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Introduction

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Welcome to AFBI's 'Farming for the Future' open days where we focus on a wide range of impactful interventions, from soil to slurry, which dairy, beef and sheep farmers could adopt now to improve productivity and reduce the environmental impact of their farm.

What were you doing 26 years ago – in 1998? It doesn't seem that long ago? In the next 26 years it will be 2050 and the expectation is that Northern Ireland (NI) will be 'net zero' for carbon. Over this period the farming sector will undertake a 'just transition' to make its fair contribution to this net zero goal. The Committee for Climate Change suggests that this 'fair contribution' represents a reduction in emissions from sources such as animals (methane emissions) and fertilisers (mainly nitrous oxide emissions) as well as vehicles etc by 2.3mt CO_2e (i.e. ~38% from current levels). Furthermore, we will also need to deliver major improvements in water quality and reductions in ammonia emissions. A major increase in biodiversity and forestry across the NI landscape is also required. All these changes need to be achieved in such a way that we continue to support NI's economy and the food security of the UK, whose population itself is expected to grow by 10% by 2050.

The carbon footprint of meat and milk production in NI is one of the lowest globally. However, due to the intensity of the ruminant sector in NI, coupled with the scale and pace of change required, the reduction of the environmental impact of ruminant farming is arguably the greatest ever challenge for the agricultural sector in Northern Ireland. This is especially at a time when there is also a high demand for the excellent quality products that NI's agri-food industry offers.

In Northern Ireland 70% of the land is farmed by 26,000 farmers. This land mass and the farming community will be key in achieving the above goals which are multiple, complex and interlinked.

Dairy, beef and sheep farming systems dominate land management and use across NI and these systems currently represent the backbone of the NI agri-food economy. However a huge responsibility rests with this group of farmers to protect the environment in an economically viable manner, all the while trying to adapt their farming systems to the changing climate and volatile weather patterns we are now experiencing.

AFBI's 'Farming for the Future' open days provide a comprehensive insight to AFBI's extensive research spanning the farming system and in support of industry, government and wider stakeholders enhance the sustainability of NI's farms.

During the open days, farmers will have the opportunity to hear from leading scientists on ways to improve soil health, optimise outputs from grazing swards and forages, minimise the loss of nutrients, especially nitrogen and phosphorus through precision nutrition, reduce the emission of methane through dietary interventions, use genetics to drive improvements, maximise the use of nutrients in slurry and optimise animal health, and welfare and management.

A wide array of exhibits will also be on display outlining AFBI's work, complemented with contributions from our strategic partners such as CAFRE, QUB and AgriSearch, as well as other organisations. The vast majority of AFBI's work is funded by the Department of Agriculture, Environment and Rural Affairs (DAERA). As such we gratefully acknowledge DAERA for their underpinning support and funding for these open days as well as the work presented at them.

The open days offer the farming industry a unique opportunity to engage with experts, share their own experiences with fellow farmers and AFBI scientists and ultimately take home new ideas to try out with confidence.

Many of the interventions and ideas on display represent win-wins for the environment and a farm's profitability and a large number also represent adaptation strategies to help manage swards in volatile weather scenarios.

NI's climate and soil is best suited to support grass based systems and whilst some opportunity exists to convert grass land to grow cereals, the percentage of land where this opportunity exists is low. As such it is expected that NI's main land use will remain as grass based and that the production of meat and milk therefore remains the most viable way to use land in NI to produce human edible food.

With this in mind AFBI's research will continue to understand and develop ways to reduce the environmental impact of livestock systems, mainly through nutrition, genetics, management and reducing ill health. Our work will also investigate and bring forward new ways to maximise the efficient use of nutrients on farms. We will also explore alternative land use strategies which complement livestock farming and create resilience to climate change for farmers. All these advances will be considered for their economic viability and how they can create resilient, profitable, environmentally responsible farms of the future.

