewes using the SF_6 tracer technique was 37.3 g/day, which was larger than CH_4 output measured in the PAC (27.06 g/day).

Conclusion

To date, research ongoing at Teagasc Athenry has developed a standard operating procedure for the portable accumulation chambers (PAC) which are being used to measure the ranking of methane output from animals. Over 2,500 animals have been measured in the PAC in addition to the measurement technique being compared to the gold standard method, the respiration chamber, and the in-field technique using SF_6 tracer gas.

Strategies to reduce methane emissions in sheep: Dietary supplementation

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Take Home Messages

- Methane, a potent greenhouse gas (GHG), is produced during the digestion of feed in the forestomach of ruminant livestock.
- Enteric methane is responsible for nearly 60% of Irish Agricultural GHG emissions.
- Ireland has committed to a 22-30% reduction in total agricultural emissions and a minimum 10% reduction in ruminant derived methane emissions by 2030 as part of the National Climate Plan.
- Dietary supplementation with feed additives is part of a combination of strategies being developed to help achieve the sector's methane emissions reduction target.
- Research is on-going to develop slow release formulations of feed additives for delivery in pasture based production systems.

Introduction

The digestion of plant matter consumed by ruminant livestock (cattle, sheep etc) is facilitated by members of a microbial ecosystem residing in the rumen (forestomach). However, one group of rumen microbes, known as methanogens, are responsible for nearly 60% of Irish agricultural related greenhouse gas (GHG) emissions through the production of methane, a GHG that is recognised by the UN's International Panel on Climate Change (IPCC) as being 28 times more potent to the environment than carbon dioxide. While the synthesis of methane (known as methanogenesis) is considered a natural by-product of rumen fermentation, a reduction in the volume of methane emitted from the national herd will be required to facilitate the ambitions of the State and agricultural sector to be carbon

neutral by 2050. Ireland has committed to a 22-30% reduction in total agricultural emissions, including a minimum 10% reduction in ruminant derived methane emissions by 2030 as part of the National Climate Action Plan.

The 'METH-ABATE' project

The on-going DAFM funded 'METH-ABATE' collaborative research project led by Teagasc and involving other research institutes and industry partners, aims to develop and validate novel technologies, mainly feed additives, to reduce methane emissions from pasture based agricultural systems. To-date a wide variety of compounds have been screened in a laboratory based, rumen simulation technique (RUSITEC) system for their methane reducing potential.

Sheep are an excellent ruminal model as well as being cheaper and easier to handle than large ruminants. Lowland cull ewes are currently being used in the feed additive trials as they are representative of the national breeding flock. Studies assessing feed additives will then be further investigated in beef and dairy cattle.

Methane measurements are conducted in sheep in Teagasc Athenry using portable accumulation chambers (PACs). This method allows for a 50 minute, one time-point measurement per animal. The production of methane over the 50 minute period is then calculated out to grams of methane produced per animal per day.

Most anti-methanogenic supplementation research to-date has been investigated while feeding the additives in housed systems through a TMR, which is not compatible with the Irish pasture based production system. As such, the end goal of the research is to develop a slow release technology in the form of a bolus or an encapsulated nut that will reduce methane emissions while sheep and cattle are at pasture.

Dietary Supplementation with feed additives

The addition of fats and lipids, containing high proportions of polyunsaturated fatty acids (PUFAs) i.e. soya oil, linseed oil and rapeseed oil, to the diet have been proven to reduce the production of methane in numerous studies. Indeed PUFAs negatively impact members of the rumen methanogen community by altering ruminal fermentation pathways to divert H_2 away from methanogenesis. For every 1% increase in the fat content of the diet, the quantity of methane an animal emits on a daily basis is predicted to decrease by 3.77%. Seaweeds have been a traditional part of animal nutrition due to their nutritional properties such as high mineral and protein content as well as increased nutrient digestibility and anti-helminthic benefits. More recently, the tropical red seaweed, *Asparagopsis taxiformis* has attracted worldwide attention by consistently reducing methane output in sheep

and cattle trials, with reductions of up to 80% recorded. Research at Teagasc observed a methane reduction of 67% in the RUSITEC system, however the Irish climate is unsuited for the commercial production of *Asparagopsis taxiformis*. As a result, researchers at Teagasc are investigating the methane reducing capabilities of locally grown brown and green seaweeds in which reductions of 36% and 15% have been observed in the RUSITEC system and are now being brought forward to a sheep study.

The most novel feed additive assessed in Teagasc to date are oxidising methane inhibitors. These synthetic compounds have a 'dual action' approach to reducing methane production. They inhibit the main enzyme necessary for methanogenesis in the rumen. They also modulate rumen oxidation reduction potential (ORP), elevating ORP to favourably alter the rumen fermentation pathway and supress methanogenesis. Promising methane reductions of 50-80% have been observed in the RUSITEC with different formulations of the oxidising methane inhibitors. Feeding seaweeds, seaweed extracts, garlic extract, oxidising methane inhibitors and soya oil to sheep in a recent study showed trends in reducing daily methane production by 5-10% in sheep, with no negative effects on animal production. These additives will be further investigated in beef cattle.

Conclusion

Assessing feed additives in sheep, beef, and dairy animals to ensure the additives successfully reduce methane production whilst having no negative impacts on animal performance is crucial. Research is currently focused on developing the feed additives into a slow release formulation for delivery at pasture. Developing a dietary feed additive that reduces methane by ~30% in conjunction with on-going research in animal breeding will contribute to reaching the 22-30% reduction set out for the agricultural sector.

Organic Sheep Farming – Factors to Consider

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Take Home Messages

- A crossbred ewe is ideal and a cross of any two existing breeds can produce good quality ewes.
- Sheep housed must be provided with a bedded solid floor area.
- An animal health plan ensures the development of health building and disease control measures appropriate for the farm.
- To control grass quality a rotational grazing system is preferred.

Introduction

In Ireland, there is approximately 90,000 hectares under organic production, which is 2% of the utilisable agricultural area. The organic drystock sector is the largest of the organic enterprises with about 70% of all organic producers involved in either cattle and/or sheep production. The current Programme for Government is to align the utilisable agricultural area under organic production in Ireland with the EU average of 7.5%

The Department of Agriculture, Food and the Marine (DAFM) is the competent authority for regulating the organic sector. They have designated Organic Control Bodies (OCB's) to provide an inspection and certification service for all organic farmers in Ireland. For full interpretation of the rules and regulations, governing organic sheep farming it is essential to study the 'Organic Food and Farming Standards in Ireland' document.

Factors to consider

There are a number of factors that you need to take into account when considering the transition to an organic sheep farming system.

Breeds and Breeding

A crossbred ewe is ideal and a cross of any two existing breeds can produce good quality ewes. Research has shown that the Texel breed has substantially better

resistance to parasites than the Suffolk. This gives the Texel a distinct advantage in an organic system and the breed also produces a lean carcass. The Belclare breed carries a proportion of Texel genes and therefore has advantages over the Suffolk in parasite resistance. If aiming to lamb ewes early it is an advantage to have Suffolk cross ewes. Organic sheep farmers tend to choose breeds with a high tolerance to worms. A crossbred ewe can be crossed with either Texel, Suffolk or Charolais to increase growth rate.
Breeding your own replacements in an organic system is of great benefit as it reduces the chances of introducing disease into the flock and helps build up resistance to pathogens on the farm.
Rams may be purchased from a non-organic farm for breeding purposes. If suitable organic female breeding stock are unavailable, with prior permission from the OCB you are permitted to buy in non-organic female breeding stock up to 20% of your adult flock.

Housing

Sheep can be outwintered. If housed, they must be provided with a bedded solid floor area. Up to 50% of the total area can be slatted. The total space required per ewe is 1.5m^2/head (minimum) with an additional 0.35m^2/lamb. Plenty of straw should be used to keep the lying area for the ewe dry at all times. Conventional straw may be used for bedding.

Flock Health

Disease prevention is key to good flock health. At the application stage of converting to an organic system an animal health plan is drawn up in consultation with your veterinary surgeon. The animal health plan addresses issues such as:

- What diseases are currently on the farm
- How can these be controlled or prevented
- What modifications can be made at farm level to reduce the risk of disease

Operating a closed flock is a big help in keeping sheep healthy and measures such as double fencing boundaries and good general hygiene will reduce the risk of infection from various sources.
A clean grazing policy minimises the risk of internal parasites, as routine dosing is not permitted in the organic system. The clean grazing plan provides clean or lightly infected pastures for grazing by the ewes and lambs during the first part of the grazing season. These are then changed to another pasture at weaning time.

After weaning, lambs should continue to graze good quality pastures such as silage aftermaths which provide clean grazing and will greatly reduce parasite burden.

Diet

Grass is the main component of the diet in an organic sheep system. As 100% of the feed must be from organic or in-conversion sources, you need to produce your entire forage requirement on your farm. However, you can source organic grain and compound ration when required. A rotational grazing system is preferred to set stocking, as it is easier to control grass quality; a rotation with three to four paddocks or fields.

Sources of Information

Teagasc ***www.teagasc.ie/organics***
DAFM ***https://www.gov.ie/en/publication/fc7c8-organic-farming/***
Irish Organic Association ***www.irishorganicassociation.ie***
Organic Trust ***www.organictrust.ie***

Teagasc BETTER Farms Sheep Programme

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Take Home Messages

- Currently, there are 13 flocks in the programme situated throughout the country: 6 lowland flocks, 2 hill flocks and 5 flocks with both hill and & lowland flocks.
- BETTER farms should be used by discussion groups and farmers to see the benefits of technology adoption first hand
- Every flock will have poor performing sheep or "passengers" that are performing significantly below the average but still costing the same to keep.
- Identifying the worst and best performing sheep can be done from basic levels using management tags right up to EID technologies.

Introduction

The aim of the Teagasc BETTER farm sheep programme is to establish focal points for the on-farm implementation, development and evaluation of technology that is relevant to the sheep sector. This is done through the collaboration of Teagasc researchers and advisors in addition to the programme farmers. Currently, there are 13 flocks in the programme situated throughout the country: 6 lowland flocks, 2 hill flocks and 5 flocks with both hill and & lowland flocks (Figure 1.). Eight of these flocks are also involved in the Teagasc Signpost programme which is a multi-annual campaign to lead climate action by all Irish farmers.

Each farm in the programme has an individual farm plan drawn up between the farmer and their local advisor and the BETTER farm team with the aim of each farm plan being to improve the productivity and profitability of the flock using the latest technologies and messages from the Teagasc research programme. Some of the key messages from the hill sheep flocks in the programme have already been

covered in this publication so this paper will focus on some of the key messages from the lowland flocks in the programme.

Using your data to make to decisions

All of the flocks in the programme are tagging lambs at birth and using EID technology to identify and record the performance of individual sheep within the flock throughout the year. This data not only provides useful information for flocks to measure performance from year to year and assess the effect different technologies or management strategies are having on overall flock performance but it also allows them to ensure the best performing and poorest performing stock are identified for breeding/culling. This is something every flock can do even at basic level using management tags to mark ewes for culling or ewe lambs for keeping for replacements during the year.

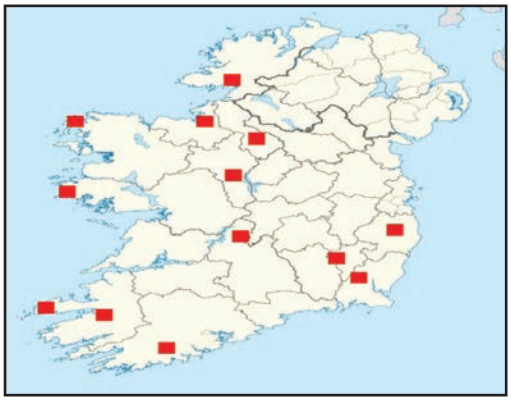
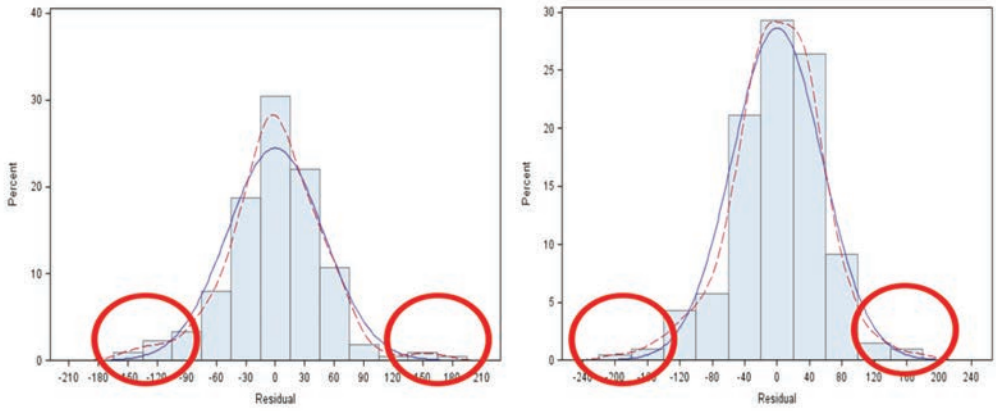


Figure 1. Location of the 13 Teagasc BETTER farm sheep flocks.

Remove passengers from the system

Every flock regardless of how good or bad their overall flock performance is will have poor performing sheep or "passengers" that are performing significantly below the average but still costing the same to keep. Identifying these ewes and culling them or at least ensuring replacement ewe lambs are not selected from them can help improve overall flock performance over time. If we take the example below which is the population distribution of lamb average daily gain (ADG) for two flocks from the BETTER sheep programme. Flock A exceeded the targets for ADG from birth to 7 weeks post-lambing while flock B's lamb performance fell

below the targets, however, both flocks have lambs that are below average (left of the curve) and lambs that are above average (to the right of the curve). For both of these flocks there is the opportunity to improve the performance potential of their flock by culling ewes responsible for the lambs to the left of the curve and trying to select ewe lambs from the right of the curve.



Conclusion

Data collection and utilisation of that data can seem like a very complicated thing at farm level. However, we can do this from basic levels through management tags right up to EID technologies. What method is used is not as important though as using the data we have to make decisions to improve the performance of the flock and the experience of the Teagasc BETTER sheep farmer's to-date has been that this is having a positive effect on flock performance.

GENETICS AND BREEDING

Exploiting genetics

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Take Home Messages

- The Terminal and Replacement €uro-Star indexes are an important selection tool that should be used when selecting rams
- Validation of commercial data shows that selecting 5 star animals increases flock performance, profitability (€18 per ewe) and reduces greenhouse gases (7%) compared to 1 star animals
- Recent changes to the €uro-Star indexes include: across-breed genomic evaluations, more commercial data and new traits such as lamb vigour and carcass data
- Future research will focus on important traits for industry including: mastitis, ewe longevity and methane emissions

Introduction

Genetics involves the passing of genes, both favourable and unfavourable, from one generation to the next. While an animal's environment or management can change throughout its lifetime, the genetics of an animal remains the same and are fundamental to the performance potential of the animal. Genetic indexes are a powerful aid that allow farmers to identify superior (and inferior) animals to become the parents of the next generation. The introduction of the national €uro-Star genetic indexes by Sheep Ireland in 2009 was a crucial step in enabling farmers to make more informed breeding and selection decisions to ensure that they have the desirable combination of genetics for their flock. This paper reviews the current €uro-Star indexes, highlights recent developments to the breeding programme and looks at the future direction of sheep breeding for the Irish industry.

Genetic indexes explained

The Sheep Ireland €uro-star indexes were introduced with the aim to identify low-cost, easy-care animals with good maternal characteristics, that also produce high

quality lambs that reach slaughter at an early age. The generation of any genetic index involves two main steps:

1. A list of traits or animal characteristics that influence an animal's performance
2. An economic value (€/lambs born) assigned to each trait based on its importance to farm profitability.

The genetic index calculated for each animal combines data based on the animal's own performance for a range of traits, such as lambing and live-weights, as well as data on the animal's relatives (i.e. sire and dam). A star rating is also generated to allow farmers to visualise the ranking of animals within breed (1 star = bottom 20%; 5 stars = top 20% of the breed) for a given trait or index. The €uro-star value is a measure of the additional profit (or loss in some incidences) that can be generated from the lambs produced by the animal. A new feature to the €uro-star index is that it now ranks animals irrespective of breed, allowing farmers to select their perferred ram irrespective of the breed.

The €uro-Star indexes are split into two (Figure 1):

1. **Terminal index** which ranks animals based on their ability to produce live, healthy, fast growing terminal progeny with little lambing difficulty. This index takes into account the progeny's growth rate, carcass characteristics, lambing and health data.
2. **Replacement index** which ranks animals on the expected maternal performance such as milk yield, lambing and health data, however terminal traits, such as growth and carcass, are also included to account for the efficiency at which animal's progeny reach slaughter.

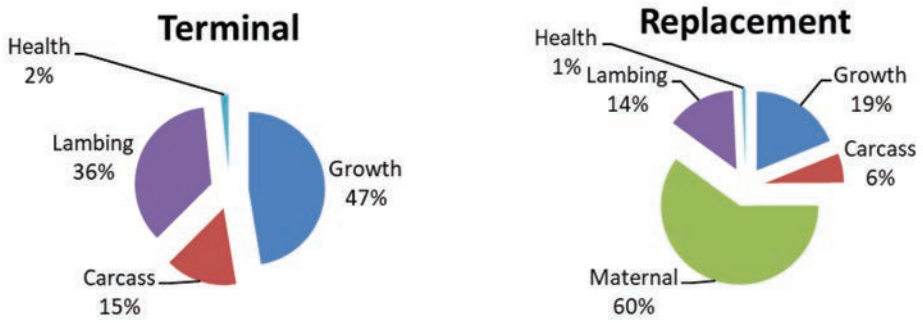

Figure 1. Relative emphasis of each trait group in the Terminal and Replacement €uro-Star indexes.

Do indexes work?

A question that is often posed by farmers is what do the genetic indexes deliver in terms of increased flock performance and profitability. A recent study undertaken by Teagasc using recording on 7,644 commercially recorded animals investigated the value of selecting 5 star animals for either the Terminal and Replacement indexes over 1 star animals. Results showed that selecting 5 star animals resulted in higher litter sizes, lower lamb mortality and heavier lambs that reach slaughter earlier. The 5 star flock sold more lambs per ewe and also at an earlier age, equating to an additional €18 net profit per ewe compared to the 1 star flock. The 5 star flock also produced 7% lower greenhouse gas emissions per unit of output (i.e. carcass weight) compared to the 1 star flock. These results clearly show the benefit of consistently selecting high star rated rams for the Irish sheep industry.

Evolution of the €uro-Star indexes

The €uro-Star indexes, like all indexes, evolve as new resaearch and data becomes available on traits of importance to Irish sheep farmers. In recent years a number of new developments have been included in the Terminal and Replacement indexes, a brief summary of the main changes are outlined below.

New traits. Lambing acounts for over 25% of the annual labour requirement on Irish sheep farms therefore, measures that could potentially reduce the labour requirement or time spent per ewe at lambing should be investigated for inclusion in the €uro-Star indexes; one such trait is lamb vigour. Lamb vigour is measured by producers at lambing, on a five-point scale based on the time taken for a lamb to stand immediately after birth. The prevalence of poor lamb vigour on Sheep Ireland recorded data was 19.9%. Research undertaken by Teagasc has shown that the trait is under genetic control and has a heritability of 40%, meaning that the genetics of the lamb is responsible for 40% of the differences observed in lamb vigour among lambs. This information has allowed for the development of a breeding value for lamb vigour which is now included in both the Terminal and Replacement €uro-star indexes as part of the lambing traits.

Carcass value is one of the main contributors to revenue in sheep enterprises. Despite the contribution of such traits to overall profitability, the lack of routinely available carcass data with accurate parentage information meant that very little carcass data was available to Sheep Ireland in the past. However carcass data is now available routinely from most of the processors in Ireland, this coupled with knowledge of the heritabiltiy of carcass traits (carcass conformation, carcass fat, and age at slaughter was 19, 8 and 16% heritable, respectively) has meant that more accurate carcass data is now feeding into the €uro-Star indexes of individual rams.

More commercial data. Although €uro-Star indexes are generally only available on pedigree rams, Sheep Ireland has placed increased emphasis in recent years on data generated on these pedigree rams in commercial flocks. Data from commercial grass based flocks now makes up over 50% of all data entering Sheep Ireland. This ensures that pedigree rams are tested in a pure commercial environment and that the genetic indexes of any pedigree rams are more reflective of how that ram would perform in a commercial flock.

Genomics. Genomic selection is a process that looks directly at the genes or DNA of an animal rather than waiting for their genes to be passed on and expressed by the animal themselves or their lambs. An animal's DNA remains the same across its lifetime and therefore the increase in accuracy from genomic selection can be achieved when the animal is still very young (i.e. a lamb with little recorded information). Genomic selection has resulted in an increase in the accuracy of young ram lambs by up to 35%, which in turn helps to increase genetic gain for the entire Irish sheep industry. The other major benefit of genomic technology is the ability to accurately assign or verify parentage information on animals that have their parents genotyped thereby reducing parentage errors and opening up recording for commerical flocks. When the genomic technology was first introduced to the Irish sheep population parentage errors were as high as 20% in pedigree recorded animals, now this figure is <5%. In a large proportion of cases where parentage mismatches have been identified by Sheep Ireland, parentage can now be assigned or corrected based on the DNA information available on the flock. To date over 60,000 animals have been genotyped by Sheep Ireland.

Data Quality Index (DQI). The DQI is an index that ranks each flock based on the quality and quantity of the data recorded by the flock. This index can be used to help commercial farmers to identify pedigree flocks that are recording large amounts of accurate data. For pedigree flocks the DQI allows breeders to identify the areas where their data recording could be improved. The target DQI score is 80% or higher and is available on every ram sales card.

Future research

Greenhouse gas emissions. Mitigation strategies are required to reduce methane emissions without impacting animal productivity; genetic improvement is one potential strategy. A large number of methane records (>6,000) have now be collected using the portable accumulation chambers and preliminary results show that the trait is under genetic control with a heritability of 25%. Over the next number of months methane records will be collected on on a large number of both pedigree and commerical animals to allow for the development of a breeding value for methane which can in incoportated in the €uro-Star indexes in the future.

Ewe longevity. Ewe longevity is an economically important trait in a breeding flock, due to the potential to reduce culling rates and female replacement costs. The ability to identify ewes that are able to outperform their flock contemporaries, can help to improve flock efficiency and profitability. However to date ewe longevity has not been included in the €uro-Star indexes due to lack of records. Research is on-going to investigate whether the trait can be incorporated into the Replacement index and to develop the optimal way for Sheep Ireland participants to record ewe longevity records.

Mastitis. Although mastitis and somatic cell count is routinely recorded in dairy cow populations, limited records exist for such health traits in sheep. The incidence of masitits in Ireland has been reported as 2.55%, with a direct heritability estimate of 4%. Since this initial research was conducted by Teagasc, a large number of phenotypes has been recorded through Sheep Ireland thereby allowing breeding values for mastitis to be generated in the near future.

Faecal Egg Count (FEC). To mitigate the effect of drug resistance worms, an alternative sustainable approach is required to reduce the over reliance on anthelmintics; genetics is one such alternative. The OviFEC project, which commenced in 2022, will involve the sampling of a large cohort of informative lambs for worm burdens, with the aim of developing a new genetic breeding value for ranking animals based on their susceptibility to high worm burdens. The resultant breeding value will be included in the €uro-Star indexes and will be available to all Irish sheep farmers to enable them to make more informed breeding decisions.

Conclusion

The €uro-star genetic indexes remain an important tool that enable sheep farmers to make more informed breeding and selection decisions and has the potential to increase profitability at farm level. Teagasc, in conjunction with Sheep Ireland and industry will strive to further enhance the Irish sheep breeding programme and ensure that the benefits are clearly seen at farm level.