Prof Elizabeth Magowan

Director of Sustainable Agri-Food Sciences, AFBI

Opportunities from the Challenges - Farming for the Future

Steven Morrison

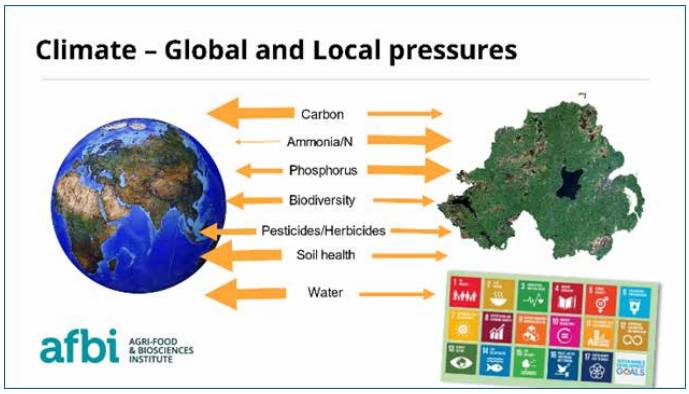
Multiple challenges and rapid rate of change needed – but these present opportunities

Key Messages:

- Northern Ireland (NI) farming has entered a period of major change which is required to address the challenges associated with our densely populated livestock sectors against a backdrop of growing demands for food and food security concerns.
- Challenges bring opportunities and there is a real opportunity for NI to be globally leading with regard to sustainable meat and milk production.
- Key challenges include climate change and adaption; greenhouse gas emissions; ammonia emissions; phosphorus balance; biodiversity loss; financial viability & market volatility; subsidy changes; work-life balance; succession & labour and changing consumer demands and societal expectations.
- Growing questions and requirements in relation to the environmental footprint of livestock farming all need to be urgently addressed.
- The Farming for the Future events have highlighted and stimulated discussion on many of the challenges and showcased some of the recent and ongoing science to help inform and address these challenges while continuing to support food security and farm profitability

Sustainability

A common definition of sustainable farming is meeting current needs without compromising the ability of future generations to meet their needs. Specifically, within agriculture the emphasis is on environmental health, economic profitability and societal responsibility – the three pillars of sustainability commonly called the three Ps – People, Planet and Profit.



Northern Ireland livestock industries are currently facing several key challenges such as: climate change and adaption; poor water quality; high ammonia emissions; biodiversity loss; and a shortage of labour availability and skills. These challenges are against a backdrop of volatile economic viability for many farms with changing arrangements and requirements in relation to support payments.

A brief overview of a number of these environmental and climatic challenges is outlined on the following pages:

Environmental challenges

1. Climate change

Northern Ireland, through the Climate Change Act (Northern Ireland) 2022 is committed to be net zero in greenhouse gas emissions by 2050 along with interim targets including an at least 48% reduction in net emissions by 2030. Agriculture does not need to be net zero but will have its part to play in achieving the NI targets. Decarbonising agriculture requires significant reductions in methane and nitrous oxide. The main sources of methane are currently the digestion of feed by cattle and sheep, slurry and peatlands. The main source of nitrous oxide is the application of slurry and fertiliser on land. It is recognised that decarbonising agriculture is a major challenge, and as other sectors reduce their emissions largely through reducing reliance on fossil fuels, agriculture's share of total Northern Ireland emissions will grow, potentially to 75% of NI's emissions, further placing livestock farming in the spotlight. The pressure to reduce GHG emissions is not only policy driven but also through supply chain pull with buyers of livestock products be that retailers, service industry or direct consumers demanding products with a lower carbon footprint.

The impacts globally of climate change are well documented with effects outside of Northern Ireland felt by local agriculture through supply/demand issues and associated costs for agricultural inputs and outputs. Locally the direct impacts of climate change are already being felt, be that through local climatic and weather conditions resulting in flooding, delayed planting, harvesting, yield and quality impacts, concerns regarding biodiversity loss and increasing incidences of wildfires.

Couple these climate change related impacts with impacts resulting from factors such geopolitics and international conflicts results in the growing need for increasing resilience in farming systems to be able to rapidly adapt and cope.

AFBI is working with farmers and a range of collaborators to reduce methane emissions so far as possible from cattle and sheep and reduce nitrous oxide from land through innovative techniques and understanding the drivers of high emissions. AFBI's work is also focused on land use and management which support the adaption of farming systems to cope with weather shocks and maximise carbon removal from the atmosphere.

2. Water Quality

High quality water is a basic and essential requirement for the well-being of the environment, economy, and society. The most recent Water Framework Directive report (2021) indicated 88% of river water bodies and 52% of lakes in Northern Ireland were of moderate status with none classified as good or high status. This highlights the need for improvement which was further put in the spotlight with challenges being faced in Lough Neagh. Many factors are highlighted as contributing to the water quality challenges in Northern Ireland but it is known that the nitrogen and phosphorus surpluses on farms (as a result of slurry and fertiliser application above requirements) which end up in the water ways play an important role.

AFBI's research is pushing the nitrogen and phosphorus content of animal feed as low as possible but also investigating novel slurry management strategies to minimise farm surpluses and maximise nutrient use efficiency and cycling.

AFBI's work is also exploring nature based solutions to protect waterways and the Soil Nutrient Health Scheme will provide farmers with data to manage nutrient applications in a manner which will minimise run off into water systems.

3. Air quality – ammonia

The UK has binding requirements under EU and international treaties to reduce ammonia emissions. Northern Ireland contributes substantially to UK emissions. Within NI, most of the ammonia in the air has originated from agriculture (32kt NH_3) and in particular the management of animal manures (27.6kt NH_3) and application of nitrogen-containing mineral fertilisers (2.6kt NH_3). Ammonia emissions from livestock farming are a key challenge in NI, as levels in the air are high and it has wide-ranging effects such as:

- Air quality - Ammonia contributes to the formation of fine particulate matter (PM2.5), which can adversely affect human health leading to respiratory and cardiovascular diseases.
- Ecosystem damage – ammonia deposition can lead to soil acidification and eutrophication of water bodies, negatively affecting plant biodiversity and aquatic ecosystems. It is estimated that almost half of the plant species extinctions occurring in the UK between 1987 and 1999 were associated with increased nitrogen availability. Grasslands, heathlands, bogs and dunes are particularly sensitive.
- Greenhouse gas emissions – ammonia itself is not a greenhouse gas but its deposition can indirectly affect carbon cycling potentially influencing GHG emissions.

AFBI's research is driving down the excretion of nitrogen from animals and investigating novel slurry interventions to minimise emissions emission during storage and spreading.

AFBI's work has also looked at the economic impact of these interventions and has worked with the national inventory to ensure it reflects NI practices and emission factors.

4. Biodiversity

Globally there is much concern about the rapid loss of biodiversity in many ecosystems. This loss disrupts functioning of ecosystems, making them more vulnerable to shocks. Species become extinct or degraded and we lose genetic diversity which is essential for resilience against environmental or disease challenges. Aside from food production, our ecosystems are essential for the provision of many services such as clean air and water, pollination of crops and climate regulation. Northern Ireland is not immune to biodiversity loss.

Many international agreements are in place with the most recent target signed up to by the UK at COP15 in 2022 being the 30by 30 target. The UK government committed to protect 30% of the UK's land and seas by 2030. For many regions to achieve these targets it may mean expanding and effectively managing protected areas as well as ensuring these areas are ecologically representative and well connected. Securing sufficient funding in difficult budgetary circumstances, landowner support, technical support, governance and a just transition to conservation actions all present challenges. Indeed, there is much challenge in how to accurately and cost effectively measure/ monitor biodiversity - what indicators should be tracked so we can robustly measure to manage in a positive way.

Through all the strategies AFBI is investigating to reduce the pressure of farming on air and water quality and the carbon footprint, there is constant recognition that the practices should not contribute to more biodiversity loss and indeed should promote biodiversity recovery.

AFBI's work focuses on both below and above ground biodiversity and maximising it where possible. It also includes work on integrated pest management to reduce the need for insecticides and pesticides.

Demand for Northern Ireland products

The one constant within livestock farming is the continual need to deal with challenge and change. That requirement is currently greater than ever against a backdrop of a continual growing demand for food to feed a growing population. The population's food basket is made up of much more than livestock-based foods. However livestock farming has an important role to play within the food security discussion as it is known that meat and milk provide essential, readily available nutrients within the human diet.

More locally, NI food and drinks sector continues to grow with inflation adjusted gross turnover largely continually increasing from the early 2000s through until 2021 (latest available data). The majority of our ruminant livestock food products are exported out of NI, so we are supporting food security in many countries, especially Great Britain, whose population itself is due to grow by 10% by 2050.