Acknowledgements

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Breeding ewe replacements – age at first lambing and ewe genotype

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Take Home Messages

- Lambing replacements at 1 year of age has no effect on
  - ewe performance at 2 years of age
  - ewe longevity
- Weight at 7 months impacts lifetime performance regardless of age at first joining
- Use of Belclare sires increased lifetime lamb output by 25%
- Relative to >75% Suffolk cross ewes producing their first lambs at 2 years of age, Belclare-cross ewes lambing as ewe lambs produce 57% more lambs during their life time

Introduction

The mean replacement rate on lowland sheep farms is 22%. The mean cost, nationally, of producing a replacement ewe, when joined for the first time at ~19 months, equates to approximately 25% of the value of her lifetime lamb-carcass output. Ewe replacement policy is a key determinant of efficiency of prime lamb production. Since the costs involved in sheep production are attributable primarily to the ewe, rather than to her lambs, production costs per lamb can be reduced by increasing the number of lambs produced per ewe lifetime. The number of lambs reared per ewe lifetime are influenced by ewe prolificacy (ewe genotype) and the number of lamb crops produced (age at first lambing).

Ewe productivity has remained relatively static, at approximately 1.3 lambs weaned per ewe joined, on Irish lowland farms for the last 30 to 40 years. This lack of improvement is most probably attributable to the absence of a significant increase in the use of more prolific ewe genotypes. Currently, 73% of lowland ewes have been sired by one of the three main terminal sire breeds (Suffolk, Texel and Charollais), and two of these breeds have inherently low productivity. Suffolk and Suffolk-cross ewes account for 55% of lowland ewes. The Belclare breed has a litter

size of approximately 2.2 under typical on-farm management conditions, and represents the sire of 10% of ewes in lowland flocks. Belclare-cross ewes have a higher prolificacy than a wide selection of other crossbred types.

Athenry study

A study was designed to evaluate the effects of age at first lambing (1 or 2 years) and ewe genotype (≥75% Suffolk, Belclare×Suffolk, purebred Belclare) on the lifetime performance of ewes. Suffolk was chosen as over half of the national flock comprise Suffolk types while the Belclare was chosen because of its proven high productivity. Charollais sires were used to avoid maternal and terminal breed confounding and to maximise hybrid vigor in the lambs.

Half of the ewe lambs, within each genotype, were joined with rams to produce their first litter at 1 year of age while the remainder were joined to produce their first litter at 2 years of age. Ewes were housed in mid-December, shorn and offered grass silage based diets. The quantity of concentrate offered during late pregnancy depended on expected litter size and grass silage feed value. Ewes were put to pasture post lambing. Ewe rearing singles or twins, and their lambs, did not receive concentrate supplementation. Ewes rearing triplets received 0.5 kg concentrate daily for 5 weeks post lambing and their lambs had access to 0.3 kg concentrate daily until weaning. Ewes lambing at one year of age, and their lambs, were managed as described for triplet rearing ewes. Concentrate was removed at weaning.

The "ram effect" can be used to induce ewes and ewe lambs to start cycling provided they are sufficiently close to the time of onset of normal cyclicity (see Table 1). For the "ram effect" to work the ewes should not be in contact (sight or smell) with rams for the previous month.

Table 1. Timetable for use of the "ram effect"

Day	
1	Introduce aproned rams
3	Remove aproned rams
14	Introduce fertile rams
18	1st peak in matings
23	2nd peak in matings

All ewe lambs were raddled during the joining period and the lambing season was compact with 62 and 84% lambing within 2 and 3 weeks, respectively. Raddle colour was changed weekly to enable the penning during winter according to expected lambing date and scanned litter size. When using the "ram effect" to synchronise the mating season it is essential to have an adequate number of rams for mating (1 experienced ram

per about 30 ewes) and to have adequate facilities (lambing pens – 1 per 5 to 6 ewes) and labour during the lambing season.

Age at first lambing

The effect of ewe genotype on ewe and lamb performance when lambing as ewe lambs, as 2- tooths and as mature ewes is presented in Table 2.

Ewe lambs: Ewes that lambed at 1-year of age reared an average of 1 lamb per ewe joined, which weighed 30.6 kg at weaning and had a carcass weight of 20.5 kg when slaughtered at 199 days of age. These lambs did not receive any concentrate supplementation post weaning.

The effect of weight at joining on the probability of a ewe rearing at least one lamb when lambing at 1 year of age was used as an efficiency index as it reflects differences due to ewe and lamb mortality, litter size and ewe barrenness. Regardless of ewe genotype, as weight at joining increased the probability of rearing at least one lamb increased. To have a 0.9 probability (90% chance) of rearing at least one lamb, ewe lamb body weight at joining would need to be 48.5, 51.2 and 60.0 kg for Belclare, Belclare×Suffolk and ≥75% Suffolk ewe lambs, respectively. Thus Belclare, Belclare×Suffolk and ≥75% Suffolk ewe lambs would need to be 63%, 64% and 72% of mature body when joining at 7.5 months of age to have a 90% probability of rearing at least one lamb.

Table 2: Effect of ewe age at first joining on performance as ewe lambs, at 2 years of age and as mature ewes

Performance at		**Age at first lambing**	
		1 year	**2 years**
1 year	Litter size	1.44	-
	Lambs reared/ewe joined	1.0	-
	Lamb weaning weight (kg)	30.6	-
	Lamb age at slaughter (days)	199	-
2 years	Litter size	1.77	1.78
	Lambs reared/ewe joined	1.41	1.38
	Lamb weaning weight (kg)	30.4	30.0
	Lamb age at slaughter (days)	202	204
≥ 3 years	Litter size	1.98	1.96
	Lambs reared/ewe joined	1.60	1.54
	Lamb weaning weight (kg)	34.0	34.4
	Lamb age at slaughter (days)	170	172
Number of lambings		4.1	3.2
Number of lambs reared during lifetime		6.7	5.3

There was also a positive relationship between ewe weight at lambing and the weight of her lambs at birth and their performance to weaning. Each 5 kg increase in ewe weight at lambing increased the lamb weight at birth by 0.26 kg, which had a positive effect on daily live-weight gain to weaning, and thus weaning weight.

2 years of age: One of the main reasons often cited for not joining ewe replacements to lamb at one year of age is the perception of a negative impact on ewe body weight when joining to lamb at 2 years of age. In the current study, ewes that lambed at 1-year were only 2 kg lighter that those that had not been joined. The lack of a significant difference in body weight is probably due to the ewes that lambed at 1-year being supplemented with concentrate during mid and late pregnancy to meet requirements for pregnancy and growth. Lambing as ewe lambs had no negative impact on ewe performance when lambing at 2 years of age or on the performance of their lamb from birth to slaughter.

Increasing ewe replacement weight at 7 months had a positive effect on the probability of rearing at least one lamb when lambing at 2 years of age. A 15% increase in ewe replacement weight at 7 months increased the probability of rearing at least one lamb by 5-8 %, depending on ewe genotype, which is 50% the response obtained when lambing at 1-year of age.

Mature ewes: When lambing at 3 years and older, age at first lambing did not impact the performance of adult ewes or that of their progeny. Mean weaning weight was 34.2 kg and lambs were 171 days old at slaughter, achieving a carcass weight of 21.4 kg. With the exception of lambs reared as triplets, lambs did not receive any concentrate supplementation from birth to slaughter. The high growth rate of these lambs clearly illustrates what is consistently achievable from well managed grass-based systems of prime lamb production.

Life time performance: Lambing as ewe lambs increase the number of lambings by one, thus age at first lambing had no negative impact on ewe longevity (Figure 1). However, lambing as ewe lambs increased the number of lamb reared by 1.3, which is equivalent to 25% of the lifetime productivity of replacement ewes joined to lamb for the first time at 2-years of age.

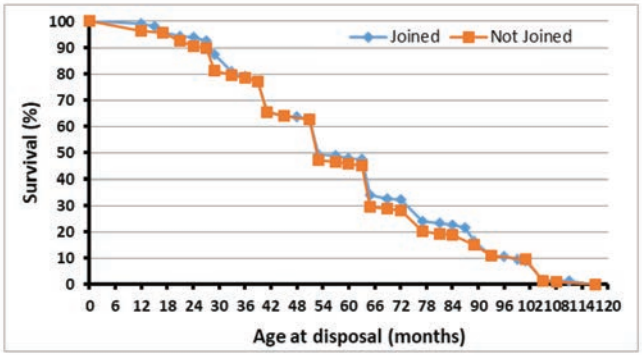

Figure 1: Effect of age at first joining on age at exit from the flock (either or culled or died)

Effect of ewe genotype

The effect of ewe genotype on ewe and lamb performance when lambing at 1 year, 2 year and as mature ewes is presented in Table 3.

Ewe lambs: Belclare ewe lambs had a higher litter size than the Belclare×Suffolk and >75% Suffolk genotypes and reared an extra 0.16 and 0.35 lambs per ewe joined relative to Belclare×Suffolk and >75% Suffolk genotypes, respectively. Mean carcass weight of the lambs at slaughter was 20.5 kg. Lambs from Belclare×Suffolk ewes were slaughtered at a younger age probably associated with hybrid vigor.

2 years of age: When lambing at 2 years of age Belclare and Belclare×Suffolk ewes reared 0.25 and 0.23 more lambs per ewe joined, respectively, than >75% Suffolk ewes. Ewe genotype had no effect on lamb performance from birth to slaughter. Mean carcass weight of the lambs at slaughter and age at slaughter was 20.6 kg and 202 days, respectively.

Adult ewes: When lambing as adult ewes (3 years and older) Belclare and Belclare×Suffolk ewes were more prolific, rearing an extra 0.28 and 0.41 lambs/ewe joined relative to the >75%Suffolk genotype. Mean lamb carcass weight and age at slaughter was 21.4 kg and 171 days respectively. Lambs from the >75% Suffolk ewes were 13 and 6 days older at slaughter than lambs from Belclare and Belclare×Suffolk ewes.

Table 3: Effect of ewe genotype on performance as ewe lambs, at 2 years and as mature ewes

Age at lambing		Ewe genotype		
		Belclare	**Belclare×Suffolk**	**>75% Suffolk**
1 year	Litter size	1.65	1.41	1.26
	Lambs reared/ewe joined	1.2	1.0	0.8
	Lamb weaning weight (kg)	29.0	31.9	30.9
	Lamb age at slaughter (days)	207	190	201
2 years	Litter size	1.90	1.84	1.59
	Lambs reared/ewe joined	1.61	1.59	1.36
	Lamb weaning weight (kg)	30.0	30.9	29.6
	Lamb age at slaughter (days)	203	201	204
≥ 3 years	Litter size	2.02	2.12	1.77
	Lambs reared/ewe joined	1.62	1.75	1.34
	Lamb weaning weight (kg)	33.9	35.0	33.7
	Lamb age at slaughter (days)	171	164	177
Number of lambings (overall)		3.5	3.8	3.6
Number of lambs reared (overall)		6.0	6.7	5.3

Life time performance: Ewe genotype had little impact on the number of lambings although that for Belclare×Suffolk was highest. However, ewe genotype had a major impact on the number of lambs reared during their lifetime. Relative to the >75% Suffolk ewes, the Belclare×Suffolk ewes reared an additional 1.4 lambs.

Weight at 7 months

Body weight of replacements at 7 months, regardless of age at first joining, influences ewe lifetime performance. An increase of 15% (~ 7.5 kg) in body weight of replacements at 7 months increases the:

1) probability of rearing a lamb by 10 – 23% at one year of age depending on genotype
2) probability of rearing a lamb by 5 to 8% at 2 years of age depending on genotype
3) number of lambs reared in life time by 0.4
4) weight of lamb weaned by 18 kg

The INZAC Flock – Review of phase I and plans for the future

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Take Home Messages

- The INZAC flock consists of three distinct groups based on their genetic merit for maternal traits: New Zealand (NZ), High genetic merit Irish (High Irish) and Low genetic merit Irish (Low Irish).
- High index Irish ewes are outperforming low index Irish ewes in terms of number of lambs born and weaned.
- New Zealand ewes have shown increased lamb output and lower assistance required at lambing compared to both Irish groups.
- Lambs born to ewes of High Irish and NZ have higher growth rates when compared to lambs born to Low Irish ewes.
- The second phase of the INZAC study has begun with a focus on difficult to measure traits including lamb slaughter data

Background

Profitable sheep enterprises require a ewe that efficiently reproduces lambs with good weight-for-age from a grass-based production system, annually. The use of genetics in animal production is a powerful tool that allows farmers to select superior animals to become parents of the next generation. The Sheep Ireland €uro-star indexes were introduced in Ireland in 2009 with the aim of providing sheep farmers with an additional tool for the selection of breeding animals. Genetic gains achievable to date have been small (30c/lamb/year) but it must be remembered that these gains are permanent and cumulative. Genetic evaluations in New Zealand have been established since 1999 and, to-date, have resulted in considerably greater rates of genetic improvement to date (€1.00/lamb/year). As a result the INZAC flock, involving the importation of genetically elite Suffolk and Texel sheep from New Zealand was established in 2015.

Summary of INZAC I

The initial phase of the INZAC study was conducted from 2016-2019 inclusive. There were a total of 180 ewes representing two main breeds (Suffolk and Texel) and three genetic merit types: New Zealand (NZ), High genetic merit Irish (High Irish) and Low genetic merit Irish (Low Irish). The two major objectives were;

1. To validate the Irish replacement €uro-star index (1 ★ v's 5 ★).
2. To compare the performance of Irish versus NZ genetically elite animals in a common environment.

The results from INZAC I showed that NZ ewes were less likely to suffer from dystocia, and their lambs were more likely to stand up and suckle unassisted relative to lambs born from High or Low Irish ewes. New Zealand and High Irish ewes had a greater number of lambs born and weaned throughout the duration of the study compared to their Low Irish counterparts. Ewe milk yield, milk fat, total solids and gross energy content was superior for milk produced by NZ ewes at week 6 post-lambing in comparison to Irish ewes. In late lactation, Low Irish ewes had a greater daily dry matter intake (DMI) and also had a greater DMI/kg of ewe live-weight compared to the High Irish ewes.

When looking at lamb data NZ lambs had greater average daily gains (ADGs) at most time points both pre- and post-weaning compared to High Irish and Low Irish lambs. High Irish lambs had greater ADGs than Low Irish lambs from birth to drafting.

The net profit of the three scenarios was simulated using a bio-economic model: the Teagasc Lamb Production model, where net profit equated to €514, €299 and €258 per hectare, for the NZ, High Irish and Low Irish scenarios, respectively. Further results from a modelling exercise completed in conjunction with AbacusBio in New Zealand demonstrated that the Irish national sheep industry could maximise genetic and economic gains by shifting market share away from conservative breeders towards progressive breeders rather than importing breeding stock from NZ.

Introduction to INZAC II

Following on from INZAC I the second phase of the INZAC study commenced in 2022. The 2nd phase of the INZAC flock comprises of 240 ewes from two main breeds, Suffolk and Texel, representing four groups as shown in Figure 1. For the additional group in the phase II study the NZ sires are mated to High Irish ewes within the same breed. The introduction of a NZxIRL group will allow us to investigate the effect of heterosis (if any) when breeding the HZ and High Irish animals. The primary objectives of INZAC II are:

1. Evaluate the integration of New Zealand genetics through mating with Irish animals of elite genetic merit and investigating their maternal performance;
2. Investigate the effect of genetic merit on novel or hard to measure traits including feed intake, methane output and carcass quality traits.

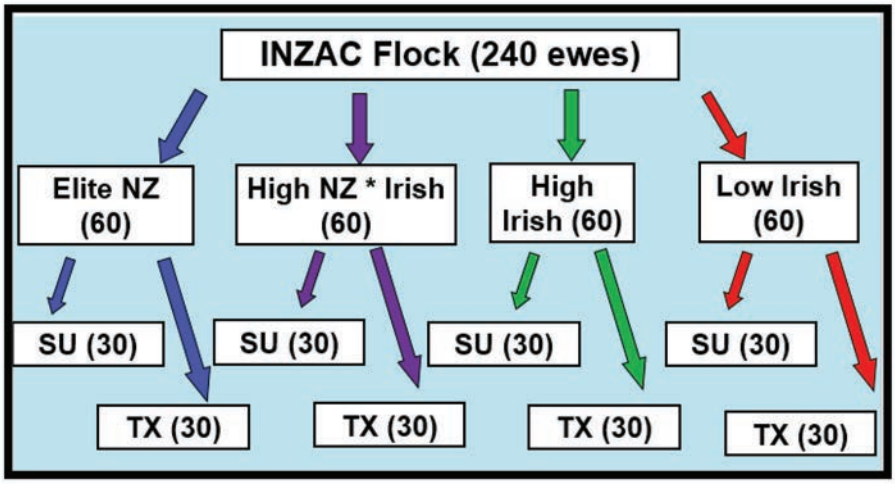

Figure 1. INZAC II flock structure

Is an animal's scrapie genotype associated with performance?

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Take Home Messages

- The scrapie genotype of an animal is now available as part of the Sheep Ireland genotyping programme
- All 15 possible scrapie genotypes are present in Ireland, although the frequency of each scrapie genotype differs by breed
- An animal's scrapie genotype has little to no association with a series of lambing, live weight, ewe performance or health traits
- Farmers should select rams based on their €uro-Star index to improve flock performance

Introduction

Genetic susceptibility to scrapie, a fatal disease of sheep and goats, is controlled by differences in one specific gene - the prion protein. The resulting scrapie genotype has been shown to be associated with an animal's susceptibility to scrapie, with the ARR variant associated with resistance, while the ARQ, ARH, VRQ variants are associated with a reduced level of resistance. Although a nataional scrapie programme was introduced in Ireland in 2002, the scheme ceased prior to the complete eradication of the most susceptible scrapie genotypes in Ireland. Since then, the frequency of the scrapie genotypes in the national population remains relatively unknown. Scrapie genotypes are now readily available as part of the Sheep Ireland genotyping programme. Therefore a large dataset is now available to assess: 1. the frequency of the various scrapie genotypes in the Irish population, and 2. if there is a relationship between an animal's scrapie genotype and subsequent performance.

Data

Scrapie genotypes were available on 16,416 animals originating from 252 lowland flocks born between the years 2004 and 2019, inclusive. The breeds represented included 733 Belclare, 333 Charollais, 739 Suffolk, 1,857 Texel, 191 Vendeen, as well as 12,563 animals from other breeds or crossbreds. Performance data on a range of animal-specific events, including date of birth, lambing data, lamb live-weight records, as well as ewe performance metrics such as ewe live-weight, body condition score and litter size were also available from the national sheep database (http://www.sheep.ie). The association between the 15 scrapie genotypes and animal performance was investigated.

Results

All 15 of the possible scrapie genotypes were detected across the population, although the frequency differed by breed. The frequency of Type 1 scrapie class was 70.85% across the entire population, but ranged from 44.70% in Texels to 85.93% in Suffolks (Table 1). The most susceptible Type 5 scrapie was only detected in purebred Texels, Beclares and crossbreds (Table 1). The scrapie genotype of either

Table 1. Number of animals (n) and percentage of purebred Belclare, Charollais, Suffolk, Texel, Vendeen or other animals with each scrapie genotype and scrapie type

Scrapie type	Scrapie Genotype	Belclare	Charollais	Suffolk	Texel	Vendeen	Other
n		733	333	739	1,857	191	12,563
1	ARR/ARR	69.6	81.1	85.9	44.7	79.6	62.6
2	ARR/AHQ	1.5	-	0.3	2.5	-	2.7
	ARR/ARH	5.9	0.6	0.1	26.3	-	11.4
	ARR/ARQ	17.9	17.1	13.3	14.5	19.9	17.1
3	AHQ/AHQ	-	-	-	0.1	-	0.1
	AHQ/ARH	0.1	-	-	0.8	-	0.3
	AHQ/ARQ	0.1	-	-	0.5	-	0.3
	ARH/ARH	0.7	-	-	4.4	-	0.5
	ARH/ARQ	1.5	-	-	4.1	-	1.7
	ARQ/ARQ	1.9	0.6	0.4	1.4	0.5	1.2
4	ARR/VRQ	0.7	0.6	-	0.5	-	1.5
5	AHQ/VRQ	-	-	-	-	-	0.1
	ARH/VRQ	-	-	-	0.2	-	0.2
	ARQ/VRQ	0.1	-	-	-	-	0.2
	VRQ/VRQ	-	-	-	-	-	0.1

the lamb or ewe did not associate with any of the lambing traits investigated including lambing difficulty score, lamb mortality and lamb birth weight. With the exception of ultrasound muscle depth, the scrapie genotype did not associate with any of the lamb performance traits investigated including lamb live-weight pre-weaning to slaughter and any of the lamb carcass traits. Lambs carrying the type 4 scrapie genotype (i.e. ARR/VRQ) had 1.20 mm, 1.38 mm, and 1.47 mm shallower ultrasound muscle depth relative to lambs of the less susceptible scrapie types of 1, 2, 3, respectively. Nonetheless, a lamb's scrapie genotype did not associate with the lamb's eventual carcass conformation, the ultimate end goal of farmers. Ewe litter size, body condition score or lameness did not differ by scrapie genotype of the ewe. For ewe mature live-weight, ARH/VRQ ewes were, on average, 3.79 kg heavier than ARR/ARR genotype ewes. Lamb dag score differed by the scrapie genotype of the ewe, although the differences were small.

Conclusions

Results from this study show that the all scrapie genotypes exist within the Irish sheep population albeit the frequency differed by breed. The scrapie genotype of either the lamb or the ewe, however, had a weak to no association with several animal performance metrics and, where associations were detected, the biological significance was small.

Acknowledgements

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How methane production and dry matter intake differ across life-stage

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Take Home Messages

- Methane and dry matter intake (DMI) were measured across various life-stages including lambs, hoggets, pregnant, lactating and dry ewes.
- Lactating ewes have both the highest methane output and dry matter intake (kg DM/day).
- No difference was found between methane output measured from lambs, hoggets and pregnant ewes.
- DMI ranged from 0.90 kg DM/day (lambs) to 2.4 kg DM/day (lactating ewes).
- Baseline values are now available for both methane output and DMI at each life-stage on Irish sheep.

Introduction

Irish agriculture is under increasing pressure to reduce its greenhouse gas emissions, in particular methane. Methane produced by ruminants' accounts for 57.5% of the total Irish agricultural emissions. To accurately select sheep for reduced methane emissions, a knowledge of an animal's methane output throughout the animal's lifetime is required. Dry matter intake (DMI) is one of the main drivers of methane output, however to date the relationship between methane output and DMI for Irish grazing sheep remains relatively unknown. The objectives of this study were to quantify methane output and DMI at specific time points across the animal's lifetime.

Study design

Methane output from 30 Suffolk and 30 Texel females was measured at various stages across their lifetime including: lambs (<12 months), dry hoggets (12 to

24 months) and ewes (>24 months). Ewes were broken down into three groups: pregnant, lactating (week 10 post-lambing) or dry. Methane output was measured using 12 portable accumulation chambers (PAC). The PAC will not give the absolute value for methane output, however it will allow for the ranking of animals as high or low methane emitters. Animals were removed from feed for at least one hour prior to their methane measurement. Methane (ppm) concentration was measured at three time points (0, 25 and 50 minutes from entry of the animal to the first chamber). A repeat measurement was taken on the same animals 14 days later. Dry matter intake (DMI) was measured to coincide with the PAC measurements. The *n*-alkane technique was used to measure DMI at grass for lambs, hoggets, lactating and dry ewes while individual pens indoors were used to measure DMI on silage and concentrates for lambs and pregnant ewes.

Results

Mean methane output at each life-stage is shown in Table 1. Greatest methane output was measured from lactating ewes (24.54 g/day), followed by dry ewes (19.04 g/day) whilst, pregnant ewes, hoggets and lambs had the lowest methane output and did not differ from each other. When methane was expressed per kg of live-weight, no difference was found between dry and lactating ewes, while lambs, hoggets and pregnant ewes did not differ from each other. For the pregnant ewes, their live-weight is also accounting for the live-weight of the growing foetus; less energy is lost to methane production as the ewe is using the energy to grow the foetus; similarly energy partitioning in lambs is mainly directed towards growth hence the lower methane per kg of live-weight. The repeatability of methane per kg live-weight across the animal's life-time was 0.78.

Life-stage	*Lamb*	*Hogget*	*Pregnant ewe*	*Lactating ewe*	*Dry ewe*
Methane output (g/day)	12.30^{a}	12.05^{a}	11.47^{a}	24.54^{b}	19.04^{c}
Live-weight (kg)	45.06^{a}	65.57^{b}	66.08^{b}	75.45^{c}	70.09^{d}
Methane per kg live-weight (g methane/kg live-weight)	0.22^{a}	0.21^{a}	0.19^{a}	0.36^{b}	0.30^{b}

Table 1. Methane output, live-weight and methane per kg live-weight across life-stages.$^{a\text{-}d}$ subscripts within rows differ from each other.

Dry matter intake at each life-stage is shown in Figure 1. Dry matter intake ranged from 0.90 kg DM/day (lamb) to 2.4 kg DM/day (lactating ewe). Future work on this project will investigate the relationship between CH_4 output and DMI. This

will ensure that by selecting low methane emitting animals, DMI is not negatively affected and therefore compromising animal performance. Methane yield (g methane/kg DMI) will be calculated and used to identify sheep that have a high DMI and low methane output.

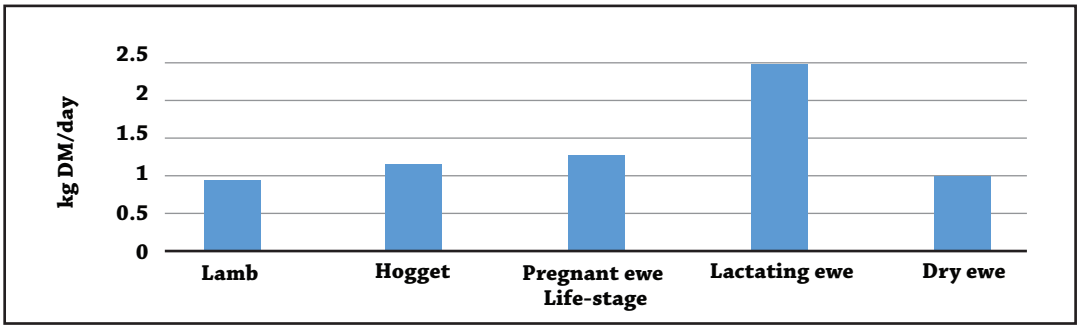

Figure 1. Dry matter intake (DMI) across life-stages in kg dry matter (DM) per day.

Conclusion

We now have baseline values for both methane output and DMI at each life-stage. This will allow for the identification of efficient sheep that are low methane emitters with high DMI.

Acknowledgements

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Sustainable breeding: what can the national genetic indexes deliver for the Irish sheep industry?

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Take Home Messages

- Total flock production, profit, and GHG emission profiles were calculated separately for two flocks consisting of 1 star versus 5 star animals
- The 5 star flock sold more lambs per ewe and also at an earlier age, equating to 3.29 kg (11%) more lamb carcass per ewe
- Greater production of the 5 star flocks resulted in an additional €18/ewe net profit than the 1 star flock.
- The 5 star flock produced 7% lower GHG emissions intensities compared to the 1 star flock

Introduction

The Irish sheep industry, like all sheep industries internationally, faces the challenge of increasing farm production and profitability while reducing environmental impacts. The Sheep Ireland €uro-Star indices are tools that could be used to select more efficient animals therefore improving flock performane whilst reducing greenhouse gas (GHG) emissions intensities, however validation of the €uro-Star indexes are required to ensure 5 star animals are yielding such improvements.The objectives of this study were, to model real-farm production differences from sheep divergent in genetic merit for the Irish Replacement and Terminal breeding indices and to quantify these differences on farm production, profit, and GHG emissions.

Flock Data

On-farm data from 387,580 records of animals with known €uro-star values born between 2018 and 2020 in Irish commercial flocks were inputted to an established

bio-economic model. Two contrasting flocks were modelled based on the real-farm production differences found between 5 and 1 star animals. Total flock production, profit, and GHG emissions were calculated separately for both flocks which consisted of:

1. A flock of ewes ranked 5 star (top 20%) on the €uro-star Replacement Index bred with rams ranked 5 star on both the Replacement and Terminal indices (hereon referred to as the 5 star flock),
2. A flock of ewes ranked 1 star (bottom 20%) on the €uro-star Replacement Index bred with rams ranked 1 star on both the Replacement and Terminal indices (hereon referred to as the 1 star flock)

Production system. Both flocks were modeled in a mid-season lowland system, consisting of 168 ewes stocked at 7.9 ewes per hectare (ha). Ewes were mated for the first time as hoggets and a replacement rate of 22% was assumed within both flocks. The on-farm performance parameters to populate both flock scenarios were taken from a previous validation study which showed that 5 star ewes had higher litter sizes and produced progeny with: greater perinatal lamb survival, heavier live weights from birth to post weaning, and reduced days to slaughter. Flock feed demand was estimated monthly according to sheep numbers and animal production stage (growth, lactation, etc). Fertilizer inputs were assumed consistent across both flocks, with surplus grass sold as baled silage. Ewes were housed over winter from 1 December and offered grass silage and supplemented with concentrates pre-lambing. An average lambing date of 1st March was assumed across both flocks and ewes and lambs were returned to pasture within 48 hours post lambing. Lambs were drafted for slaughter once reaching a target live weight. A life cycle assessment was conducted on both flocks using the same production input data to predict the GHG emissions from both modelled flocks.

Results

The modelled results showed that flock weaning rates were 1.70 and 1.54 lambs weaned per ewe presented for breeding for the 5 star and 1 star flocks, respectively. The 5 star flock sold 0.16 more lambs per ewe, equating to 11% (3.29 kg) more lamb carcass per ewe, than the 1 star flock; lambs from the 5 star flock were also sold at an earlier age. The greater production of the 5 star flock resulted in an additional €18 net profit per ewe compared to the 1 star flock; the average net profit per ewe currently in Ireland is €22 showing there is large scope for improving margins based on genetic indices. Total flock GHG emissions were marginally greater for the 5 star flock as a result of the 0.16 more lamb sold per ewe, however the GHG emissions per kg of carcass sold were 21.7 and 23.3 kg CO_2-eq /kg for the 5 star and

1 star genetic merit flocks, respectively (Figure 1). The lower emissions intensity of the 5 star flock was due to the dilution effect of greater lamb production and lambs being drafted for slaughter earlier.

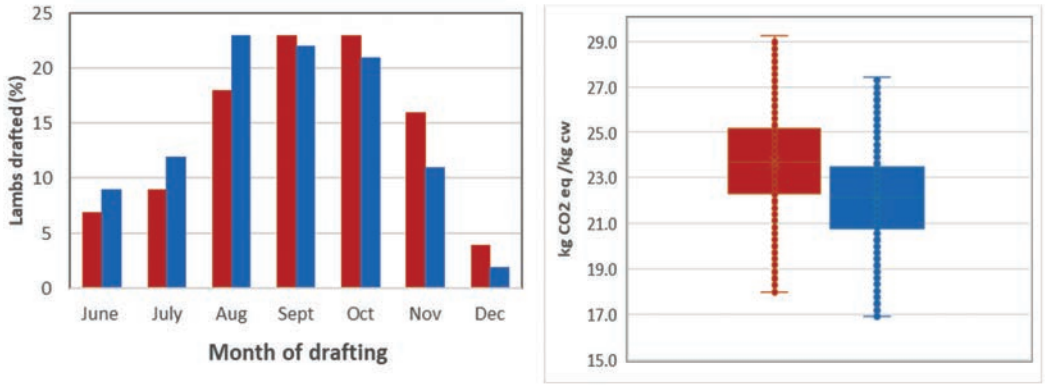

Figure 1. Average percentage of lambs drafted per month and the lobal warming potential (kg CO_2-eq) per kg carcass weight for the 1 star (red bars) and the 5 star (blue bars) flock.

Conclusions

Results suggest that substantial profit gains through selection rams of higher star ratings across both the Replacement and Terminal indexes whilst also reducing their environmental impact.

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Do Sheep Ireland genetic evaluations work for maternal traits?

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Take Home Messages

- Genetic evaluations are a powerful tool that aid farmers in identifying superior animals for breeding
- Continual validation of the genetic evaluations are required to ensure that animals of greater star ratings yield greater performance this is especially true of maternal traits
- Result to date show that 5 star animals across a range of maternal trait consistently outperform animals with lower star ratings
- Breeding should form an integral component of profitable sheep production systems

Introduction

Animal genetics is a powerful tool that aid farmers in identifying superior animals to become the parents of the next generation. Genetics involves the transmission of favourable or unfavourable genes from one generation to the next and the use of genetic indexes is an important selection aid that enables farmers to identify superior animals across a range of traits. Animal genetics, unlike management or feeding, is cumulative and permanent – this, however, could also be a disadvantage in that poor breeding decisions, even for one year, could have devastating repercussions for many generations thereafter. Since their inception in 2009, the Irish national sheep genetic evaluations have aimed to breed low cost, easy care sheep with good maternal characteristics, that also produces a good quality lamb that reaches slaughter at an early age. However continual validation of the

genetic evaluations are required to ensure that animals of greater genetic merit yield greater performance or profitability for Irish sheep farmers; this is especially true for often difficult to measure maternal traits. The objective of this paper was to quantify the relevance and accuracy of the Irish maternal genetic evaluations for improving maternal flock performance.

Data

To assess the usefulness of the genetic indexes in detecting differences in performance between animals performance data across a range of animal-specific events including: lambing (i.e., lambing dystocia, lamb survival, birth weights), lamb performance records (i.e., weaning weight), ewe performance records (i.e., number of lambs born), health traits (i.e., dag scores) recorded between 2017 and 2021 were extracted from the Sheep Ireland database; the data consisted of both crossbred (28%) and purebred (72%) animals. The number of records available differed per trait but varied from 105,248 to 37,587 records. To quantify the accuracy of the Irish maternal genetic evaluations for improving maternal traits in the national flock, individual animal breeding values for maternal traits were compared to performance on farm for the same trait.

Results

Results show that 5 star ewes star ewes across a range of maternal traits had greater reproductive performance on farm. Ewes with a 5 star rating for fertility (i.e. the number of lambs born breeding value) produced, on average, an additional 0.38 lambs per lambing compared to a ewe of 1 star for the number of lambs born breeding value. Although 5 star ewes produced a 0.23 kg heavier lamb at birth, 5 star ewes had experienced lower levels of lambing difficulty (10% less lamb dystocia)

Trait	5 star	1 star	Difference
Number of lambs born (1 to 4)	2.07	1.69	0.38
Lambing dystocia (%)	19%	29%	10%
Lamb survival (%)	91%	86%	5%
Birth weight (kg)	4.66	4.43	0.23
Weaning weight (kg)	36.99	35.37	1.62
Dag score (1-5)	1.51	2.07	0.56

Table 1. On farm performance of animals differing in star ratings for key performance traits for lambing, lamb performance and health traits.

compared to ewes of 1 star for the relavent trait. Lower lamb mortality was also associated with ewes of 5 star rating for lamb survival, on average, 5% more lambs survived at lambing compared to 1 star ewes. Greater growth rates were also seen with lambs born to 5 star ewes both at pre-weaning and weaning with lambs born to 5 star ewes 0.64 kg and 1.62 kg heavier at pre-weaning and weaning compared to lambs born to 1 star ewes, respectively. Animals of 5 star rating also had a lower dag score (0.56 score) compared to animals of a 1 star rating.

Conclusion

Results from this research indicate that selection of breeding animals for favourable maternal genetic attributes will result in favourable improvements in performance and profitability at farm level. Genetic evaluations are an important tool for sheep farmers to make more informed breeding decisions for increasing farm profitability.

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Precision farming with genomics

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Take Home Messages

- Genomics is the study of DNA.
- Genomic selection has the potential to achieve even greater accuracy than pedigree-based selection methods, thereby accelerating the rate of genetic gain.
- DNA data can be used to estimate breed composition with a high degree of accuracy.
- DNA data can be used to track genes with major effects on important traits in the population.

Introduction

A newly formed sheep embryo inherits half of its DNA from its sire and the other half is inherited from the dam, this combined set of DNA is unique to the embryo and remains constant over its lifetime as it develops into a lamb and finally matures into a ewe or a ram. Encoded in the DNA are the full set of genes which contribute to, and are sometimes exclusively responsible for, nearly all the important traits in sheep. The study of DNA and its properties is known as genomics. Over recent years the number of genotyped sheep has risen steadily to over 55,000 genotyped animals as of 2022. This large genomic dataset is enabling Sheep Ireland to identify animals that have superior genetic merit with high levels of accuracy through the €uro-star indexes. Besides generating predictions of the likely lifetime performance of an animal from the day they are born, studying DNA can give additional benefits such as identifying errors in parentage recording, precisely estimating breed composition, and tracking genes known to have a large effect on important traits in sheep.

Genomic selection

In the absence of inbreeding, full-siblings share on average 50% of their DNA; this is just an average and the actual percentage of DNA shared between full-siblings can vary (95% of full-siblings pairs will share between 42% and 58% of their DNA). Similar to the case of full-siblings, the actual percentage of DNA shared between any two relatives varies around some average value. The only exception to this rule is the parent-offspring relationship in which the offspring always shares exactly 50% of their DNA with the parent, assuming the offspring is not inbred. The percentage of DNA shared between any two animals can be estimated very precisely using genomic data, whereas with pedigree data only the expected average relationship between the relatives can be estimated. The ability to accurately estimate the relationship between animals is central to genetic selection breeding programs, not only to accurately estimate the genetic merit of an animal but also to avoid breeding related animals. Due to the greater precision of the estimated relationship between animals using genomic data compared to pedigree data, genomic selection is expected to be more accurate than pedigree selection methods and hence are expected to further accelerate the rate of genetic gain.

Correcting parentage errors

Where ewes are mob-mated it can be difficult to identify the sire of each lamb within that flock with 100% certainty. In some cases it is impossible to identify the correct sire for a lamb when the lambs of the same litter have been sired by more than one ram; this phenomenon is known as heteropaternal superfecundation. With genomics it is possible to match the DNA of the lamb with their true sire since the lamb shares 50% of their DNA with the sire. This enables parentage records to be verified with genomics and also corrected if the true parent is also genotyped.

Breed composition

Breed composition can be estimated for each animal using ancestry records provided the records are highly accurate and extend a number of generations. When detailed pedigree records are not available breed composition can only be determined using DNA data. Genomic data can be used to identify the breed of an animal because over long periods of time populations acquire mutations to their DNA which are specific to that population. These unique combinations of DNA variants are indicative of the breed, which means the breed of an animal can be determined using only their genomic data. Genomic data can even be used to identify the breed composition of a crossbred animal, this information may be useful for verifying breed composition in composite breeds.

Major genes

For the most part, an animal will have two copies of every gene. One copy of the gene will be inherited from the sire and the other copy from the dam. The gene copy from the sire may be slightly different from the gene copy from the dam and these different copies of the same gene may have slightly different effects on particular traits; the different versions of the same gene are known as gene variants. Certain traits in sheep are known to be caused, or strongly influenced, by a single gene; these types of genes are often referred to as major genes. An example of a major gene in sheep is BMP15; a particular variant of the BMP15 gene is linked with increased ovulation rates in ewes but only when the ewes have a single copy of the gene variant, if the ewe has two copies of that particular BMP15 gene variant they will be sterile. With genomics this gene variant of BMP15 can be tracked in the population and breeding can be structured such that no lambs will be born with two copies of the BMP15 gene variant that results in sterility.

Commercial data recording & Sheep Irelands free recording app

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Take Home Messages

- Performance recording should be considered by Irish commercial farmers to help drive improvement in their sheep enterprise
- Commercial farm data represents almost 50% of all information used within the €uroStar genetic evaluations annually.
- The Sheep Ireland app now provides a free practical tool to all commercial sheep farmers to maximise the use of EID technology in the national flock.

Introduction

Performance recording in a commercial flock has been viewed as an impractical task by most sheep farmers in the past, but the tools now exist to change this view dramatically. Lambing time is a key period when it comes to data recording. Unfortunately lambing time also presents the peak labour requirement on all sheep farms regardless of the system in operation, indoor/outdoor lambing or a combination of both. While it is always difficult to find time during lambing, one activity which should be prioritised is the capture of some information on the flock. Capturing information during this key period has the potential to deliver major time saving benefits into the future. This data will allow you to learn from the past lambing periods and improve on these.

Commercial farm performance recording can be simple

The simplest form of data capture in a lambing shed can be a white board or notepad. Record all mortalities, record a reason where possible. Having an overall count of issues will be useful to benchmark against other flocks and to diagnose persistent problems. Additional issues that might be worth noting are prevalence of prolapse, number of ewes requiring assistance to lamb, number of ewes with inadequate colostrum etc. Recording the incidence of such issues is quick and easy

and will serve as a useful reminder to act or seek external advice in advance of your next lambing season.
The gold standard in terms of flock analysis is to capture data on each individual sheep in the flock. Tagging lambs at birth and capturing data on them from this point forward is the way to achieve maximum results. Now that EID is mandatory for all lambs leaving the farm, there is no disadvantage to EID tagging lambs at a younger age (ideally soon after birth). This will maximise the potential to capture valuable data.

Importance of commercial farm data to the €uroStar evaluations

Almost 50% of the data entering the Sheep Ireland database and the €uroStar evaluations annually comes from commercial grass-based flocks. Sources of this commercial data include:

- The Sheep Ireland Central Progeny Test (CPT) flocks
- The Teagasc BETTER Farm programme & OviData flocks
- Teagasc sheep research flocks
- Independent commercial flocks involved in LambPlus.

These flocks use pedigree €uroStar rams to mate their ewes, and all the data collected on the subsequent lambs born contribute to the €uroStar evaluations published for Irish sheep farmers. The level of animal performance data collected on these commercial flocks now matches that being collected by pedigree LambPlus ram breeders, something which should give all users of the €uroStar genetic evaluations great confidence. Commercial farm data also allows Sheep Ireland to validate that €uroStar indexes are working on the ground. This commercial farm data contributes to genetic evaluations being published for pedigree rams and helps to build the accuracy% of these evaluations.

Sheep Irelands free data recording app

Use of the free Sheep Ireland data collection app is growing every year. The apps main function is data collection, feeding all information collected to the relevant farmers online flock account on the Sheep Ireland website. Once data is submitted via the app, there are a multitude of services and flock reports available via the Sheep Ireland website for the benefit of the user.
The app can connect to a EID reader via Bluetooth or you can enter data via manual data entry. The app can record matings, pregnancies, parentage, lambing, weights and health and more, all in real-time, removing all paper for flocks that choose this option if they wish. Given the remote nature of many sheep farms, the app will

capture data while the phone is not connected to the internet/phone signal. This information is simply stored until such time as the recording device connects to a phone signal/internet source at which point the data is sent to the Sheep Ireland database to populate the relevant flocks online flock account.

Getting involved in commercial recording with Sheep Ireland

If you are interested in performance recording your flock, mating time is the best time to start. Recording the tag numbers, ages and main breed of each ewe is step one and all other events like pregnancy scanning, lambing etc can be added from there. If you are interested in performance recording, give Sheep Ireland a call on 023 8820451 or email query@sheep.ie to get your flock set up on the free Sheep Ireland flock performance recording phone app.

FLOCK HEALTH

Slowing the development of anthelmintic resistance in stomach worms of sheep

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Take Home Messages

- Stomach worms can develop the ability to survive killing by wormers – known as anthelmintic resistance.
- Anthelmintic resistance to the three commonly used classes of wormers, white, yellow and clear, is now widespread in Ireland.
- In order to slow the further development of anthelmintic resistance, four key actions have been identified that can be implemented on many sheep farms in Ireland.
- The key actions are 1) don't treat mature ewes for stomach worms unless there is a demonstrated need; 2) use a white wormer to control Nematodirus; 3) use a new active to quarantine treat incoming sheep; 4) use faecal egg counts to establish what wormers work on the farm and to time treatments.

Introduction

Grazing sheep are continually exposed to gastrointestinal nematodes (stomach worms). In the case of naïve lambs, heavy infection can result in a depression in appetite and increased protein loss from the gut which results in ill-thrift and in severe cases even death. Even sub-clinical infection can result in production losses, in the form of reduced growth rate and light, under finished carcasses. Therefore, good control of these worms is critical in Ireland's grass-based production system. Two major types of stomach worms infect lambs, *Nematodirus* and Strongyles. Each worm type has its own particular life cycle and different worm types predominate depending on the time of year, geographic location and local weather conditions. *Nematodirus* is a lamb crop to lamb crop infection. This is due to the fact that eggs passed by lambs one year hatch the following spring and are available to infect

the next year's crop of lambs. Therefore, *Nematodirus* can be a major cause of parasitic gastroenteritis in young spring lambs. The Department of Agriculture, Food and the Marine, in conjunction with Met Éireann predict when *Nematodirus* eggs will hatch and every year produce a forecast predicting the peak hatch and advise when farmers should treat to prevent disease due to this parasite. Assuming exposure, lambs develop immunity to *Nematodirus* relatively quickly, usually from 3 months of age. Later in the season, i.e. from June onwards, other Strongyle worms predominate. Immunity to these worms is slower to develop, although sheep generally have good immunity from 1 year of age. However, older sheep can be susceptible to these worms if immunocompromised or under stress.

Control and treatment of stomach worms

Good stomach worm control is highly dependent of the availability of effective wormers. Despite the large number of products on the market, there are currently only 5 classes of wormer licenced in Ireland for the control of stomach worms in sheep and all products fall into one of these classes. These classes are 1) benzimidazole (white wormer - 1-BZ), 2) levamisole (yellow wormer - 2-LV) 3) macrocyclic lactones (clear wormer - 3-ML) 4) amino-acetonitrile derivatives (orange wormer - 4-AD) and 5) spiroindoles (purple wormer -5-SI). The last 2 classes, orange and purple wormers, have been prescription only medicines in Ireland since they launched in 2010 and 2012 respectively and have not been widely used. Anthelmintic resistance refers to the ability of worms to survive a dose that should kill them. Wormers 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 also ineffective.

Anthelmintic resistance in Ireland

Anthelmintic resistant worms were first identified in Ireland in the 1990s. Since then the prevalence of anthelmintic resistance has increased and this now represents a major threat to the sustainability of our sheep production system. A recent study tested 18 farms in Ireland for resistance to the three commonly used wormer classes, white, yellow and clear. The results of this study are presented in Table 1. Of concern was the high percentage of farms with resistance to the macrocyclic lactones, a class that contains ivermectin. The prevalence of resistance to this class in particular has increased substantially in the last 10 years.

Table 1. Prevalence of resistance to white, yellow and clear wormers on Irish sheep farms

No. of farms tested	White	Yellow	Clear
18	100%	17%	61%

Risk factors for the development of anthelmintic resistance

On each farm, the approach to slow the further spread of anthelmintic resistance in Ireland falls under four main categories

1. **Identify and mitigate any high-risk practices for the development of anthelmintic resistance.** High-risk practices are those that place a selective pressure on worms to develop resistance. Examples include unnecessary or too frequent dosing of sheep, using incorrect dosing technique e.g. under-dosing and dosing and moving sheep to pasture only lowly contaminated with worms e.g. silage after grass.
2. **Ensure appropriate anthelmintics are used to control infection.** Using an inappropriate wormer will not give good worm control and may select for resistance. Examples include using combination wormer/flukicides when only fluke control is required or using a wormer that is ineffective due to resistance.
3. **Prevent buying in resistant worms by implementing a good biosecurity policy.** Worms can only move short distances on grass. Therefore, a major way that resistant worms spread is by animal movement. A closed flock or a good biosecurity policy will prevent bringing resistant worms onto the farm.
4. **Ensuring sufficient worms in refugia.** Refugia refers to worms that are not exposed to a wormer and so are not under selection pressure to develop resistance. These worms provide a source of susceptible genes to dilute the resistant worms. The major sources of refugia are worms in animals that are untreated with anthelmintic and worms on pasture.

Four key actions to slow the development of anthelmintic resistance

Given the evidence for widespread anthelmintic resistance and the urgent need to implement strategies to slow the further development of resistance, four key actions have been identified that can be implemented on the majority of sheep farms in Ireland. These four actions are outlined below:

Do not dose mature ewes for stomach worms unless there is a demonstrated need. Mature ewes should have good immunity to stomach worms and should not need to be treated. Refraining from treating ewes will reduce unnecessary dosing.