Summary

Sustainability is not just about delivering for the environment and nature but must also protect animal welfare, deliver societal expectation, and deliver a financial return for all stakeholders in the supply chain. Focusing on the environmental pillar of sustainability, Northern Ireland's livestock sectors are poised for a sustainable transformation by addressing current challenges with innovative solutions and practices. Restoring land health, boosting biodiversity, nutrient management plans that make best use of nutrients and protect waterways are just a few examples of practices that can help Northern Ireland lead the way in environmental stewardship, ensuring a vibrant, resilient, and sustainable agricultural future.

The AFBI Dairy Herd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The AFBI dairy herd

Conrad Ferris

Introduction

The dairy herd at AFBI Hillsborough comprises 300 dairy cows and 180 young-stock, all of which are Holstein-Friesian. The herd is a 'research herd', whose primary role is to facilitate a diverse range of research studies examining issues of relevance to the Northern Ireland Dairy Sector. Approximately 40% of cows calve in the autumn and 60% of cows calve in the spring. Cows within the herd are normally split into 10 – 12 separate groups to facilitate the experiments being undertaken.

Genetic merit

The milking herd has a Profitable Lifetime Index (£PLI) of £288, and is ranked within the top 1% of UK herds for PLI. The ranking of the herd for other parameters, compared to the current UK breed average, is shown in Table 1.

The values highlight that while the herd is ranked within the top 25% for milk volume, it is ranked within the top 5% for kg of fat and kg of protein. In addition, the herd is now ranked within the top 10% of herds for lifespan, the top 5% of herds for somatic cell count, the top 20% of herds for fertility index, and the top 25% of herds for mastitis. These values reflect the sire selection policy which has been adopted during the last 15 years. The annual improvement in PLI (£) and fat plus protein yield (kg) of all animals in the herd from calves through to those in their fifth lactation, is presented in Figures 1 and 2, respectively.

Breeding and sire selection

Calving commences mid-September and continues until the end of March. All cows are allowed a 42-day voluntary waiting period, with breeding of the Autumn calving component of the herd commencing during the first week in December.

Table 1 Genetic averages of the AFBI Hillsborough (milking) herd for a number of traits, and percentage positioning of the herd for each of these traits, compared to the current UK breed average

	AFBI HERD AVERAGE	POSITION COMPARED TO BREED AVERAGE IN THE UK
£PLI	288	Top 1%
PTA Milk (kg)	141	Top 25%
PTA Fat (kg)	12.4	Top 5%
PTA Protein (kg)	9.9	Top 5%
PTA Fat (%)	0.09	Top 5%
PTA Protein (%)	0.06	Top 5 %
Lifespan	42	Top 10%
SCC	-6.3	Top 5%
Fertility Index	2.9	Top 20%
Mastitis	-0.3	Top 25%
Maintenance	-4.7	Top 30%
Healthy cow	84	Top 5%
Enviro cow	1.4	Top 1%
Inbreeding (%)	7.9	