Untreated ewes will also act as a source of refugia. In order for untreated ewes to be a useful source of refugia they must graze the same pasture as susceptible lambs. A leader-follower grazing system post-weaning will enable this. As ewes have good immunity they will ingest more worms than they shed, thus removing worms from the pasture. However, it is important to bear in mind that there are some exceptions in which ewes may need to be treated for stomach worms. For example, thin, immunocompromised or otherwise sick ewes may benefit from treatment. In this case, the treatment can be targeted only to those ewes that need it. Yearlings may not have full immunity against stomach worms and so lactating yearling ewes may be under pressure and may benefit from treatment. If ewes are infected with *Haemonchus contortus*, commonly known as the barber's pole worm, they may also require treatment as they will not have immunity. This worm is rare in Ireland but outbreaks have occurred.

Use only white wormers to control Nematodirus. As outlined above, *Nematodirus* can be a problem in young lambs. *Nematodirus* eggs hatch en masse in spring, and if this coincides with when lambs start eating significant quantities of grass it can lead to severe disease. Because of the life cycle of *Nematodirus*, where it generally hatches once per year in spring, anthelmintic resistance is much slower to develop in this worm. To-date anthelmintic resistance has not been recorded in *Nematodirus* in the Republic of Ireland. Therefore, white wormers can be used to control this worm. Resistance to white wormers is common in the Strongyle worms that predominate later in the season; therefore, this wormer will not be effective on many farms later in the season. Using white wormers to control *Nematodirus* will reduce use of the other wormers and represents appropriate use of an anthelmintic to control infection.

Implement a good biosecurity protocol for bought in sheep. Animal movement is a major way in which anthelmintic resistance can spread. In order to prevent bringing resistant worms into the farm incoming sheep should be quarantined treated with either (i) an orange wormer plus a yellow or clear wormer or (ii) a purple wormer plus a yellow wormer. Sheep should then be housed for 48 hours to allow any eggs that might already be in the gastrointestinal tract to pass out. They should then be turned out to pasture recently grazed by sheep. This pasture will contain the worm population found on that farm which will act as a source of refugia and dilute any resistant worms surviving in the treated sheep.

Use faecal egg counts. Faecal egg counts determine the number of worm eggs in a dung sample and provide a useful indicator of the level of infection in a flock. Faecal egg counts can be used from weaning onwards to determine when treatment is required. A composite faecal sample, from 10-15 lambs in a group, can be submitted

to a laboratory for analysis. A faecal egg count of 600 eggs per gram or above may indicate the need to treat. Monitoring faecal egg count will ensure that animals are only treated when necessary and that a susceptible population of worms in refugia is maintained. Faecal egg counts should also be used to determine which anthelmintics are effective on the farm. A composite faecal sample after treatment should show no worm eggs remaining post-treatment. The time after treatment that the faecal sample is collected is crucial, for white and clear wormers the post-treatment sample should be collected 2 weeks post-treatment while for yellow wormers the post-treatment sample should be collected 1 week post-treatment. Knowing which anthelmintics are effective on the farm is a pre-requisite to ensuring that an appropriate anthelmintic is used. The best anthelmintic is one that works on your farm! Contact your vet or adviser for full details on how to check anthelmintic efficacy.

More details on these four key actions can be found at https://www.teagasc.ie/animals/sheep/flock-health/anthelmintic-resistance/.

Anthelmintic resistance is major threat to our grass-based lamb production system. The four key steps outlined above are simple, cost-effective measures to slow the development of resistance that are applicable on many farms in Ireland. Further steps and a comprehensive parasite control programme can be developed in conjunction with your vet. A free parasite control consultation with a trained veterinary practitioner is also now available through the Animal Health Ireland Parasite Control Targeted Advisory Service for Animal Health https://animalhealthireland.ie/programmes/parasite-control/parasite-control-tasah-consult/.

The future of testing and treating liver fluke in Ireland

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Take Home Messages

- A new ELISA laboratory diagnostic test that can detect liver fluke infection as early as 4 weeks post-infection has been developed.
- Ongoing research aims to develop a pen-side diagnostic test (lateral flow test) for liver fluke which may change how we test and treat animals in the future.
- Animal trials are on-going to develop a liver fluke vaccine to protect sheep against liver fluke infection.

Introduction

Liver fluke, Fasciola hepatica, is an economically significant parasite that infects grazing sheep and negatively impacts meat production, ewe fertility and wool production. Liver fluke causes three different types of disease, acute, sub-acute and chronic, depending upon the level of fluke challenge and the animals' resilience. If left untreated, infection with this parasite results in chronic ill-thrift and in severe cases even death.

Disease Type	Symptoms	Stage of infection	Flukicide Treatments
Acute	Sudden death, anaemia, weakness, abdominal pain	2-6 weeks after ingestion of a large number of immature flukes	Flukicides active against early immature stage flukes
Sub-acute	Rapid weight loss, anaemia	A mixture of immature and adult flukes	Flukicides active against immature and mature stage flukes
Chronic	Gradual weight loss, anaemia, bottle jaw, swollen stomach	Adult flukes (+10 weeks) reside in the bile ducts of the liver	All flukicides can treat this stage of infection

Control and treatment of liver fluke

Early fluke detection and control is of great importance. This includes monitoring sheep health, limiting access to areas considered to be "flukey" grounds, particularly in autumn/winter, and correctly treating animals with an appropriate flukicide. As control efforts are heavily dependent on the administration of flukicides, it is in every farmer's interest to follow best practice when dosing their flocks to avoid treatment failure and the potential development of flukicide resistance. This includes regularly calibrating the dosing gun and checking that it is in good condition, weighing the animals and selecting the correct dose rate, and rotating the flukicide products used based on the stage of liver fluke targeted.

Research into new diagnostics for liver fluke

Early detection of liver fluke is important for any at-risk farms to minimise the overall impact of this disease on sheep health, welfare and production efficiency. While a number of diagnostic techniques are currently available, they are limited by the stages of infection they can detect. For example, faecal egg counts (FEC) only detect the mature stage, which typically occurs between 10 and 12 weeks after initial exposure to fluke. As such, a negative FEC does not necessarily mean that the animal is not infected because immature parasites, which do not lay eggs, may be present. In contrast, immunodiagnostic methods, which detect antibodies or antigens circulating in the blood or found in the faeces, can detect immature stages of infection. Research conducted by Teagasc and the Molecular Parasitology laboratory at NUI Galway has seen the development of a laboratory diagnostic test that can detect infection as early as 4 post-infection weeks in sheep (1). This means that fluke infection can be detected before eggs are shed onto the pasture. Further work seeks to develop this test into a hand-held, pen-side, lateral flow test for liver fluke. Requiring only a small quantity of blood from the animal, these lateral flow tests would allow rapid, on-site detection of infection.

Development of liver fluke vaccines

Vaccination offers an alternative and sustainable approach to controlling liver fluke infection. A collaborative research project between Teagasc and the Molecular Parasitology laboratory, NUI Galway aims to develop a vaccine that is capable of preventing liver fluke infection in sheep. The vaccines currently being tested utilise a variety of proteins found in liver fluke. The aim of using these proteins is to stimulate the sheep immune system to mount an effective immune response to kill off the parasite and to limit any future infections. If proven to be effective, vaccination will help reduce reliance on flukicide treatments and will improve

production efficiency, which may be limited by this parasite. A number of vaccines have recently been tested in trials at Teagasc, Athenry, and field trials of promising candidates are starting in the summer of 2022 to assess how well the vaccine works when faced with the day-to-day challenges that sheep experience at pasture. The development of a vaccine which protects against liver fluke infection would provide a method of non-chemical control of fluke and would have a cumulative effect due to the prevention of egg shedding, thus breaking the liver fluke life cycle.

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OviFEC: using genetics to tackle gastrointestinal nematode infections

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Take Home Messages

- Over-reliance and inappropriate use of anthelmintics has resulted in the evolution of anthelmintic resistant nematodes
- To mitigate the effect of anthelmintic resistance, an alternative sustainable approach is required; genetics is one such approach
- The OviFEC project aims to develop a breeding value for resistance to gastrointestinal nematodes enabling farms to select rams based on their genetic potential for reduced faecal egg counts
- Measurements for the development of a breeding value for FEC will commence in summer 2022

Introduction

One of the major constraints to the long-term sustainability of sheep farming is susceptibility to infectious diseases. Over-reliance and inappropriate use of anthelmintics has resulted in the evolution of anthelmintic resistant nematodes. A study conducted by members of the project team found high levels of anthelmintic resistance on Irish sheep farms, with almost half of all anthelmintic treatments being ineffective. To mitigate the effect of anthelmintic resistance, an alternative sustainable approach is required; one such approach is the use of breeding to select for animals that have a natural resistance to gastrointestinal nematodes. A small number of countries internationally have commenced breeding for resistance to gastrointestinal nematodes in sheep; Ireland aims to develop such a breeding value

as part of the Department of Agriculture, Food and the Marine funded OviFEC project.

Breeding for reduced suspectiblity to gastrointestinal nematodes

Preliminary analyses of faecal egg count (FEC) data on Irish flocks was undertaken by the project team and showed that considerable genetic variation existed within the trait. A health index on traits such as lameness and dag score now forms part of the national breeding objectives; however, FEC was not included in the health index heretofore as more phenotypes (available routinely) are required before its inclusion in the national breeding objectives. Although the underlying genetics of FEC in sheep has been studied extensively internationally, with the exception of New Zealand and Australia, no other country has included FEC as a breeding goal trait in their sheep indexes. OviFEC will focus on:

1) collecting faecal egg counts on a large cohort of informative lambs
2) developing national genetic and genomic evaluations for FEC
3) ensuring the long term legacy of OviFEC by developing a simple streamlined process to assist farmers to collect FEC phenotypes routinely for genetic evaluations in the future.

Phenotyping Strategy

The CPT and Teagasc research flocks among others will play a central role in the recording of FEC data for the project. This will also enable the project to harness routinely collected data on a range of production traits such as lambing, lamb performance, ewe traits and other health traits. In addition, parentage will also be available on all animals through a combination of farmer recording and genomic DNA information. For the initial study FEC data will be collected for approximately 1,000 lambs in Teagasc Athenry at two time points during summer 2022. All lambs will be exposed to a natural gastrointestinal nematode challenge at pasture and individual lamb FEC samples will be recorded at two independent time points once the FEC of the grazing group reaches approximately 600 eggs per gram. This research will enable the team to decide if one or two independent FEC samples are required for future genetic studies and is central to the development of future sampling strategies for FEC in Ireland. In 2023, larger groups of lambs, most likely from the CPT flocks, will be individually sampled based on the protocol developed as part of the first research project. The accummulation of data from 2022 and 2023 will enable genetic analysis to be undertaken to determine the heritability of FEC in the Irish sheep population; the relationship between FEC and other

traits including dag score, lameness and lamb weight will also be estimated. This research is required for the development of a breeding value for FEC which can be incoporated into the existing €uro-Star indexes.

Application

As part of OviFEC, a new service will be designed by Sheep Ireland for the recording of FEC in existing performance recording flocks as part of the national breeding programme. This service will enable flocks to obtain all the necessary information and materials required to repeat the FEC recording protocol developed as part of OviFEC. As part of OviFEC a web-based interface to place and pay for FEC sampling kits and associated FEC analysis, and to select the specific animals for testing will be developed. As part of the FEC sampling pack, the farmer will also receive information on the necessary steps required for the successful recording of FEC on indvidual animals.

Conclusions

The OviFEC project represents an important milestone in breeding sheep with resistance to gastrointestinal nematodes in Ireland. As part of this project a phenotyping protocol for future FEC sampling as well as the development of a breeding value for FEC will be available for the Irish sheep industry.

Acknowledgements

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Prevalence and seasonality of trace mineral concentrations in Irish pastures grazed by sheep

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Take Home Messages

- Cobalt, copper, iodine and selenium are considered the main essential trace minerals for sheep production
- Herbage concentrations of trace minerals vary significantly throughout the year
- Herbage on the majority of farms are deficient for cobalt (73%) and iodine (80%), and are deficient or marginal for selenium (100%) and Zn (78%)
- Herbage had sufficient copper on all farms (100%)

Introduction

Minerals perform many important functions in the body and imbalances (deficiency or toxicity) can have detrimental effects on the performance, fertility, health and profitability of livestock. An adequate supply of minerals is essential for maintaining optimum growth, health and reproduction of livestock and marginal deficiencies can have a substantial impact on performance and health. In lowland sheep production systems, herbage, either grazed or conserved can provide up to 95% of annual feed requirements. Grazed herbage is therefore an important source of minerals for animals in grass-based systems.

Recent results from the Teagasc National Farm Survey show that 69% of Irish sheep farmers supplement their flock (ewes and/or lambs) with minerals at least once annually. The most used methods are drenching for lambs and mineral buckets for ewes. Only 35% of farmers who supplement base their decision on veterinary advice or laboratory analysis.

Information on monthly variation in herbage trace element concentrations and, hence, the adequacy of supply from a grass only diet, would provide producers with evidence on when supplementation may be necessary and which minerals are likely to be deficient or marginal and thus result in reduced animal performance.

Therefore, producers could better match mineral supplementation strategies with pasture herbage concentrations allowing for more targeted mineral supplementation, thus improving animal performance and reducing production costs in grass-based sheep systems.

Ireland study

Herbage was sampled monthly, pre-grazing, from 3 paddocks on 56 lowland farms which were selected, based on geographical location, soil type and farm system, as being representative of lowland sheep producing areas throughout Ireland. Herbage was cut to the expected post-grazing sward height (4 cm in March and April, 5 cm in May and 6 cm from June to November). The herbage samples were analysed for a suite of 22 minerals.

Herbage mineral concentrations

Cobalt, copper, iodine and selenium are considered the main essential trace minerals for sheep production. The mean concentration of these minerals is presented in Table 1. The concentrations of these minerals varied throughout the grazing season. The concentration of cobalt was lowest in June and July and increased in September and October (Figure 1). The concentration of iodine declined between March and June and was higher in September and October relative to all other months. The concentration of selenium was at a minimum in April/May and was higher in June, July, August, September and October. Herbage copper concentration increased during the grazing season being lower in March than in May, July, August, September and October.

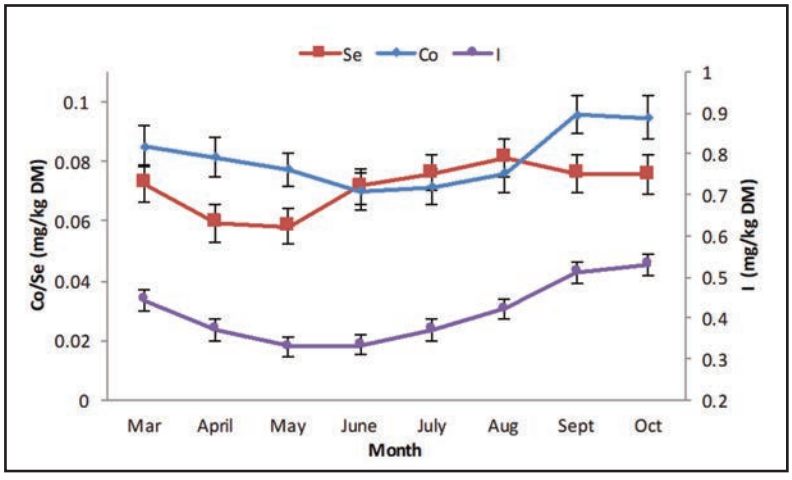

Figure 1 : Monthly mean concentrations of cobalt, selenium and iodine

The proportion of farms classified as deficient, marginal or sufficient for cobalt, copper, iodine, selenium and zinc is presented in Table 1. The majority of farms were deficient for cobalt (73%) and iodine (80%), deficient or marginal for selenium (100%) and zine (78%). The herbage on all the farms was classified as sufficient for copper.

Table 1 Dietary mineral requirements of sheep and the incidence of deficient, marginal and sufficient farms

Trace mineral	Mean mineral herbage concentration (mg/kg DM)	Requirement[1] (mg/kg DM)	Farm classification2 (%)		
			Deficient	Marginal	Sufficient
Co	0.089	0.10 – 0.20	73	27	0
Cu	7.8	4 - 6	0	0	100
I	0.44	>0.5	80	-	20
Se	0.091	0.05 – 0.5	11	89	0
Zn	31.0	26 - 33	23	55	22

[1] Based on NRC (2007) maintenance requirements of an 80 kg ewe and requirements of growing lambs. [2] Mean farm herbage concentration of < 0.10, <4, <0.5, <0.05, and <26 mg/kg DM (for deficient); 0.10 to 0.20, 4 to 5, ≥0.5, 0.05 to 0.3 and 26 to 32 mg/kg DM (for marginal); >0.2, >5, ≥ 0.5, >0.3 and >32 for mg/kg DM (for sufficient) for Co, Cu, I, Se and Zn, respectively.

Cobalt supplementation – effect on ewe and lamb performance

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Take Home Messages

- 73% of farms have deficient herbage cobalt concentrations
- At Athenry cobalt supplementation
  - had no beneficial effect on ewe productivity
  - increased post weaning lamb performance
- No benefit to including B12 with cobalt on lamb performance

Introduction

The productivity of Irish lowland flocks is low at approximately 1.3 lambs reared per ewe joined, and has remained relatively static for the last 40 years. Whilst high levels of lamb performance is consistently achievable from grazed grass offered as the sole diet, many producers report that they are unable to finish lambs from grazed grass alone. Whilst the reasons for producers inability to finish lambs from grazed grass or the lack of an increase in ewe productivity are likely to include ewe genotype, grassland management practices and parasite control, mineral (trace element) deficiency can be an issue.

Cobalt is an essential mineral for sheep as it is a component of vitamin B_{12} which is acquired by ruminants from the B_{12} synthesised by rumen microorganisms. Symptoms of deficiency include loss of condition, poor fleece quality, ears become dry and scaly (photosensitisation), loss of appetite, runny eyes with tear staining on the face, and raised worm counts (immune suppression). As cobalt is not stored in the body and is needed in the rumen, a continuous supply is required throughout the grazing season for vitamin B_{12} production.

Selenium deficiency is associated with poor lamb performance and white muscle disease. Its metabolism is closely related to vitamin E which acts as an antioxidant.

Trace element deficiency

Two of the main trace elements of concern in sheep production are cobalt and selenium. Results from a recent survey undertaken on 56 lowland sheep farms throughout Ireland showed that, based on NRC requirements, herbage on 73 % of farms had deficient cobalt concentrations whilst herbage on 11 and 89% of farms had deficient and marginal selenium concentrations, respectively.

Athenry ewe study

The effects of supplementation with cobalt, and method of administration (drench, bolus), on ewe reproduction and offspring performance to weaning were evaluated in a recent study at Athenry. There were 3 treatments: no supplementation (control), cobalt only drench and cobalt only bolus. The ewes on the cobalt drench treatment received a drench each 2 weeks from 7 weeks pre-joining until 6 weeks prelambing. The ewes on the bolus treatment received a bolus at 7 weeks pre joining. The mean cobalt concentration of the grazed grass was 0.10 mg/kg dry matter. Mean plasma concentration of vitamin B_{12} was marginal or low for 64 and 44% of the ewes which received no supplementation (control) in years 1 and 2 of the study, respectively.

The effects of cobalt supplementation and method of supplementation, on ewe performance and the performance of their progeny to weaning is presented in Table 1. Supplementation with cobalt, either by drench or bolus, had no benefit on litter size or the number of lambs reared. Lamb weight at birth or at weaning was not improved by cobalt supplementation, either by drench or bolus.

Table 1. Effect of trace element supplementation on ewe and lamb performance

	Treatment		
	Control	**Cobalt drench**	**Cobalt bolus**
Litter size	2.10	2.12	2.08
Number of lambs reared per ewe joined	1.79	1.73	1.65
Lamb birth weight (kg)	4.7	4.8	4.7
Lamb weaning weight (kg)	32.8	32.7	32.8

Athenry lamb study

The effects of supplementation with cobalt, either alone or in combination with vitamin B_{12} and selenium, on lamb performance post weaning were evaluated in a recent study at Athenry. There were 3 treatments: no supplementation (control), cobalt supplemented alone, or a combination of cobalt, vitamin B_{12} and selenium. The lambs received their treatments, by drench, every 2 weeks. Lambs were drafted

for slaughter at regular intervals when they had achieved target liveweight. During the first 7 weeks of the study (July/August) trace element supplementation had no effect on growth rate. However, as the grazing season progressed supplementation with cobalt, either alone or in combination with vitamin B_{12} and selenium, increased lamb weight gain. Consequently, trace element supplementation increased average weight at drafting and carcass weight by 2.1 kg and 1.4 kg, respectively (Table 2). There was no benefit from including vitamin B_{12} and selenium with cobalt under the conditions of the Athenry farm.

Table 2. Effect of trace element supplementation on lamb performance

	Treatment		
	Control	**Cobalt**	**Cobalt + B12 +Selenium**
Weight at drafting (kg)	45.5	47.4	47.8
Carcass weight (kg)	19.1	20.4	20.6
Lambs drafted by 23 September (%)	71	87	91
Lambs drafted by 4 November (%)	92	98	99

Lamb mortality – causes and management practices

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Take Home Messages

- Infection and dystocia, both potentially preventable, are the 2 main causes of lamb mortality
- 43, 58 and 74% of lamb mortality occurs at birth, by 24 and 72 hours after birth, respectively
- Implementing an appropriate late pregnancy nutrition plan will reduce the incidence of dystocia
- Clean and disinfect the lambing area and individual lambing pens after each ewe vacates. Apply iodine correctly to lambs navels.
- Ensure lambs receive adequate quantities of quality colostrum

When does most mortality occur?

A recent study at Athenry identified the time of death of lambs from birth to weaning (see Figure 1). The highest proportion of mortality occurred prior to, or at birth (43%), from birth to 24 hours (15%), and from 24 to 72 hours (16%). Eighty percent of lamb mortality occurred in the first 7 days after birth.

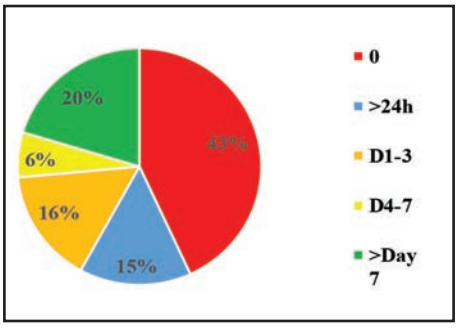

Figure 1. Time of lamb mortality

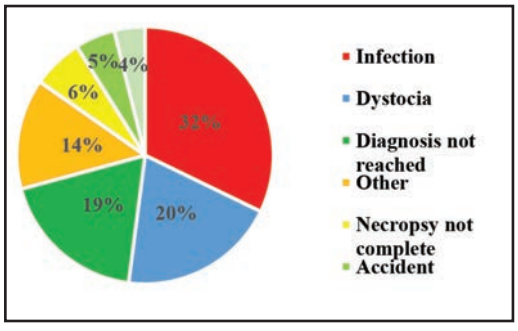

Figure 2. Causes of lamb mortality

Main causes of lamb mortality

The main causes of lamb mortality in a recent study at Athenry are presented in Figure 2. Infection was the main cause of lamb death accounting for 32% of lamb mortality. Enteritis (i.e. scour), naval/joint ill and *Chlamydophila abortus* (EAE) accounted for 33, 31 and 23% of mortality attributed to infection. Thirty nine percent of mortality due to infection occurred from 24 hours to 7 days of age, and most were attributed to various infections e.g. *E-coli* infections. The deaths due to infection that occurred from 7 days of age to weaning were mainly associated with enteritis (infection in the intestines causing scouring) and pneumonia.

Dystocia was the second main cause of lamb mortality. Dystocia is defined as a difficult birth due to a long, unassisted parturition or prolonged delivery requiring assistance.

How to reduce lamb mortality?

Infection and dystocia, the two main causes of lamb mortality on Irish sheep farms and are potentially preventable. Reductions in lamb mortality are difficult to achieve until the major causes are known. Seventy percent of Irish farmers do not record lamb mortality, thus may not be aware of an issue. A simple lamb mortality chart in the lambing shed can be used to record mortality, and the perceived cause. Post-mortem is the best method to capture information relating to factors associated with lamb mortality. Having the essential equipment required and being competent using this equipment will reduce the incidence of lamb mortality.

Infection: A large proportion of lamb mortality attributed to infection occurs before birth (still born) and many may be due to abortions. A post mortem of aborted lambs (and placenta if available) is the best method of identifying the causing agent and if a vaccination programme should be implemented. A 'closed flock' (breeding own flock replacements) is a good biosecurity policy in preventing bringing disease onto a farm.

A high proportion of farmers (75%) lamb indoors and most (89%) use straw bedding. Lambing indoors can increase the risk of infection due to poor hygiene. Exposure of the lamb's navel on wet and/or soiled bedding at birth increases the risk of infection entering the lamb. Applying a 10% iodine solution to lambs navels helps reduce infection. Ewes teats and/or wool which are wet and/or soiled with faeces increases the risk of lambs ingesting *E.coli* while attempting to suckle for the first time. Whilst 88% of farmers use individual lambing pens, only 41% cleaned and disinfected them after each ewe and her lambs vacated.

Offering ewes a good plane of nutrition during late pregnancy should ensure new born lambs are of optimum birth weight, are vigorous and that the ewe has

adequate quantities of quality colostrum. Many neonatal diseases are associated with inadequate serum IgG absorption. New born lambs require 50 ml of colostrum per 1kg of body weight, for 4 feeds in the first 24 hours. For example, a 5 kg lamb requires 1 litre colostrum (4 [feeds] x 250ml colostrum/feed) in the first 24 hours. Lambs which are unsuccessful at getting to the udder in the first hours post-partum should receive colostrum via a stomach tube. Ewe colostrum should be used if available. Stomach tubes need to be disinfected between each lamb to reduce the spread of infection.

Dystocia: Birth weight is a key factor influencing lamb performance. The optimum birth weight of lambs born as singles, twins and triplets is 6, 5.6 and 4.7 kgs, respectively. Sires can influence dystocia. Ram breeds that have easy lambing traits should be selected for ewes lambing for the first time or those of light mature live weight. Ewe breed had an impact on the prevalence of dystocia. Selecting replacements from maternal breeds and using rams to suit the system type should reduce dystocia and increase flock productivity.

Nutritional management of ewes during late pregnancy should be based on expected lambing date and litter size (determined by ultrasonic scanning). The use of raddle on rams at joining, and regularly changing the colour during the joining period facilitates an accurate estimation of expected lambing date. Knowing expected lambing date and litter size facilitates grouping ewes in late pregnancy for concentrate feeding. If ewes are offered excessive energy intakes above requirement for an extended period during mid and late pregnancy the body weight of lambs at birth will be increased. Likewise, if ewes are offered a restricted plane of nutrition during late pregnancy lamb birthweight will be reduced thus increasing lamb mortality, regardless primarily due to hypothermia or exposure.

TechCare – Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

Tim Keady and Bríd McClearn

Teagasc, Animal and Grassland Research and Innovation Centre, Mellows Campus, Athenry, Co. Galway.

Take Home Messages

- TechCare aims to demonstrate innovative approaches to monitor animal-based welfare indicators and improve welfare management in small ruminants systems using PLF technologies
- A list of welfare issues and indicators for sheep and goats in different production systems and environments has been complied
- Potential digital tools are being piloted on research farms
- Relevant technologies will be validated under large scale, commercial farms

Introduction

Precision livestock farming (PLF) can be defined as a 'sensor-based' individual animal approach. It has been widely adopted in the management of high-value animals, and many commercial companies have or are in the process of developing

PLF applications for intensive enterprises such as pig and poultry. However, PLF has not yet been widely applied in species where animals are considered to have a lower individual value or with less economic interest, as is the case with small ruminants such as sheep and goats, or in extensive management systems. This is despite the potential welfare and production efficiency advantages that could be achieved by applying PLF technologies.
All small ruminants in the EU are now individually identifiable through the use of electronic identification (EID). Small ruminants are usually managed in groups, so average welfare state may be considered. Considering a PLF approach to welfare management in these species will allow individual animal to be identified within the group, so that feed, health care or other aspects linked to welfare can be individualized.

TechCare

The objective of TechCare is to demonstrate innovative approaches to monitor animal-based welfare indicators, and improve welfare management in small ruminant systems using PLF technologies along the whole production chain, enabling all stakeholders to choose animal welfare friendly products.
TechCare is a 4-year project involving 19 partners from 9 countries from Scandinavia to the Middle East (Ireland, France, Norway, Greece, Italy, Israel, Romania, Spain and UK). TechCare has developed a list of welfare issues and indicators for sheep and goats in the different production systems and environments relevant to the partner countries.
TechCare has prioritised the common welfare priorities of the small ruminant sectors that are related to health issues (e.g. mastitis, parasites, lameness) and environmental factors (e.g. climatic conditions outdoor and comfort indicators indoor), nutritional issues (e.g. feed competition) and risks from predators and wild animals.
An extensive inventory of existing PLF and digital tools that may be applicable to small ruminant welfare management has been complied. Some of the digital tools with potential to produce early warnings revolve around the use of low-frequency and high-frequency electronic identification technologies, weighing devices, weather/air quality sensors, milk meters and water meters.
Pilot studies covering meat sheep, dairy sheep and dairy goat production systems are currently being undertaken on research farms in France, Israel, Italy, Norway and UK. The pilot studies are implementing and testing a series of PLF and digital tools in different settings, with the aim of providing adequate information to set up early warning systems for the identified welfare issues.

The most promising solutions from the pilot studies will be validated under large scale, commercial farms in a number of partner countries, including Ireland, during the next phases of the project.

More information is available on the Techcare website and social media channels

(www.techcare-project.eu)

HILL SHEEP

Hill Sheep: Updates from the BETTER farm hill sheep programme and hill lamb finishing studies

Frank Campion, Mark Dolan, Jonathan Molloy, Noel Claffey and Damian Costello.

Teagasc, Animal & Grassland Research and Innovation Centre, Athenry, Co. Galway.

Take Home Messages

- 7 Teagasc BETTER hill sheep flocks nationwide which are available for discussion group visits
- Performance differences within individual breeds and strains appears more important and improvement within breed is an easier way for producers to improve flock performance
- Assessing the weight of lambs at weaning is an important part of deciding a marketing plan
- Potential for hill farmers to finish proportion of their own lambs to 'light' carcass weights

Introduction

Hill sheep farming plays a vital role in the economic health of rural economies and the maintenance of the natural landscape in many of Ireland's most scenic areas. In Ireland, hill bred ewes account for 29% of the national ewe flock with a further 18% of the national ewe flock being hill breed crosses (DAFM Sheep Census, 2020). Maintaining and developing these farms to become more sustainable is vital for Irish agriculture and rural economies.

The Teagasc hill sheep research programme is focused around a network of 7 BETTER hill sheep flocks as shown in Figure 1. along with the continuing work into developing systems and blueprints for finishing hill bred lambs post-weaning. Some of the main findings and work coming out of the programme are presented at today's event and summarised in this paper.

Teagasc BETTER Farm Hill sheep flocks

The Teagasc BETTER farm hill sheep flocks are located around the country and each farm has an individually tailored farm plan aimed at allowing that flock to develop and improve the physical and financial performance of the flock. A consistent and important message that has come from these flocks has been the importance of a

defined breeding policy aimed at breeding a ewe flock that can graze the hill to its potential in a sustainable manner while also producing an adequate crop of lambs for sale each year.

As shown previously having ewes in correct body condition score and live weight at mating and ensuring cross breeding is carefully managed so enough replacement ewe lambs are produced yearly are vital components of hill flock breeding policies. Selecting rams for use on hill farms is also a vitally important part of any breeding policy and something that garners plenty of discussion within the industry, however, most of the time producers have little or no information to go on when selecting rams. All of the Teagasc BETTER hill flocks are using EID data recording technology which has allowed us to look at this area in recent years on the farms.

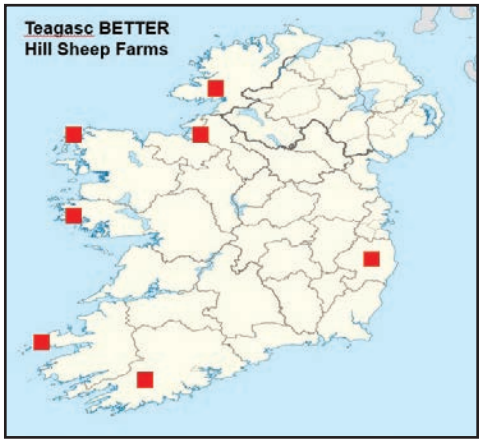

Figure 1. Map of the Teagasc BETTER hill sheep flocks

Breed comparison studies

In November 2017 and 2018 on a Co. Cork Teagasc BETTER sheep farm, two Lanark rams, a Swaledale ram and a Dingle Scotch ram were mated to a flock of purebred Scottish Blackface ewes. The same rams were used both years. The rams were released in single sire mating groups for 17 days (first cycle) with the groups then collapsed. All these lambs were born and grazed on the same farm until weaning time and ewes were randomly selected at mating time. As presented in Table 1. the performance of the single born and reared lambs from rams across the two years was similar between the breeds and while there was significant differences between the Lanark sired lambs at birth and weaning these were small with less than a 1kg difference in weaning weight.

Table 1. Lamb performance of single born lambs from 3 different SBF strains of sheep over 2 years.

	Birth Weight (kg)	Weaning Weight (kg)	ADG Birth to Weaning (g/day)
Dingle Scotch	5.2	23.2	184
Lanark	5.1	22.4	176
Swaledale	5.2	23.1	183

Similarly when the daughters of each of these rams who were selected for breeding were mated as hoggets the difference in performance between the breeds was small and for the most part insignificant as presented in Table 2. Despite the Lanark SBF hogget ewes having a 3.4kg heavier mating weight and having a slightly higher litter size these differences are biologically insignificant and as seen previously the performance of the single lambs to weaning was unaffected by breed.

Within breed differences

In any group of sheep there is going to be a mixture of low and high performing animals and a significant feature of other studies examining differences between breeds has shown that the variation within breed is often greater than the variation between breeds (O'Brien et al., 2017). If we look again at the previous example of the performance of lambs from the Dingle Scotch, Lanark and Swaledale rams the differences between the breeds for lamb weaning weight was insignificant but the variation within each breed was similar to that between the breeds. This data highlights the importance of selecting the best performing sheep within a breed as opposed to focusing on the differences between breeds. However, equally as important it highlights the importance of developing and supporting data recording groups that are selling performance recorded hill rams that will allow producers to select rams on both their physical attributes and their performance potential.

Table 2. Comparison of hogget ewe performance from 3 different SBF strains of sheep over 2 years in the same hill flock

	Mating Weight (kg)	Mating BCS	Litter Size
Dingle Scotch	41.4	2.8	1.10
Lanark	44.8	2.9	1.22
Swaledale	43.3	2.7	1.15

Marketing lambs

Selling hill bred lambs as stores, attempting to finish lambs on farm or doing a mixture of both is an area of discussion for hill sheep farmers every year with farm facilities, grass supply and ultimately market conditions all key components in what decisions are made. This means every year is different and careful consideration needs to be given in the run up to weaning as to what decisions are to be made. However, a further vital element is assessing the quality of the lamb crop and for the Teagasc BETTER hill flocks this involves assessing the weight categories of their lambs with a typical example shown in Figure 2. These categories can vary

between years meaning what options are chosen post-weaning will have to be tailored.

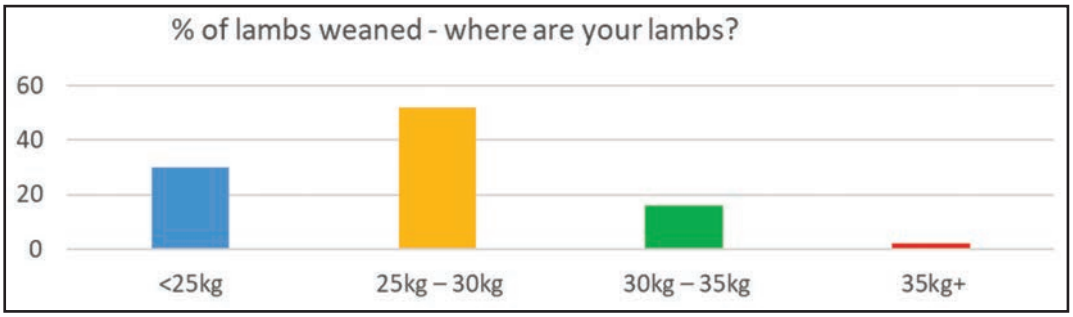

Figure 2. Example of what the breakdown of the weaning weights of hill flock will look like at weaning time.

Previous research carried out in Teagasc Athenry has shown the potential to finish hill bred male lambs to carcass weighs in excess of 18 kg while meeting market muscle and fat score specifications satisfactorily (Claffey et al., 2018). Recently, these studies have begun looking further into finishing lambs on different types of forages such as Kale, Forage Rape and Hybrid Brassica while also looking at rumen function, methane output and meat quality components from these systems. Ultimately some of these finishing systems are aimed at developing blueprints for store lamb purchasers to show the potential when purchasing hill bred lambs for finishing. However, the development of systems for finishing these lambs, particularly the lighter type lambs, to comparatively lighter carcass weights offers a potential for most hill farmers to finish a proportion of their own lambs on farm.

'Light lamb' finishing

Some of the results to date from studies under taken in Teagasc Athenry to ascertain if it was possible to finish light Scottish blackface lambs to produce carcasses of 12-16 kg with a suitable covering of fat are presented in Table 3. Lambs were housed after weaning at an average live weight of 25 kg and slowly built up to ad-lib concentrate intake. Both castrate and ram lambs were used and were drafted for slaughter once they reached 30 kg live weight for castrates and over 31kg live weight for ram lambs and had a level of fat cover equivalent to fat score 2 post slaughter. Where lambs, particularly ram lambs, reached 36 kg live weight and were deemed "unfinished" then they were retained and finished to 'French' market specification (>18kg carcass weight).

Proper selection of lambs for slaughter is essential with this system and lambs need to be weighed regularly to avoid lambs falling out of specification for the 'light' lamb trade and still being under finished for 'French' specification markets. Where lambs are too heavy for the 'light' lamb market or reach the correct live weight but have insufficient fat cover to market specifications then it is necessary to carry these lambs to a minimum of 42 kg to finish for the 'French' specification market. The finishing period for these lambs is approximately 5 to 7 weeks of intensive feeding during which time lambs are consuming approximately 1.15 kg DM of concentrates per head per day once eating concentrates ad-lib.

Table 3. Effect of lamb sex on lamb performance pre- and post-slaughter.

	Rams	Castrates
Housing live weight (kg)	25.7	25.5
Slaughter live weight (kg)	34.1	33.1
ADG from housing to sale (g/day)	233	181
Carcass Weight (kg)	14.8	14.6
Carcass grade	2.3	2.4
Fat score	2.5	2.6
KO%	43.3	44.2

Conclusion

Hill farmers are often working a very marginal circumstances with a big reliance on store lamb prices but careful planning around breeding policy and marketing of the lamb crop each year can allow for flock physical and financial performance benefits.

Options for finishing hill bred lambs post weaning

Mark A. Dolan[1, 2], Tommy M. Boland[2], Noel A. Claffey[1], Frank P. Campion[1]

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Take Home Messages

- Forage rape was the highest yielding forage brassica followed by Hybrid Brassica and Kale
- Lambs had the highest average daily gain when offered ad-libitum concentrates indoors
- Lambs offered forage brassica crops out performed lambs grazing perennial ryegrass over the winter period
- Lamb offered forage rape and hybrid brassica had a significantly higher average daily gain than lambs offered kale

Introduction

Every year approximately 200,000-300,000 male hill bred store lambs and 100,000-200,000 male hill crossbred store lambs are sold for further finishing. Previous studies by Teagasc in Athenry have shown that hill bred lambs perform to a satisfactory level when offered ad-libitum concentrates indoors. However, there is a paucity of information on the potential of using forages for finishing store lambs to carcass weights of 18-21 kg in the autumn/winter when both hill and lowland lambs are being sold for further finishing. This paper will outline an ongoing study investigating the performance of hill bred lambs when offered forage brassicas, perennial ryegrass and ad-libitum concentrates indoors.

Current study

This study has two main objectives, firstly to examine the performance of hill and crossbred hill lambs when grazed on a selection of forages and secondly to quantify the differences in crop yield potential and carrying capacity of these forages when utilised in store lamb finishing systems. There are six dietary treatments including

three forage brassica crops namely; Forage Rape (Stego variety), Kale (Maris Kestrel variety) and Hybrid Brassica (Redstart variety). Performance from these forages is being compared to newly reseeded perennial ryegrass swards (Abergain and Aberchoice varieties), permanent pasture swards which consists of predominantly perennial ryegrass and ad-libitum concentrates offered indoors. Each treatment consists of 25 Scottish Blackface rams, 25 Scottish Blackface castrates and 25 Terminal x Scottish Blackface lambs between 25- 35 kg live weight. Lambs commence their treatment diets from early October.

Crop management

For the current study, lambs were introduced to the forage brassicas gradually with a run back to grass up until the point of full time access after approximately 10 days. Once lambs have acclimatised to the diet they are offered ad-libitum access to barley straw. Lambs received two-day allocations of forage brassica, to try to maximise the utilisation of the crop and the performance of the lambs. Lambs housed indoors were offered a high quality cereal based nut, which also contained 0.5% ammonia chloride to mitigate the risk of urinary calculi.

Table 1: Effect of dietary type on average daily gain, percentage of lambs slaughtered, factory live weight, cold carcass weight and kill out percentage

	Concentrate	Forage rape	Hybrid brassica	Kale	Re-seed	Permeant Pasture
Average daily gain (g/day)	245	141	135	123	57	44
% slaughtered off treatment diet	100	49	44	33	7	4
Factory live weight (kg)	45.6	43.1	43.4	43.2	45.7	46.8
Cold carcass weight (kg)	21.1	19.2	19	19.4	20.1	20.1
Kill out percentage (%)	45.1	45.1	44.4	43.8	44	44

Table 2: Average forage yield (kg DM/ha) and utilisation (%)

	Forage rape	Hybrid brassica	Kale	Re-seed	Permeant Pasture
Forage yield (kg DM/ha)	7125	6024	5412	6578	3908
Forage utilisation (%)	60	63	53		

Lamb performance

The performance of lambs on the six dietary treatments is summarised in Table 1. Lambs offered concentrates indoors had higher growth rates, slaughter weights and carcass weights when compared to lambs grazing the outdoor forages. There

was no significant difference in lamb growth rates between lambs grazing Forage Rape and Hybrid Brassica. However, lambs grazing both of these forages had higher growth rates compared to lambs grazing Kale. Average daily gain for the perennial ryegrass treatments were significantly lower than all other diets. Diet type had no effect on the kill out percentage of lambs. Forage Rape was the highest yielding forage followed by Hybrid Brassica and Kale as shown in Table 2. Forage Rape also had the highest percentage of lambs drafted for slaughter as the increase in crop yield allowed for a longer grazing period. Lambs grazing Forage Rape and Hybrid Brassica utilised 60% and 63% of the crop while the Kale was more difficult to utilise (53%) due to its thicker stem.

Conclusion

Results from this study show that lamb performance to slaughter is effected by the type of forage offered. Forage brassicas have the potential to finish hill bred lambs post weaning, however, further investigation is warranted into the effect of crop yield and starting lamb live weight on the performance of lambs grazing these crops.

Hill flockbooks: providing a foundation to protect and progress hill breeds and the sector

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Take Home Messages

- Hill flockbooks can deliver protection from breed dilution from other strains, manage inbreeding, and provide a foundation for systematic breed improvement.
- Technology such as genomics, smart phone apps, EID readers are becoming more accessible. This technology has the potential to dramatically reduce the paperwork and time associated with parentage recording.
- To improve key traits for hill breeds (e.g. correct mouths or weight gain), recording parentage and linking this to data for these traits is the best way to achieve this.

Hill Flockbooks

Currently, only two hill flockbooks have been set up in Ireland, both established in the last two years (The Donegal Wicklow Cheviot and the Mayo-Connemara Blackface Sheep Societies). However, with the proposed Sheep Improvement Scheme (SIS) in 2023, there is now an excellent opportunity for more hill flockbooks to join them. In the proposed SIS, hill farmers will be required to purchase a genomically tested and DNA sire verified ram. This will provide a market and demand for rams that are part of an organised flockbook and help sustain the effort to establish a flockbook for at least five years. While some rams may also be sourced from outside these groups, we expect the majority will come from the 14 hill groups/clubs/flockbooks already established.

Why are hill flockbooks important?

According to the 2019 Sheep census published by DAFM, there were 82,055 breeding rams in Ireland, of which 19% were hill rams (Table 1). However, the percentage of breeding ewes recorded as hill or hill cross accounted for 49% of the national ewe flock making this 19% of hill rams the most significant cohort in the

country each year, given the percentage of their offspring retained for breeding in the national flock.

Table 1. The number of hill, hill cross, lowland, and lowland cross breeding rams and ewes in Ireland, according to the Department of Agriculture, Forestry and the Marine (DAFM) 2019 National Sheep & Goat Census

	Hill	Hill Cross	Lowland	Lowland Cross
Breeding rams	15,656 **19%**	7,528 **9%**	44,568 **54%**	14,303 **17%**
Breeding ewes	809,052 **31%**	452,815 **18%**	475,776 **19%**	833,227 **32%**

Recording parentage information is the first step in protecting these bloodlines from being diluted down with genetics from different breed types and against inbreeding, which is the primary goal of any flockbook. With additional parentage/bloodline information, breeders and farmers can make more informed decisions on a sale day. They can be confident of the breed make-up of the ram and cross-check the ram's parentage information against the previous rams used in their flock to avoid potential inbreeding problems.

How long will the ram retain a full mouth? How milky will his daughters be? How fertile will his daughters be? Answering these questions and predicting a ram's future performance on the day of a sale is next to impossible without parentage information and data on how their ancestors performed. The only way to predict these traits with a certain level of reliability is to collect data on their family tree and combine this into a central database for the breed where they can be analysed. A prediction of the future performance of the progeny can then be made and displayed in sales catalogues

Technology

There have been several significant advancements in the industry in the last five years. First is the introduction of genomics to the sheep sector. Genomics has multiple benefits; however, from a flockbook point of view, the largest is the ability to accurately verify or predict the parentage of any animal where the parent has also been tested. This means if a breeder has all of their stock rams tested with Sheep Ireland, they can then DNA sire verify any lamb in the flock with 100% accuracy via the Sheep Ireland genomic service.

Next was the introduction of full EID implementation. EID tagging for all sheep has added an extra cost to the production system. One way to combat this is to harness the ability it gives to record lots of information with an EID reader quickly. This information can then be used to make more informed management decisions. Finally, Sheep Ireland released a free recording app in 2018 that connects to EID readers via Bluetooth. The app can record matings, pregnancies, parentage, lambing, weights and health and more, all in real-time, removing all paper for flocks that choose this option if they wish. The app also works while the phone is not connected to the internet, an essential feature for many hill flocks in more remote areas.

Improving traits essential to the Hill sector

One of the critical drivers to establishing the Mayo-Connemara Blackface Flockbook was the group's desire to systematically improve some key traits within the breed. For example, to improve the longevity of the ewes by breeding for better mouths. In 2021, a protocol for recording the mouths was developed, and 1,700 animals were recorded, with lots of variation observed (Table 2). Once enough data is collected on animals with parentage information, a breeding index will be developed to identify the rams that breed daughters with the best mouths.

Table 2. The results of a mouth survey conducted on hill flocks in 2021 by Sheep Ireland.

	Normal	Overshot	Undershot	Broken
Number of Sheep (%)	1,439 **(87%)**	146 **(9%)**	5 **(<1%)**	61 **(4%)**

ECONOMICS AND OUTLOOK

Outlook for Sheep Incomes

Anne Kinsella and Kevin Hanrahan

Agricultural Economics and Farm Surveys Department, Rural Economy Development Programme, Teagasc

Take Home Messages

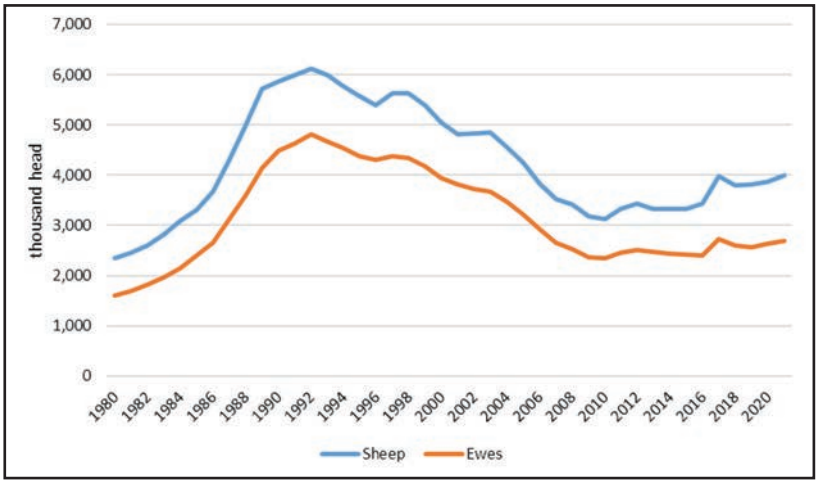
- Irish and European lamb prices are likely to remain at significantly higher levels than in recent years.
- Higher output value in 2022 will however be offset by the impact of much higher input prices on the costs of production.
- Fertiliser, Feed and Fuel prices paid by Irish sheep farmers in 2022 will be significantly higher than in 2021. As a result the costs of sheep production in 2022 will be 30% higher than in 2021.
- Teagasc's forecast for lowland sheep enterprise margins is that they will decline dramatically relative to the record margins per hectare that were earned by Irish sheep farmers in 2021.
- The average Family farm income earned by sheep farmers in Ireland is forecast to decline by 20% in 2022.

Introduction

In this paper we present the results of the Teagasc forecast for margins from sheep production (lowland lamb) in 2022. The research underpinning this analysis was conducted in the first quarter of 2022 following the invasion of Ukraine by the Russian Federation. The ongoing war in Ukraine has had dramatic impacts on energy, fertiliser and animal feed prices in particular and has added to the general inflationary pressures in the Irish and EU economy. The medium to longer term economic impact of this geo-political shock on the Irish economy and on the Irish agricultural sector in particular will depend on what happens in Ukraine (how long will the war continue) and on the response of the wider international community to Russia's illegal invasion. In this paper we do not attempt to forecast the outcome of the war but analyse how incomes in the sector will evolve conditional on assumptions about how sheep output prices and input costs develop over the course of 2022.

According to the latest results from the CSO Census of Agriculture over 35 thousand Irish farms have a sheep enterprise. Based on their degree of specialisation, in 2020, 17,435 farms were specialised in sheep production. The national flock as measured by the CSO has grown in recent years, with total ewe numbers in December 2021 of just under 2.7 million head, with a total sheep flock in December 2021 of just under 4 million sheep the highest level since 2005.
The Irish sheep sector in 2021 produced over €360 m of output at the farm level based on the production of over 63 thousand tonnes of sheep meat carcass from close to 3 million sheep sent for slaughter in 2021. The overwhelming majority of Irish sheep meat output is exported, with over 90% of the carcass output produced in 2021 exported to markets in the UK and EU. Developments in the supply and use balance for sheep meat and other competing meats on these markets is the key determinant of Irish sheep prices.

Figure 1: Irish Sheep and Ewe Numbers 1980-2021 (December enumeration)



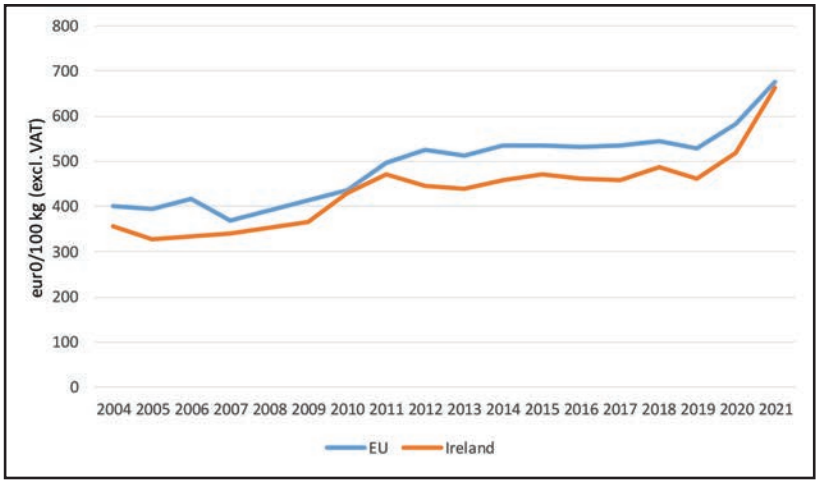
Source: Eurostat dataset Sheep Population Annual Data (apro_mt_lssheep).

EU production of sheep meat has been relatively stable in recent years varying between 570 and 590 thousand tonnes. Over the same period total domestic use (consumption) of sheep meat has contracted from just over 700 thousand tonnes to circa 670 thousand tonnes in 2021. The self-sufficiency of the EU in sheep meat has as a result increased from 90% to 95% as domestic production has taken the place of lower volumes of imports. Imports of sheep meat into the EU

from traditional sources such as New Zealand and Australia have contracted while imports form the UK have contracted as a result of developments in supplies in the UK and the additional non-tariff trade costs associated with Brexit. Declining imports from New Zealand in particular have been due to increased competition for New Zealand exports from East Asian markets in particular China. The growth in Asian demand for sheep meat in recent years is at least in part due to the effects of disease outbreaks in the pig sector in these countries but also reflects the impact of ongoing economic development in these economies and resulting growth in for meat that have been reflected in relatively buoyant world prices for sheep meat and other meats. As a result of these supply and use developments, EU and consequently Irish lamb prices have increased in recent years as illustrated in Figure 2.

Irish lamb prices for the year to date (late May 2022) are 3% higher than in 2021 and Teagasc's forecasts for lamb prices for 2022 is that over the whole year that prices will average up to 10% higher than in 2021. As noted in the discussion above, developments on exports markets will be the key determinant of the prices received over the remainder of the year (European Commission ,2022). EU prices are currently 8% ahead of prices in 2021 so the price outlook remains cautiously optimistic. With aggregate sheep throughout at export licensed factories strongly up on 2021, output value on Irish sheep farms is likely to be higher in 2022.

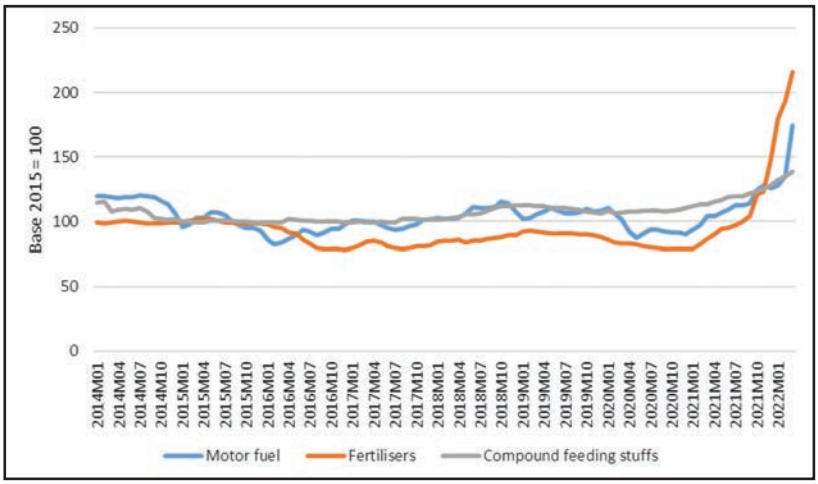
Figure 2 EU and Irish heavy lamb prices (2004-2021)



Source: Weekly Report on Heavy and Light Lamb Prices in the EU, Week 20, 2022.

The higher sheep prices in 2022 are coinciding with record costs of production. The CSO track output and input prices on a monthly basis (CSO, 2022). The prices of energy (fuel), fertilisers and purchased animal feed are all up dramatically on the level of prices paid for these inputs in 2021. For the year to March 2022 agricultural motor fuel, fertiliser and feeding stuff prices were 68%, 149% and 23% higher than in March 2021 (Figure 3). The much higher costs of production are forecast to prevail for the remainder of 2022.

Figure 3: Fuel, Fertiliser and Feed Prices (January 2014 - ~March 2022)



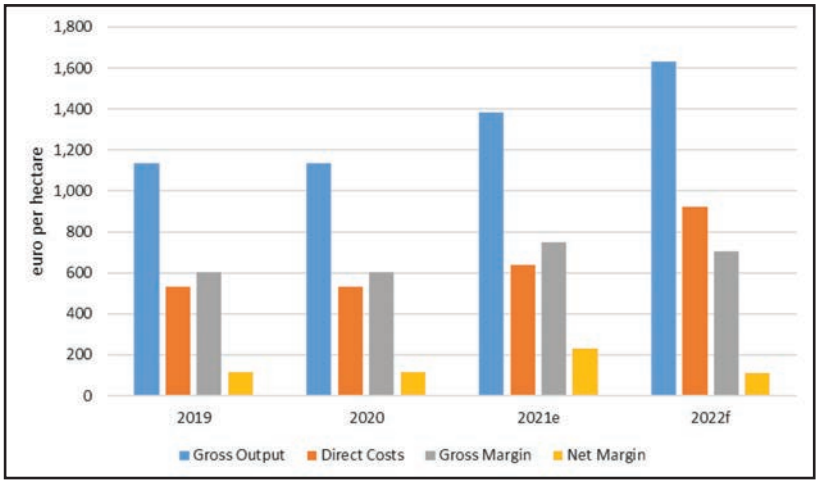
Source: CSO Agricultural Price Indices March 2022.

The particularly high fertiliser price level is expected to lead to reduced use by farmers in 2022. However, the imperative of producing sufficient forage to feed grazing animals and to produce silage for the next winter season, means that the reduction in demand for fertiliser by Irish farmers in response to the much higher prices is likely to be relatively limited. In our forecast fertiliser use declines, but overall costs of production on Irish sheep farms are nevertheless forecast to increase by 30% compared to 2021.

In 2022 the margins earned from sheep production are forecast to decline from the record levels earned in 2021 (see Figure 4). Higher lamb and sheep prices in 2022, while welcome in terms of the additional output value, are likely in 2022 to be insufficient to cover the increase costs of production. Sheep farmers are incurring dramatic increases in costs of production as a result of the large increases in fuel, fertiliser and feed prices in 2022.

The average gross margin earned by the average mid-season lowland lamb enterprise on a per hectare basis (excluding all decoupled CAP direct payments) is expected to decline by 5% on the level earned in 2021 to circa €700 per hectare. The average net margin forecast for 2022 is expected to drop to €110 per hectare from a record high level of over €230 per hectare in 2021. Despite the forecast fall in the margins earned from sheep farming, the positive average net margins that are likely to be earned remain significantly in excess of the gross and net margins likely to be earned on other dry stock enterprises in 2022. The forecast decline in gross and net margins per hectare are reflected in our forecast for family farm income on the average sheep farming system where incomes are forecast to be 20% lower in 2022 than in 2021.

Figure 4 Mid-Season Lowland Lamb Gross Output, Direct Costs, Gross Margin and Net Margin



Source: Dillon et al. (2022) and Kinsella and Hanrahan (2021)

References

Dillon et al. (2022) "Situation and Outlook for Irish Agriculture April 2022: Updated following the invasion of Ukraine." Go to https://www.teagasc.ie/media/website/publications/2022/OutlookrevisedApril2022.pdf

ENVIRONMENT

Teagasc Biodiversity Management Practices Self-Assessment Tool: Linear Habitats for lowland sheep farms

Catherine Keena[1] and Jim Kinsella[2]

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Take Home Messages

The Teagasc Biodiversity Management Practices Self-Assessment Tool: Linear Habitats shows how well the linear habitats on a farm are managed to deliver biodiversity side by side with productive agriculture. The four element are:

- Hedges.
- Farming platform structure
- Field margins
- Watercourses

Introduction

Biodiversity management practices undertaken by farmers are a key element of farm sustainability. There is a need to include biodiversity management in the assessment of farm sustainability. This paper draws on existing evidence and literature to inform the development of an innovative, affordable, repeatable and rapid assessment tool that measures biodiversity management practice on farms and gives clear messages on Best Practice Biodiversity Management. The tool combines four elements of intensively managed livestock farms, which are of high relevance to biodiversity management, namely: hedges, farm landscape structure, field margins and watercourses (Figure 1).

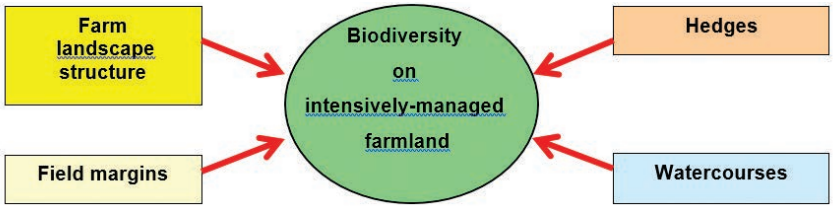

Figure 1. Diagrammatic representation of the characteristics of farms that combine to reflect biodiversity on intensively managed Irish farmlands

In order to effect biodiversity practice change on farms, engagement with farmers is key. A study on biodiversity knowledge exchange with Irish farmers using face-to-face questionnaire-based interviews on-farm concluded that while farmers were positive towards biodiversity, it was not a priority. There was a lack of understanding of biodiversity, requiring effective training. Farm advisors were identified as the key source of environmental information, and along with other farmers and family members, were key influencers of farming decisions.

Hedges

Hedgerow structure is important for biodiversity. There are two distinct hedge types in Ireland. Both types are good, but each requires very different management. A lack of understanding of each hedge type leads to inappropriate management and damage to hedges. Ideally, each farm should have both types of hedges present to maximise biodiversity benefits.

1. Escaped (never-topped) hedge or treeline: Do NOT top. Side trim only
2. Topped hedges: Top to maintain as a hedge – a little above the previous years cut. Aim to grow up to at least 1.5 m and retain a new thorn tree in every hedge

Figure 2. Do not top an 'Escaped hedge' and do not let a 'Topped hedge' escape.

The bigger and bulkier a hedge is the better. A hedge height over 1.5 m provides suitable nest sites for birds with adequate cover above and below their nests. Birds do not nest at the base of hedges where foxes can reach them. Neither do they nest at the top of a hedge, exposed to birds such as magpies or birds of prey.
Flowering hedges provide flowers for bees and fruit and seeds for birds and small mammals. Escaped hedges flower freely with the biodiversity value in their canopy. Topped hedges with a dense base provide great cover at ground level for mammals

as well as nest sites. With the recommended regular hedge cutting necessary for maintenance (little and often is recommended), there are few flowers or food on the body of Topped hedges. Retaining occasional thorn trees provide flowers and food. Existing Topped hedges with no mature thorn trees can be greatly improved by selecting individual or clumps of thorns from within the hedge and allow to develop into mature trees. The practice of retaining an occasional new thorn tree every year provides a diversity of tree heights. Songbirds use smaller developing trees which are a metre or so above the body of a hedge as 'songposts'.

Farmed landscape structure

Agricultural landscapes can be viewed as a mosaic of habitats, many linear in nature, within agricultural land. Average field size has the strongest overall effect on biodiversity on intensively managed farmland. The positive effect of decreasing average field size is not due to an increase in cover of natural and semi-natural areas in landscapes with smaller fields. Rather for a given amount of natural or semi-natural cover, farmlands with smaller fields have higher biodiversity. Linear habitats are networks or corridors for nature through the countryside. Their greater edge: area increases habitat diversity.

Under the Environment Impact Assessment (Agriculture) Regulations, permission must be sought from the Department of Agriculture Food and the Marine where hedge removal will result in a field over 5 ha. Farmed landscape with average field size less than 5 ha provides networks for nature and corridors of movement for birds, bats, bees and butterflies to move through the countryside.

Field margins

Field margins are a rough grass habitat, which is absent from a lot of intensively managed farmland in Ireland. Uncultivated and unsprayed field margins allows the rough grass margin to continue undisturbed, protecting the soil biodiversity. Their presence allows grasses and wildflowers to flower and seed, providing habitat for associated invertebrates, birds and small mammals. Birds such as linnet feed on grass seed. There is a high biodiversity value in native plants growing wild naturally. Wildflowers growing wild in unimproved field margins undisturbed and unfertilised for millennia are not to be confused or equated with sowing unregulated packets of flower seed following cultivation and the pre-existing plants (or 'weeds') sprayed-off to make the area look 'pretty' for a short time until the process is repeated. In this latter case, the word wildflowers has been hijacked! We need to maintain our native species of flora and fauna, which have been here for thousands of years and are in tune with each other with regards timing of flowering

and other growth stages. Some are inconspicuous – in other words, they may not be 'showy' or attractive to humans. Actions to protect our declining biodiversity must be evidence-based and directed by science, rather than individual preferences. It cannot be about actions that make the landscape attractive to humans, those that are easiest, or about focusing on one species at the expense of others.

Watercourses

All watercourses are important for biodiversity, including small watercourses and drains which are important in their own right, and also important for their influence on larger watercourses. Fenced watercourse banks prevent siltation from eroded banks allow natural bankside vegetation to flourish. Watercourse margins provide further protection for watercourses and allows space for native wildflowers and grasses to grow, providing habitat for associated fauna. Prevention of livestock drinking access to watercourses prevents siltation of watercourses, and protects the habitat for instream biodiversity

Conclusion

Linear habitats comprising hedges, field margins and watercourses are valuable habitats for biodiversity within the farming platform, alongside land managed for agricultural production. Best practice biodiversity management practices on these linear habitats are important. Complete the Teagasc Biodiversity Management Practices Self-Assessment Tool: Linear Habitats for your farm to see how you score (see the next page).

Teagasc
Biodiversity Management Practices
Self- Assessment Tool: Linear Habitats

Tick if Yes

Hedge Management

1. Is the height of all your internal hedges at least 1.5m above ground level (or above hedge bank if present)?
2. Is there a flowering thorn tree* in every hedge?

Layout of Farming Platform

3. Is your average field size** less than 5 ha?

Field Margin Management

4. Do you always retain at least 1.5m uncultivated margins when cultivating?
5. Do you avoid spraying within your field margins (except for spot spraying noxious weeds)?

Watercourse Management

6. Are all watercourse banks on your farm fenced?
7. Is there a fenced margin over 1.5m on all watercourses?
8. Do you prevent livestock drinking access to all watercourses?

What is your score? (*TOTAL number of Ticks*)

Target Score = 8

***Flowering thorn tree**
- Escaped hedges (untopped / treelines) naturally contain flowering thorn trees
- Topped hedges may contain individual flowering thorn saplings or trees **IF** retained

****Average field size:**
- Owned land ..... ha/No of fields (surrounded by permanent biodiverse boundaries) ..... = ... ha
- Biodiverse boundaries include hedges, watercourses, vegetated margins, etc – Not wire fences

***** **Noxious weeds:** Ragwort, dock, thistle, wild oat, male wild hop and common barberry

Agricultural sustainability support and advisory programme (ASSAP)

Noel Meehan[1] and Ivan Kelly[2]

[1] *ASSAP Manager, Teagasc, Deerpark, Ballinasloe, Co. Galway*
[2] *ASSAP Advisor, Athenry, Co Galway*

Take Home Messages

- Ireland has been set a target by the E.U. Water Framework Directive of achieving 'Good Status' for all waters.
- The River Basin Management Plan for Ireland sets out Irelands plan to achieve good status
- The ASSAP service is available to farmers in 190 Priority Areas for Action (PAA's) and is a key part of helping achieve good status
- The ASSAP is a free and confidential advisory service available to all farmers in a PAA

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 waters in Ireland. However, despite a lot of good work over the last 20-30 years we are falling short in achieving this target and water quality has declined slightly in recent years.

Irelands response to challenges around water quality is set out under the national river basin management plan. As part of this plan, 190 priority areas for action (PAA) have been identified across the country where water quality improvements need to be made. There are multiple pressures across each of these PAA's including industry, waste water treatment plants and septic tanks, forestry, agriculture and urban pressures.

Implementation of the ASSAP

The Local Authority Waters Programme (LAWPRO) have deployed a catchment assessment team of 60 scientists across the country to assess streams in PAA's in

detail and identify the significant pressures impacting water in each PAA. This group communicates the detailed information about the PAA to all of the stakeholders across the local community including agricultural and non-agricultural land owners and businesses.

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 is made up of a group of 33 advisors (20 working under Teagasc jointly funded by DHLGH and DAFM and 13 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. In general an advisor will assess the farmyard, nutrient management practices and general farm land management practices including the use of pesticides and other toxic substances like sheep dip, etc.

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 be designed to 'break the pathway' and prevent nutrients and other contaminants from entering water. A written summary of the advice and actions will be provided and a timeframe for completion agreed between them.

Figure 1: Heavy rainfall leads to overland flow of water, Phosphorus and soil particles

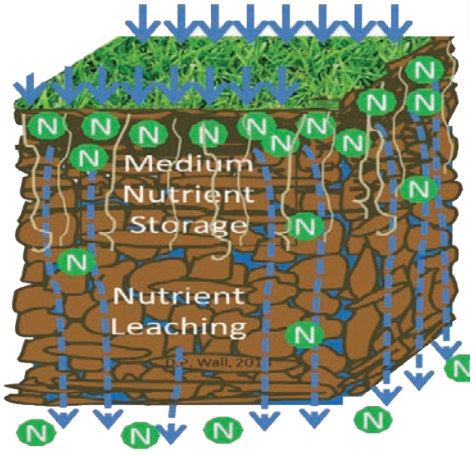

Figure 2: Nitrogen that is not used up by grass/plant is available to leached to groundwater/ streams during heavy rainfall

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. Support from the farming organisations for the programme has been very strong and this is vital in communicating and informing farmers about the ASSAP programme and its key messages.

The Signpost Programme

Seamus Kearney

Teagasc Moorepark, Fermoy, Co. Cork

The Signpost Programme is a Teagasc led partnership of 60 companies and organisations from across the Irish agricultural sector working with farmers to reduce gaseous emissions, improve water quality and enhance biodiversity of food production. While gaseous emissions are low on sheep farms (relative to dairy and cattle farms), there are still many actions sheep farmers can take to improve profits while reducing gaseous emissions.

1. The Signpost Programme objectives are to;

- **Lead and support the transition** of Irish farming towards more sustainable farming systems;
- **Contribute to the agricultural sector efforts to reduce agricultural emissions in line with national policy objectives**, specifically,
  - To reduce GHG emissions by 22 - 30% to the range 16 – 18 $MtCO_{2e}$ by 2030, in line with Climate Action Plan (2021) objectives; and
  - To reduce ammonia emissions by 1% below 2005 levels in the 2020 to 2029 period and by 5% from 2030 onwards;
- **Promote farming practices and systems which can improve margins** and the overall sustainability of farming systems;
- **Build national capability and capacity** (both of Irish farmers and those supporting them) to undertake the changes required;
- **Be a trusted knowledge source and broker**, facilitating the alignment of programme partners and the strengthening of existing and new programme collaborations.

2. Signpost demonstration sheep farms (Figure 1) will be central to the programme as they will implement current profit improving and gaseous emissions reducing technologies. They will point the way forward for all sheep farmers.

3. The advisory programme will be delivered by Teagasc and industry advisors where all farmers will be given training opportunities in increasing profitability and reducing gaseous emissions. Training starting in Autumn 2022.

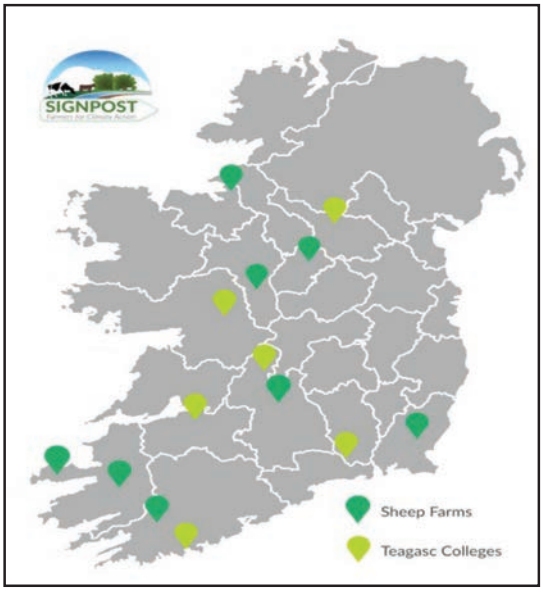

Figure 1. Sheep and College Signpost Farms

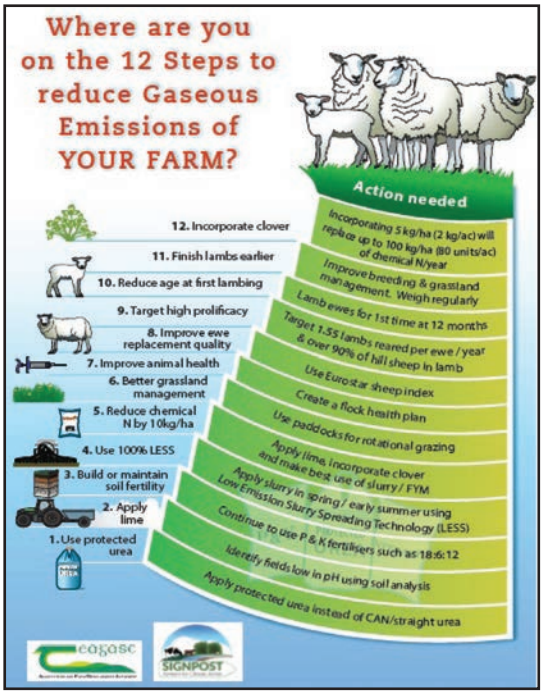

Figure 2. 12 Steps to reduce Gaseous Emissions of YOUR FARM

How can you get involved?

You can get involved in the Signpost programme by undertaking farm actions to improve profitability while reducing gaseous emissions. You can undertake these actions by working through the 12 Steps to reduce Gaseous Emissions of YOUR FARM (Figure 2). Starting at step 1 using protected urea on your farm and work all the way to step 12 incorporating clover. By implementing these 12 steps sheep farmers can maintain output with less animals (reducing replacements, reducing cull ewe numbers, more lambs per ewe, earlier lambing of young ewes and earlier finishing off grass) and less fertiliser (correcting lime, correcting P & K status, LESS, protected urea, paddock grazing and clover) use on farms. Make a start and take your first step today.

UPLAND
EIP PROJECTS

SUAS – Lessons learned

Declan Byrne, Project Manager

Introduction

The objective of this document is to outline the lessons learnt from the SUAS EIP Project that we, as an operation group, believe should be built on in the new Cooperation Project for the East South East region. SUAS is a five-year project operating in the Wicklow/Dublin Mountains operated by the Wicklow Upland Council. Budget €1.9m.

General Comments

Our experiences in the SUAS Project to date are;

- Changes in habitat condition occur slowly and responses to measures put in place by farmers may require a 10 to 15 year timeframe. Therefore, providing evidence of habitat improvements may not always be possible within a five or six year timeframe.
- The condition of some unfavourable bad habitats may be beyond restoration due to prohibitive costs, lack of practical implementable measures in difficult upland terrains and the long recovery timeframes. These include large scale rewetting actions, landslide prevention or amelioration, controlling invasive species (including bracken, gorse, etc.) and peat erosion.
- Grazing is our most basic management tool in the uplands and was key to the formation of the habitats we have there today. Grazing practices in the Wicklow/Dublin Mountains has changed over the past 20-30 years to a system that in many areas is not delivering the management required for the maintenance of the habitats we are trying to protect.
- There is a diverse range of ownership types in our uplands, ranging from private ownership, leasing, grazing rights, collops, grazing licences and common ownership. Average LPIS plot size is large with some sites over 1,000ha.
- The importance of engaging with relevant agencies (e.g. NPWS), experts and other community groups.
- Burning is a major issue in the Wicklow & Dublin Mountains. Most of this burning has been uncontrolled and during the restricted period. SUAS has been supporting farmers in promoting the concept of prescribed burning, i.e. “Controlled burning as part of a habitat management plan”, with appropriate aftercare and developing towards sustainable management practices. Wildfires are still a problem.

- Recognition that we do not have all the answers to the challenges of halting and reversing biodiversity loss, enhancing ecosystem services, and preserving habitats and landscapes.
- Where habitat scores are low, there needs to be a minimum payment for farmers to encourage participation. Some of these sites contain deep peat in danger of erosion and should be priority areas for management, but unless there are sufficient farmer payments, these areas will not engage with the scheme.
- Farmers need to have an idea of their potential habitat scores/income before engaging a planner to develop a management plan, because if payments are very low, they may decide not to participate at all.
- We also note there are some very good habitats of national importance are excluded as they are not Natura sites, and it is not clarified yet if non SAC commonages will be included or not.

Specific Comments

The SUAS project trialled the formation of Commonage Groups to bring shareholders together to implement measures on the upland. The experiences and outcomes have been extremely positive in terms of adoption, implementation, and delivery of agreed upland measures.

The success of Commonage Groups depends on allowing adequate time and support for group formation and development. SUAS has shown that Groups can overcome many obstacles including long running feuds between shareholders and where some individuals have caused damage to a commonage. The groups can play a major role in delivering grazing management overcoming the long-running issue of inactive shareholders. The money invested in Groups has and will continue pay dividends on the uplands.

Participation by the farmers and the Commonage Group members with the ecologists, hydrologists, ornithologists, environmental scientists, field officers and farm advisors in the initial and ongoing assessment of the upland habitats and biodiversity has been shown to be crucial.

Training programmes, including site visits, are essential to building the capacities of farmers and shareholders to manage the upland challenges. At the centre of the training is learning and understanding the targets for the habitats and the measures required to achieve them. Basic training should be completed before habitat management plans are developed and agreed between the farmers and the project. Farmers and shareholders must be compensated for the time they invest in training.

SUAS Approach to habitat management planning

1. The initial assessment of the upland by the advisor/planner/ecologist is extremely important and must involve farmer and shareholder participation. The key outputs are determining:
   - Baseline conditions, site targets and priorities
   - The management actions required to
     - Maintain the habitats
     - Improve the habitats
   - Determining the appropriate grazing levels (Type of stock, number, timing, areas to be grazed).
   - The habitat score and score payments
2. The next step is for the Commonage Group and the Project Team to agree the Management Plan.
   - It will include details of who grazes what stock on the commonage & who is responsible for carrying out the actions/measures.
   - If contractors or other investment required and organising payments for services delivered.
3. Following agreement of the Management Plan between the Commonage Group and Project Team it needs to be implemented, monitored and updated.
   - Measures carried out (and if done, done properly)
   - Measures delivering as expected.
   - Grazing levels appropriate to the carrying capacity.
   - Habitat condition.

Wild Atlantic Nature LIFE IP Project

Derek McLoughlin Project Manager

LIFE IP Wild Atlantic Nature aims to improve Ireland's performance in conserving habitats, and in particular to improve the conservation status in the Special Areas of Conservation (SAC) Network of blanket bog, a priority habitat under the Habitats Directive. It will build on the successes of locally adapted programmes, including EU-funded LIFE and European Innovation Partnerships (EIP), to work with farmers, local communities and other stakeholders to create resilience within rural communities in the light of our biodiversity and climate crises.

Central to the project is the pilot Results-Based Payment Scheme (RBPS) which rewards participating farmers for environmental services, these include biodiversity, water quality and carbon storage and sequestration. Farmers receive payment for providing public services on their land whilst ensuring the flexibility to continue to farm. Farmer payments relate to ecological quality for their peatland, grassland and/ or woodland habitats. The higher the quality of these habitats, the higher the payment the farmers receive. This approach has the effect of creating a market for environmental services, and provides an opportunity for farmers to manage their farm to deliver better quality habitats. This approach differs from traditional agri-environment schemes such as GLAS, where a flat-rate payment was made independent of environmental quality.

The pilot RBPS commenced in the Owenduff/Nephin Complex SAC, Co. Mayo in 2021 and has been extended into further blanket bog SACs in counties Donegal, Sligo and Mayo in 2022. It is hoped that approximately 850 farmers will participate in the pilot scheme for 2022.

WILD ATLANTIC NATURE LIFE

Inishowen Upland Farmers Project

Catherine Keena[a], Henry O'Donnell[b]

[a] *Teagasc, Crops, Environment and Land-Use Research Programme, Kildalton, Co. Kilkenny*

[b] *Inishowen Upland Farmers Project, Drumfries, Clonmany, Co. Donegal*

Take Home Messages

- A whole - farm approach promotes more joined-up thinking about nature and the farming enterprise
- There is a place for trees on all farms to improve the resilience of livestock and arable farms
- Diverse swards are favoured for production and environmental reasons
- Ponds are recommended for environmental reasons and also as a possible water supply for livestock
- Managed grazing by bovines on the uplands will improve the grazing for sheep on the same platform.

Introduction

The Inishowen Upland Farmers project is an upland European Innovation Partnership project funded by the Department of Agriculture, Food and the Marine. Local farmers are leading the project. The Operational Group includes Teagasc, Leader, Sligo IT and local agricultural consultants. The objective is to have a whole farm approach to landscape management and develop innovative measures which increase farm profitability through the implementation of five key measures on suitable farms within the Inishowen peninsula while at the same time delivering on climate change, biodiversity and water quality initiatives as well as trialling best practice in upland management. The Inishowen Upland Farmers project commenced in 2019.

Inishowen Upland Farmers in action

There are 25 farmers participating in the project. Each farm has been mapped to inform decisions made in conjunction with farmers to draft individual farm plans. A whole farm landscape approach is used to strategically locate actions. A demonstration farm was used effectively to demonstrate actions before farmers

undertook them on their own farms. This helped farmers understand and undertake appropriate actions.

Grazing the uplands with cattle which has been undertaken by twelve farmers, some with privately owned hill and some on commonage. On the commonages shareholders will engage in a share farming type arrangement to acknowledge the activity of the participant putting the cattle on the uplands. Cattle compliment sheep in grazing the uplands as they are non-selective grazers, removing vegetation that sheep won't eat. This encourages regrowth of palatable vegetation for both cattle and sheep and maintains the diversity in the habitat required for Favourable Conservation Status.

Several agroforestry plots have been established on the demonstration farm, each with a specific purpose: shelter; disease control; act as a barrier to nutrients and sediment; and produce timber. Grazing is prevented in the short-term to allow trees establish, but will be opened up to grazing. It has been agreed that this area will remain as eligible land for payments.

Diverse swards have been established on 21 farms. Conventional reseeding methods have most successful establishment. Redshank has been an issue, but was controlled by topping. Farmers are pleased with early results on animal performance. Only three participants undertook the option of red clover to be harvested as round bale silage. Initial results show a very productive, low nitrogen input sward.

Approximately twenty ponds have been created and are developing. Strategic locations were chosen. Some are in the uplands and others in riparian zones adjacent to watercourses. Effects on water flow are evident.

Conclusions and implications

A whole farm approach promotes more joined-up thinking about nature and the farming enterprise. Farmers are more likely to engage if core changes support the core farm business. Innovative measures can be designed that improve the profitability and efficiency of farming while delivering on climate change, biodiversity and water quality. There is a place for trees on all farms to improve the resilience of livestock and arable farms. Rather than planting a hectare of trees and forgetting about them, it is important to plan and get benefits from the trees in terms of disease control, shelter, water infiltration, lengthening the grazing season and flood mitigation and a crop of timber in the long term. The objective should be to have lots of trees on the farm without forestry replacing livestock farming. Diverse Swards are productive and highly palatable giving high animal performance. They are low input system requiring little or no artificial nitrogen fertilisers and

because of the different rooting structures they improve soil structure and water infiltration. They have many environmental benefits and anthelmintic properties. There is a place for ponds on most farms for the environmental benefits as well as the possibility for on farm use as a water supply for livestock. Managed grazing by bovines on the uplands will improve the grazing for sheep on the same platform.

MacGillycuddy Reeks European Innovation Partnership Project

Catherine Keena[a], Mary Toomey[b], Patricia Deane[b]

[a] *Teagasc, Crops, Environment and Land-Use Research Programme, Kildalton, Co. Kilkenny*
[b] *Macgillycuddy Reeks EIP, South Kerry Development Partnership CLG, The Old Barracks, Beaufort Village, Killarney Co. Kerry*

Take Home Messages

- Single-species grazing, uncontrolled burning and invasion of bracken and rhododendron are affecting biodiversity of high nature value of farmland in the MacGillycuddy Reeks.
- Controlled dual grazing in upland areas can play an important role in maintaining the balance of species in these habitats, and needs to be encouraged and supported.
- The control of bracken and treatment of rhododendron is essential if further deterioration in habitat quality, loss of grazing land is to be prevented, and potential loss of livestock due to rhododendron poisoning is to be avoided.
- A dedicated agri-environmental scheme for the area with long-term commitment and adequate resources is essential for the conservation of this unique landscape.
- Participating farmers actively involved in the project can see the positive outcomes and many more farmers in the area are eager to join or see the project expanded.

Introduction

The MacGillycuddy Reeks European Innovation Partnership Project is an upland European Innovation Partnership project funded by the Department of Agriculture, Food and the Marine, as part of Ireland's Rural Development Programme 2014-2020. South Kerry Development Partnership administers the project. The Operational Group includes local farmer, advisor and community group representatives; and members from South Kerry Development Partnership,

MacGillycuddy Reeks farmer representatives, NPWS, IT Tralee, MacGillycuddy Reeks Forum, Kerry County Council, Kerry LIFE and Teagasc. The objective is to improve the sustainability and support the economic viability of these farmers and to improve the ecological condition of heath and bog habitats in this Natura 2000 area. The MacGillycuddy Reeks EIP commenced in 2018.

MacGillycuddy Reeks EIP in action

There are 24 sites with 31 participants in the project. All land in the project supports peatland habitats such as dry and wet heath and upland blanket bog which are rare and protected habitats. Each site is assessed by the project ecologist who devises a detailed annual work plan with the farmer. The assessment considers the ecological integrity of the site in terms of the diversity and structure of the vegetation and the pressures and threats. An annual assessment is carried out and farmers are incentivised to improve the habitat condition (through specific actions in their annual work plan) as they receive a 'results-based' payment.

Habitat scores range from 15 to 100, averaging 51. While the number of positive indicator species was good across the majority of sites, vegetation structure and moss coverage was frequently poor to moderate. The majority of sites are primarily sheep grazed resulting in preferential grazing on dwarf shrubs, over less palatable species such as purple moor-grass or molinia, gorse and rushes. Uncontrolled burning to manage these less palatable species is contributing further to the deterioration of these habitats. The project is addressing this imbalance by introducing the concept of controlled dual grazing using both sheep and cattle. Controlling sheep numbers to allow dwarf shrubs to recover and introducing light summer grazing using suitable breeds of cattle such as Droimeann, Kerry or Dexter, which graze coarse vegetation can improve the vegetation structure of these habitats and the grazing condition of the land.

Bracken is present on 14 sites and the cover ranges from 5 % to 75%, averaging 30%. Treating bracken under the project has three options: knapsack spraying; cutting twice during the growing season; and trampling with cattle. Knapsack treatment is onerous, and group work is strongly encouraged. Access to water for spraying can be a constraint in this difficult terrain. The project is supporting landowners by using a ram pump to fill water barrels placed close to bracken stands where needed. A B&B system has been set up to give farmers the option of obtaining cattle for short periods to trample bracken, rather than purchasing them.

Rhododendron is present on ten sites with the area ranging from 0.2ha to 27.3ha averaging 11.1ha. Under the project two options are used for the control of the invasive alien species rhododendron. Stem treatment is used for younger plants

using a hatchet to make shallow downward cuts in the bark approximately 2-3cm apart around the base of the trunk and applying herbicide including a blue marker dye on exposed bark to identify treated plants. Results of treatment are seen quickly during growing season, although treatment can be carried out all year round, except in extremely wet weather when herbicide could be washed off. Stump treatment is used for dense mature thickets, where plants are cut close to the ground using a chainsaw and the stumps treated with herbicide.

Conclusions and implications

The tradition of sheep farming in the MacGillycuddy Reeks EIP project is strong at present but needs to be supported to ensure its viability into the future. The habitats in the Reeks are threatened due to a variety of factors including single-species grazing, economically unviable labour-intensive practices and invasion by bracken and rhododendron.

Initial results have been very promising both in term of the success of the actions and in terms of the willingness of participants to engage with actions and the over-arching objectives of the project. The lasting success of these actions is dependent on ongoing monitoring of grazing levels and the provision of ongoing resources to control the bracken and the rhododendron in the long-term.

References:

Barron, C. (2009) The control of rhododendron in native woodlands. Native Woodland Information Note 3, Woodlands of Ireland and Irish Forest Service.

Blackstairs Farming Futures (BFF)

Catherine Keena[a], Owen Carton[b], Tomas McCarthy[b], Thomas Gorman[b] and Martin Shannon[b]

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Take Home Messages

- Commonage groups can be established and operate effectively for farming and environmental goals which are not mutually exclusive
- Knowledge exchange on upland issues is more effective through onsite visits
- The social aspect of working together with neighbours is extremely positive, as well as sharing the workload
- The Results Based Agri-Environment Payments Scheme for commonage is a potentially effective approach for inclusion in future agri-environment schemes.

Introduction

The Blackstairs Farming Futures (BFF) is an upland European Innovation Partnership project funded by the Department of Agriculture, Food and the Marine. Local farmers are leading the project. The Operational Group includes members from Teagasc, GMIT and NPWS. The project objectives are to develop: Commonage Community Groups (CGG) to provide a useful commonage governance model; Results-based Agri-environmental Payment Scheme (RBAPS) for upland habitats and commonage land; and Broader Community Engagement in the environment, culture and tradition of farming in the uplands. The BFF commenced in 2018.

Blackstairs Farming Futures in action

There are 94 Blackstairs commonage shareholders, from nine commonages, participating in the BFF project. They represent approximately 21% of all Blackstairs commonage shareholders and cover an area of 1,202 ha. Seven of the commonages are in the Blackstairs Special Area of Conservation (SAC) and two are outside.
Three commonages were recruited in early 2019 and a further six in 2020. Each

participating commonage formed a CCG with a constitution ("club rules") and elected a Chair. The process of CCG formation involved a series of three meetings with the shareholders. The discussions considered the project background, developing a constitution or rules for working together and the election of a Chair. It is worth highlighting the social aspects of meeting members through work is proving extremely positive.

Feedback from the three 2019 CCGs indicated they performed excellently with the members working collectively on implementing their work programmes. The Chairs provided significant leadership for the CCGs though there are differences in how each one operated. The approach to and the development of measures on the commonages demonstrates the potential of the CCG's capacity to take "ownership" of improving the sustainability of the commonages - for shareholders, habitats and cultural heritage.

The BFF RBAPS involves CCG payment for i) the quality of the habitat and ii) complementary measures or actions to improve the score. A scorecard was developed in 2019 to provide an ecological assessment of the habitat on commonage and it evolved in 2020 to improve its effectiveness. Habitat scores ranged from 5 to 8 in 2020. Two members of the CCG accompanied the ecologist when scoring the commonage in 2020, with both parties benefiting from the sharing of their farming and habitat knowledge and experiences. Communications between farmers and the ecologist were more effective when outdoors and in a familiar environment on site. The commonage score results and the ecologist's recommendations for improving it were presented to the CCGs. The CCGs and the Project Office worked together to develop and agree on the annual Complementary Measures Work Programme (CMWP) or the actions for implementation on the commonage. The actions reflected the ecologist recommendations and those identified by the CCG members. The 2020 CMWP included an innovation where a CCG member can take the lead to develop a new action that will be considered for inclusion in their 2021 work programme. The activities being explored include ones focused on maintaining or improving commonage water quality, the protection and preservation of cultural heritage sites and the use of communal flocks.

Conclusions and Implications

Nine Commonage Community Groups were established, and to-date are operating effectively. Actions to improve habitats are being implemented under CMWPs for each group. The actions include boundary fencing, bracken and scrub control, prescribed burning, access road, improvements, sitka spruce sapling removal, keeping grazing records and the preservation of cultural heritage. Farmers are very

interested in prescribed burning to manage overgrown vegetation; while this can be part of the effective management of uplands, inappropriate burning damages habitats. Working as a collective is considered by farmers to be more efficient and spreads workload – such as fencing commonage boundaries with adjacent enclosed land. Farmers believe initiatives such as the BFF encourage farmers to start or return to sending sheep to the hill.

A scoring system to evaluate the quality of the commonage habitat was developed and is used to determine commonage payments. Achieving best practice management on the uplands requires resources and co-ordinated efforts with an effective communication strategy.

Significant progress has been made and the project initiatives will continue to evolve based on good communications and using the lessons learnt by the participating CCGs, the project ecologist and the Operational Group. The project outcomes will provide evidence to inform future agri-environment schemes for commonage and the uplands.

Comeragh Upland Communities EIP

Owen Carton[1], Catriona Foley[2], Catherine Keena[3]

[1] CUC Project Manager, [2] Teagasc Dungarvan Co Waterford, [3] Teagasc Kildalton, Co Kilkenny.

Introduction

Hill sheep grazing on the Comeraghs continues to shape its terrestrial ecosystems' structure, diversity, and functioning. The Comeragh mountains deliver high-quality lamb output. In recent years farming in the uplands has been recognised as having the potential to provide public good benefits or services based on its natural and cultural heritage. These "new ecosystems" services and public goods potentially include biodiversity, the provision of clean water, carbon sequestration, landscape and access. They offer an opportunity for the necessary increase in farmer incomes from the uplands. The mix of deliverables from upland farms and commonages will vary, reflecting the natural resources, the policy objectives and incentives, and the ambitions of those farming the uplands.

Achieving the right upland solutions requires knowledge, understanding, and a commitment to work together by all the key 'actors'. The project represents an initial exploration of how the farmer's upland habitat management knowledge and experiences might be developed. To date, very few, if any, opportunities for such learning have been made available. These new skills will facilitate farmers in implementing the sometimes-challenging management changes required to deliver a broader range of goods and services. Critical to its success will be farmers taking ownership of the need for change. Secondly, the project wanted to explore how to build a better relationship between the farming and non-farming Comeragh communities that could enhance the opportunity for better social, economic and environmental outcomes.

Against this background, we developed the project around **three innovations** inspired by Brendan Dunford, the Burrenbeo Trust, Gwyn Jones, and the many Irish pioneers of Results-Based Payment Agri-environmental schemes. These were:

1. Habitats/biodiversity are integral to the mountain's natural and cultural heritage; [*They are not stand-alone issues]*.
2. Engaging the hearts and minds of the farmers in addressing the challenges of delivering the required broader range of goods and services. [*Payments alone for providing the range of services needed will not be enough to achieve the necessary level of change]*.

3. Farmer engagement with the non-farming rural Comeragh community. [*Creating the potential for enhanced progress with rural development in the area*]. Our project objective was to provide a model training framework for farmers to meet the new and vital challenges to ensure a future for those living and working there through better management of the natural and cultural heritage.

There were three primary objectives:
1. To provide Habitat Management Training.
2. To explore the landscape & cultural heritage (archaeology, placenames, living memories and folklore) of the area.
3. To devise mechanisms for sharing the natural and cultural heritage of the area with the broader community.

Farmers participated in 25 days of field training with project team members, external experts, site visits, community-based tea talks and robust discussion group meetings in local parish halls. As a project group, we were supported in our work by a wide range of experts who gave freely of their time to facilitate and deliver the training.

Learnings

There are minimal high-quality, evidence-based Irish studies to provide our upland farmers with a basis for their management decisions. In addition, there is no guidance on upland grazing and management options relevant to the delivery of ecosystem goods and services. For example, evidence-based grazing management advice for the range of upland habitats and their current conditions.

A large but scatted and diffuse body of international information exists that is used for all manner of purposes. It sometimes contributes to the obfuscation encountered when trying to provide upland management advice. Indeed, sometimes it chooses to ignore the practicality and cost of the necessary implementation measures on the uplands.

While the conservation objectives have been set for many uplands in the Natura 2000 network, there are no clearly defined mechanisms for achieving them, especially for those in an unfavourably bad condition. Clarity is absent at the national level of the target habitats for non-Natura 2000 uplands.

The Discussion Group provided an excellent forum for learning. Its members enabled it, in part, because they have worked together as a group for almost 25 years. The innovative Commonage Group's pioneering development in the SUAS EIP project may require a few years to realise its full capacity.

FORESTRY

Forestry – farm planning and integrating forestry

Noel Kennedy

Teagasc, Forestry Development Department, Roscommon

Take Home Messages

- Setting clear objectives and timely planning are essential for new farm forest enterprises
- The current DAFM Forestry Programme offers a range of forestry categories for approved applicants
- Suitable categories can be considered to meet financial, social and environmental enhancement objectives
- Comprehensive supports are available from Teagasc

Introduction

New forest and woodland creation can deliver a wide range of future benefits on your farm. Whether small or larger areas are involved, setting clear objectives and timely planning are central to success. Do you wish to explore options to enhance the farm environment? Is the provision of additional farm income or a tax efficient future pension fund a strong priority? How will a future farm forest fit in with current enterprises and future plans? Teagasc provides comprehensive supports to help inform good decision-making and achieve the right trees in the right places to meet your objectives.

Selecting suitable planting categories

Good planning is essential to ensure tree species selection matches the prevailing soil and site conditions for new farm forest projects. The current Forestry Programme, administered by the Department of Agriculture Food and the Marine (DAFM), continues up to the end of 2022 with work also progressing on its successor. The current programme incorporates 12 Grant and Premium Categories (called GPCs), offering a range of forest options on suitable farm locations. These include productive conifers and broadleaves, native woodland and agroforestry (Figure 1). All new forest planting requires 15% of the land area planted to be

dedicated to biodiversity enhancement (e.g. retained habitats, hedgerows and open areas). Every tree species, conifer or broadleaf, has its own unique biodiversity characteristics. The more diversity of species that occur in a forest, the more biodiversity and ecosystem benefits are likely to be delivered.

New farm forests can incorporate either individual or a mix of planting categories, which are suited to prevailing site conditions. This flexibility allows landowners to combine, as appropriate, commercial forest categories and those which provide the strongest environmental benefits. For example, new native woodland (GPCs 9 and 10), alongside an undisturbed water setback, can form a landscape feature that protects and enhance water quality in suitable farm locations (Figure 2). This **'Woodland for Water'** measure provides an ideal buffer against potential nutrient or sediment reaching sensitive watercourses. It can therefore work in combination with and facilitate adjoining land uses such as commercial forests (e.g. GPC 3) or productive agriculture (Figure 2). As well as its protective role, the undisturbed setback conserves and, over time, promotes the development of diverse habitats, their flora and fauna, and overall biodiversity in this critical zone between the water and adjoining land uses.

GPC 3: Mainly spruce & 15% other species
€510 - 520/ha/yr (15 years)

GPC 4: eg Scots pine
€590 - €600/ha/yr (15 years)

GPC 6: Oak
€645 - 660/ha/yr (5 years)

GPC 8: Birch/alder
€605 - 620/ha/yr (5 years)

GPC 9/10: Native woodland
€665 - 680/ha/yr (15 years)

GPC 11: Agroforestry
€645 - 660/ha/yr (5 years)

Figure 1: Examples of available GPCs with current annual premium rates and payment durations

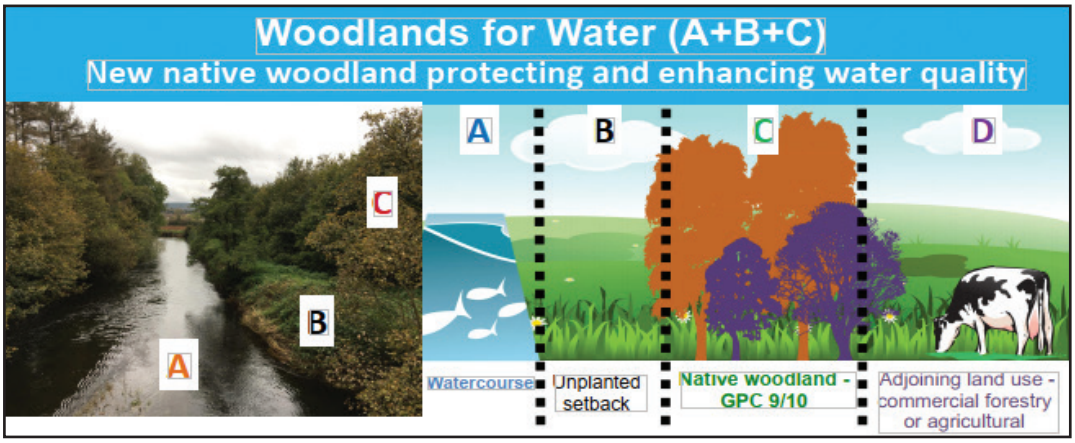

Figure 2: Woodland for water measure combing an unplanted setback and new native woodland (GPC 9/10)

Agroforestry (GPC 11) is an exciting planting option particularly suited to lowland sheep farming. It combines farming and forestry working together in a mutually beneficial way. Silvopasture is a type of agroforestry involving the growing of wider spaced high-quality trees managed to integrate with livestock production and grass growth. It can provide a range of benefits including improved soil health, nutrient capture, biodiversity, carbon uptake, animal welfare and livestock productivity.

Financial Fitness

Forestry can play a significant role in enhancing financial fitness on the farm. For approved applicants, grants are available to cover the majority or all costs of establishment and early management. In addition, annual income tax-free premiums up to €680 per ha per year are available as compensatory payments for agricultural income foregone (Figure 1). When you are considering the permanent land use change that is forestry, it is also important to look beyond annual forestry premiums. Gaining an appreciation of the potential financial returns from future harvests is critical. These returns depend on a range of factors including the tree species selected, forest productivity (yield class) and its future management. In general, productive conifer species with a relatively short forest cycle (rotation) provide the highest financial returns.

The Teagasc Forest Investment Valuation Estimator (FIVE) is a beneficial tool used by forestry advisors in collaboration with clients to help inform decision-making in relation to potential land use and forestry. FIVE provides indicative analysis

and decision support, particularly in relation to reviewing pre-planting options and comparing criteria such as species, yield classes and forest rotation lengths according to landowners' preferences and objectives.

Integrating farming and forestry

Adopting a whole-farm planning approach is also essential when assessing the options for forestry planning and integration on the farm. This requires analysis of how planting land may interact with farm enterprise combinations, farm schemes/supports and future succession planning. For example, the capacity for forestry parcels to also retain the Basic Payment, subject to eligibility conditions, is a key financial farm benefit.

Carbon benefits

The planting of new forests is also a significant land-based measure to help address the effects of climate change. Forests play an important role in the capture and removal of carbon dioxide from the atmosphere and subsequent storage in forests biomass and soils, a process called sequestration. While not a silver bullet, farm forests and woodlands, in appropriate locations, can significantly benefit the carbon efficiency and green credentials of farm businesses including reducing their carbon footprint. Teagasc, in conjunction with DAFM and Forest Environmental Research and Services (FERS) Limited, has developed an online Forest Carbon Tool (www.teagasc.ie/forestcarbontool). The tool provides indicative data for potential carbon sequestration associated with new forest enterprises. It includes current planting category options under the DAFM Forestry Programme. It is particularly useful when considering the relative carbon removal merits of different forest categories and planting combinations.

Further information

The forestry option has many benefits but it is important that farmers and landowners are fully aware of all implications in advance of informed decision-making. Teagasc forestry staff provide independent and objective advice that supports whole farm planning and the appropriate forest options tailored to your objectives and farm characteristics. Contact your local Teagasc forestry staff and log onto www.teagasc.ie/forestry for further information.

HEALTH & SAFETY

Best practice for health and safety on sheep farms

John McNamara,[1] Serena Gibbons & Paul Mullins[2] and Francis Bligh[3]

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Take Home Messages

- Farm Accidents and Ill health cause tragedy, suffering and long-term disability. They also have the potential to jeopardise a persons' capacity to farm effectively and hence jeopardise farm income. Therefore it is in everyone's' best interests to give practical safety and health management adequate attention.
- In 2021, ten fatal accidents occurred associated with farming, one with 'forestry and logging 'and one due to farm construction. In 2022, 2 deaths have been reported to the 14th of April (provisional figure). An estimated 2,800 serious accidents take place each year.
- Farmers have been identified as an occupational group who have a high level of Ill Health. The data available suggests that farmers are positive to giving their health more attention, including having a regular G.P. check-up.
- Considerable grant aid support for farm safety improvements is currently available through the Targeted Agricultural Modernisation Scheme (TAMS11). Sheep farmers need to consider how to me make the optimum application for this scheme.
- Farmers need to comply with the legal requirements for agricultural vehicles and trailers used in public roads and of 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. In 2020, 20 farm deaths occurred, being 37% of all workplace deaths (54). In 2021, the number of farm deaths reduced to 10 with one in 'forestry and logging 'and one due to farm construction.

In 2022, 2 deaths have been reported up to the 14th of April (provisional figure). Childhood deaths are particularly tragic and in recent years, there has been a significant increase in the occurrence of these fatalities. Farm accidents causing serious injury occur at the high level of 2,800 per year. Eleven percent of sheep farms had an accident in the previous 5 years. Accidents causing injury on sheep farms were associated with farm vehicles/ machinery (33%); trips/falls (27%); livestock (20%); chainsaws/wood (7%); buildings (7%) and other (7%).
An accident can lead to a permanent disability and interfere with a person's capacity to farm effectively. At this Teagasc sheep opneday, there will be a Farm Safety and Health Exhibit to demonstrate how farm health and safety can be improved.

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 updated 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 are estimated to make up about 95% of farms nationally. Teagasc staff will be on hand today to explain the requirements to manage safety and health and to outline the resources available to assist farmers.

Targeted Agricultural Modernisation Scheme (TAMS11).
Grant aid is available through the various TAMS Schemes up to 2022 (closing dates to be finalised). Full details of each scheme are available on the DAFM web site at http://www.agriculture.gov.ie/farmerschemespayments/tams/. The principal areas where funding is available include slurry aeration, 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 last 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.). Your claim for payment will not be processed until evidence of completion of the course is provided. It is recommended that you discuss your application with your Advisor, to optimise the benefit for your farm. The FBD Insurance booklet 'Build in Safety – An Advisory Booklet for Farmers', outlining how to comply with SHWW Construction Regulations will be available today.

Agricultural Vehicle Standards for Public Roads Revised standards for use of Agricultural Vehicles on public roads are in place. In addition to 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 will be demonstrated at todays openday as follows:

Braking – More powerful braking systems will be required for agricultural vehicles operating at speeds in excess of 40km/h. Most of the correctly maintained tractors which have come into use in the past 30 years already meet these requirements.

Lighting & Visibility – Agricultural vehicles will need to be equipped with appropriate lighting systems, flashing amber beacons and reflective markings.

Weights, Dimensions & 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 will benefit from being able to operate at higher weight limits of up to 24 and 34 tonnes for tandem and triaxle agricultural trailers respectively that meet certain additional requirements. A comprehensive exhibit of vehicles and trailers to illustrate the requirements of the new legislation will be on show to and Gardai will be on-hand at Sheep 2022 to demonstrate weight limits for livestock and horse boxes and trailers.

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 the 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 provided. 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 meter boom width must be tested. The interval between tests must not exceed 5 years until 2025. A list of approved sprayer testers is available on the DAFM Web. Today we will present information on the key issues of effective sprayer operation and use of Protective Equipment will be provided.

Safety of Children on Farms

Safety of children and Young persons must be paramount on farms. The following precaution need to be considered 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 and 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' will be available today.

Preventing Accidents with Farm Vehicles and Machinery

Vehicle and Machinery related deaths account for 53% of all farm deaths (10 year average to 2020). With 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 vehicle part (2%). With machinery, being crushed (23%) or struck (18%) or collapse (18%) are the most frequent causes of death followed by power drive entanglement (14%). The data shows that most fatal accidents occur due to being crushed or struck, so safety vigilance is especially needed when in proximity to moving vehicles/ machines. A demonstration of Blind spot areas around Farm Vehicles will take place at today's openday.

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 PTO. A range of modern and effective PTO covers will be on display today.

Quads (ATV's) are useful machines on farms for travel but they have a high risk of death and serious injury if miss-used. New regulations related to ATV use and wearing of a helmet come into force in 2023. A demonstration of safe driving of a quad will take place today.

Preventing Accidents with Cattle and Sheep

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%) and bullocks and other cattle (41%) accounting for the remaining. 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.
Preventing accidents with sheep revolves around have safe handling facilities. When herding sheep in hilly or mountainous areas or when beside rivers/ streams particular attention needs to be given to managing the safety risks associated with the terrain. This applies particularly if an ATV is being used. Special attention needs to be given to preventing musculoskeletal injuries when handling sheep.

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 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 when slurry due to fermentation in semi-emptied tanks. Never enter a slurry tank as lack of oxygen or the presence of poison gasses could be fatal. Also, never have an ignition source near a slurry tank due to the methane explosion risk.

Farmers Health
A major Irish study has indicated that farmers in the working age (16-65 years) have a 5.1 higher 'all cause' death rate than the occupational group with the lowest rate. The major causes where death rates are elevated include cardiovascular disease (CVD), cancers and injuries. A further Irish study indicated that 59% of farmers had a G.P. health check in the last year compared to 74% for the general population. Among farmers, despite 60% being classified as overweight or obese, just 27% believed that they were too heavy. Farmers have been shown to gain an adequate number of steps, however, in general, they have been shown to gain an in-adequate level of moderate to high intensity exercise essential for cardiovascular health. Information will be available at todays event to advise farmers on suitable exercise and fitness for health.

Looking after Wellness
We can all go through low points from time to time times in our lives and it is not unusual to experience symptoms related to stress, anxiety and depression. So as part of Sheep 2022 we decided to invite a number of national organisations

to promote positive mental wellbeing including: Mental Health Ireland and Samaritans Ireland.

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Preventing Sheep Infections

A booklet entitled 'Staying Healthy on your Farm' which deals with infections zoonosis or contracted from animals is available from the Health Services Executive at:
http://www.zoonoses.ie/public/publications/Staying_Healthy_on_your_Farm.pdf
Orf is caused by a virus transmissible to humans by contact with infected sheep and it is a common infection among sheep farmers. Infection causes skin lesions on hands, arms or face. The lesions may persist for weeks and can be itchy and painful. With secondary bacterial infection, Farmers contract the disease by direct contact with infected animals or contact with contaminated objects such as fences or feeding troughs. Prevention is by

- Ensuring general cleanliness of animal housing areas;
- Consult your vet on how to control the disease in your flock;
- Consider using a live vaccine for flocks with an Orf problem.
- Wash any known exposed area with soap and water.

Toxoplasma is a small parasite that causes infection in humans. There may be no symptoms or mild symptoms such as aches and pains, a slightly raised temperature and/or 'swollen glands'. Pregnant women are a high-risk group. Infection in the unborn child is the result of an acute infection acquired by the mother in pregnancy and passed on to the baby in the womb. The result of this infection can be a miscarriage, or brain or/and eye damage in the new-born child. It is in the cat gut that the male and female parasites come together to produce one of the infective forms. If a suitable host such as a human swallows these then infection may follow. Sheep that are aborting, or lambing may also present a hazard. Prevention is by

- Vaccinate sheep used for breeding.
- Ensure hand-washing facilities are available and are kept clean;
- Dispose of cat faeces and litter daily, remembering to wash hands afterwards;
- Control stray cats and prevent them from gaining access to sandboxes and sandpits used by children for play. Sandboxes should be covered when not in use;
- Ensure that pregnant women are aware of the risks.

Enzootic Abortion is caused by Chlamydia, *which* is a parasite that is widespread in animals and can be transmitted to humans. The disease usually arrives on farm

for the first time when infected replacements are bought-in or wildlife spread. Infection spreads from ewe to ewe in infected afterbirth, on new lambs and in vaginal discharges for up to two weeks post lambing. This can lead to significant contamination of the bedding. Lambs can also be born already infected from mothers carrying the disease. This infection is a risk to pregnant women assisting at lambing due to the risk of causing miscarriage.
Precautions include:

- Vaccinate sheep used for breeding
- Ensure that pregnant women are kept away from lambing area

Further Information
A key to improving farm health and safety is the genuine interest of farmers. New and current information can be downloaded at the following web sites:
Teagasc: http://www.teagasc.ie/health_safety/
H.S.A.: http://www.hsa.ie/

BIA INNOVATOR

Creating a valuable Income Extension through Food Innovation

Elaine Donohue

Bia Innovator Campus, Mellows Campus, Athenry, Co Galway

Introduction

Bia Innovator Campus is a new €8m investment under construction at Mellows Campus Athenry. It will bring multi-strand food and beverage incubation, scaling and innovation infrastructure, bundled with future-of-food supports including NPD, sustainability and trade development to the West of Ireland.

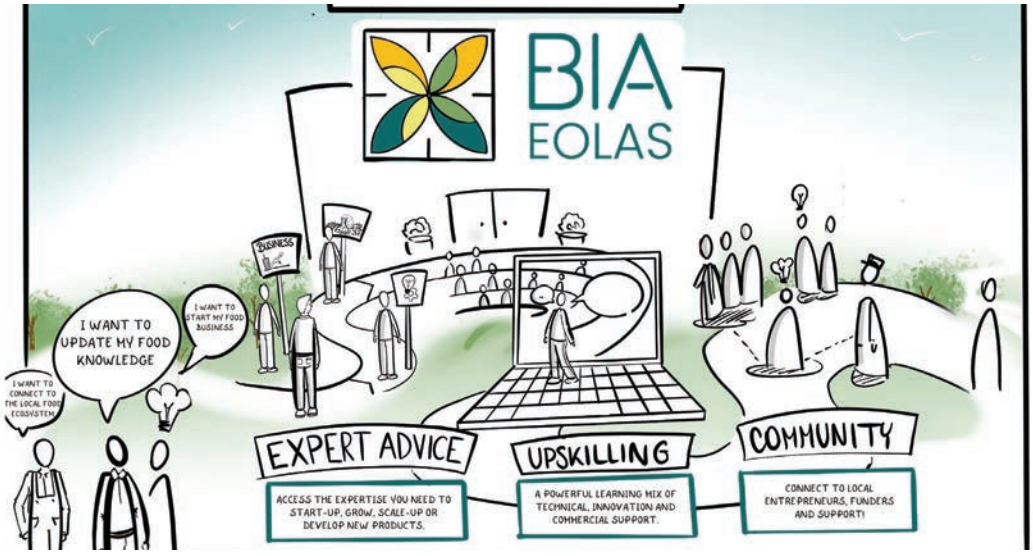
- You will be able to access supports; advice and the practical know how to add value to your raw material.
- You can engage with us and see if food production is something you might like to explore.
- We help anyone from the very start, you do not need to have any experience or know how.

Birds Eye View of Campus

What does this mean for the Sheep Industry?
You will be able to access supports, advice and the practical know how to add value to your raw material. The campus is made up of three core areas;

1. *Bia Eolas:* A place for you to learn, either from our mentors, on a course, signing up to a taster event or just becoming a member of the campus to learn and see what other food producers are doing and seeing how you might learn from your peers.

Mentoring	Start your own business exploration
Shadowing other businesses	Testing your idea/concept
Feasibility study	Growing your understanding
Assessing your learning needs	



Learning Pathway at Bia Innovator Campus

2. *Bia Accelerate:* We help existing businesses to grow and accelerate. We look at many aspects of your business and guide you in your next steps. Sometimes this involves looking at where you would like to be and breaking down the requirements to achieve your goal. Every business has different strengths

and areas for development so we can help you with the areas in which you are weaker or where your understanding needs development. Every food business is on its own journey at different stages with different levels of resource.

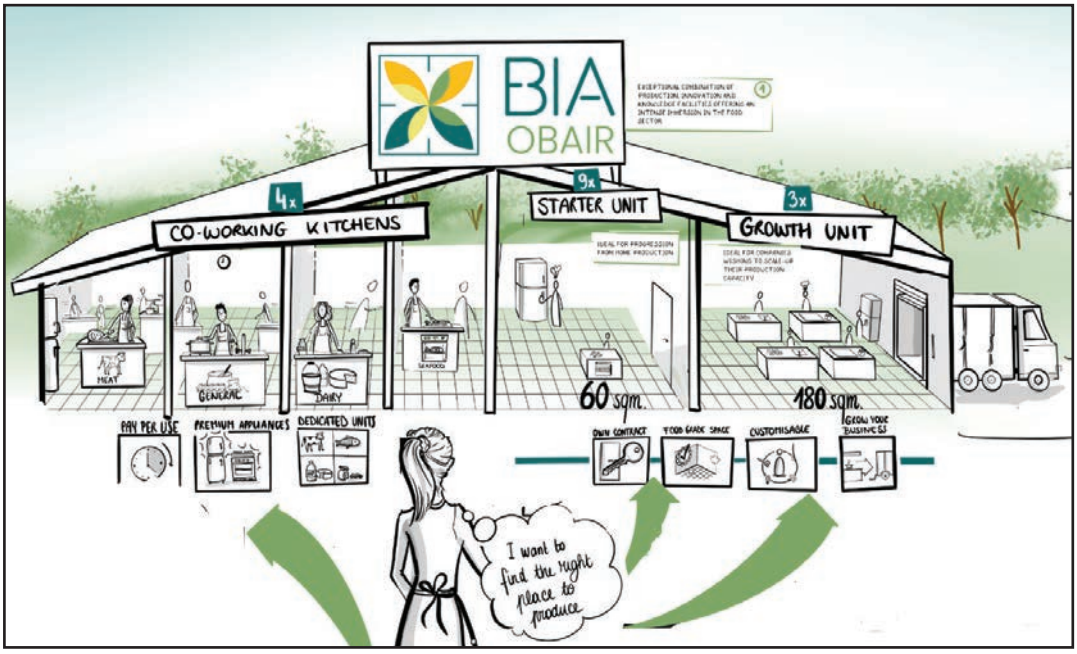
Manufacturing	Managing your growth stages
Production	Sourcing
Regulatory Compliance & Standards	Supply Chain & Logistics
Commercial Awareness	Technical
Cost Analysis	Quality
Branding & Marketing	Innovation
Category Analysis	Capacity building across your business

3. *Bia Obair:* We help to de-risk start-ups by reducing the Capital investment at all stages. To meet the basic requirements of the regulators, many start ups find the cost of food production space prohibitive at the early stage when they are unsure if their business is sustainable. The solution to this is that you can start producing your product at Bia Innovator Campus in our shared production units on a pay as you go system. As part of this, you can use our state-of-the-art commercial equipment and re-invest your hard-earned money in business development and growing your customer base for sustainability and longer-term success. As you grow through Bia Obair, you are focusing your energy and monies on business growth rather than servicing debt.

   Step One: Shared Production Units; we have Meat, Dairy, Seafood and General Production spaces fitted with commercial equipment to save you production time and provide high standard environment to help you excel.

   Step Two: Own Door Starter Units; We have nine own door production units that you can rent and operate your business from independently. These spaces are 60sqm each with a communal tea station, meeting room and toilets. They are fitted out with premium grade food grade panelling to the walls and ceiling alongside a resin floor with heavy duty stainless steel drainage channels. Gas, Water and Electricity are supplied to the door, ready for second fix. We estimate that you could have approximately 8 staff operating from this unit and on a maximum three shift cycle, this would allow your team to grow to twenty-four.
   Step Three: Growth Units; We have three own door production units that you

can rent and operate your business from independently. These spaces are 240sqm each and require a larger secondary fit out for welfare facilities. They are supplied with premium grade food grade panelling to the walls and ceiling alongside a resin floor with heavy duty stainless steel drainage channels. Gas, Water and Electricity are supplied to the door, ready for second fix. We estimate that you could have approximately 20-25 staff operating from this unit and on a maximum three shift cycle, this would allow your team to grow to 60-75.



Production Pathway at Bia Innovator Campus

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