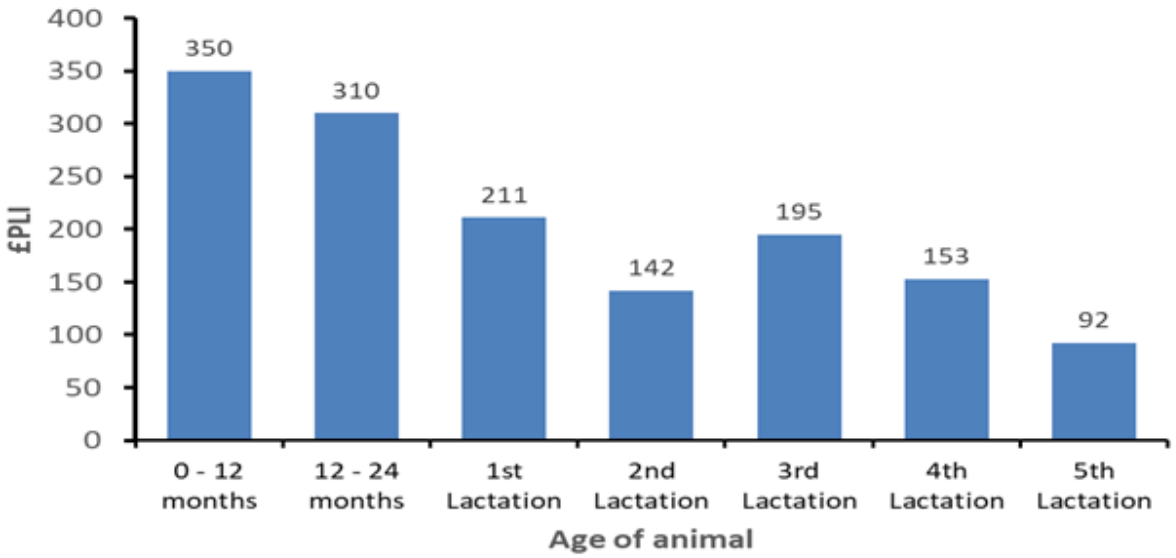


Figure 1 Profitable Lifetime Index (£PLI) of animals within the AFBI dairy herd, presented by age structure and lactation number

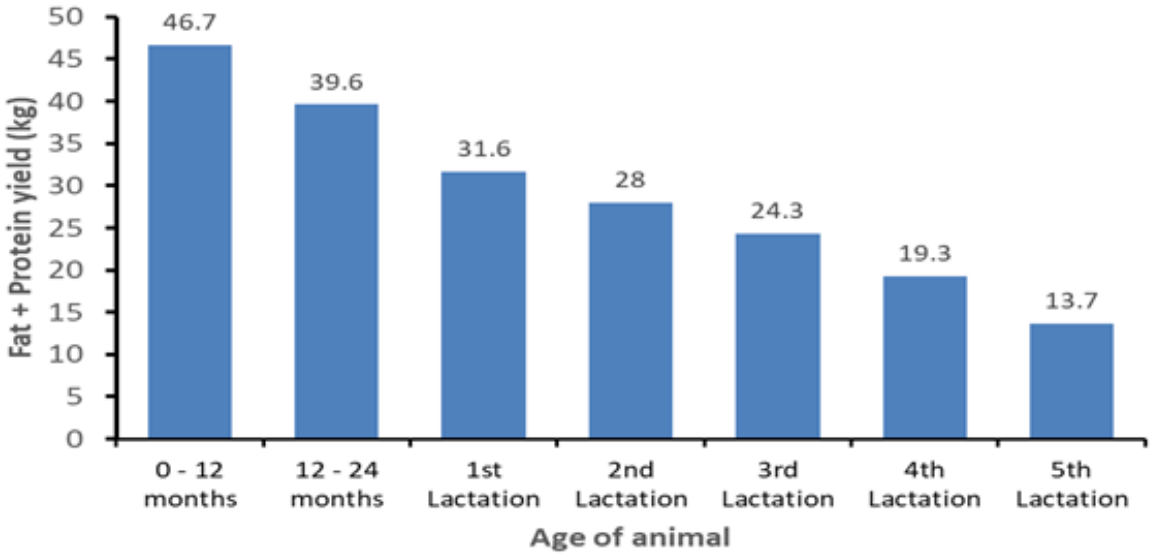


Figure 2 PTA for Fat plus Protein yield (kg) of animals within the AFBI dairy herd, presented by age structure and lactation number

Previously, breeding of the spring calving component of the herd commenced during the first week of April. However this year we are seeking to move our calving pattern forward, and as such all animals which calve in spring are eligible to be bred following a 42-day voluntary waiting period. Heat detection is undertaken by visual observation, supported by 'Cow Manager' heat detection ear sensors. All cows in the herd are bred using artificial insemination, with insemination undertaken by a commercial company following morning milking.

Cows observed in heat the previous day, or at morning milking, are inseminated between 9.00 and 10.00 am.

The long term breeding objectives are to maintain the herd within the top 5-10% of UK herds for PLI, while improving functional traits and milk composition. Over the last 5 years we have moved from using genomically selected sires on approximately 30% of the herd, to almost exclusively using genomically selected sires across the entire herd. Furthermore, in the past sires used were normally selected from within the top 10 highest ranked sires for PLI, however

maintaining inbreeding below a value of 8% has become increasingly challenging with this policy. We now aim to select sires from within the top 50 PLI ranked sires available within the UK. However, a number of essential secondary criteria are also applied, namely sires must have a positive deviation for fat and protein percentage, be positive for fertility and negative for somatic cell count. In addition, the following 'desirable traits' are applied, namely positive for lifespan, positive for TB advantage, and have a PTA for milk of >200 kg. Sires used on heifers are also selected taking calving ease into account.

The level of inbreeding in the herd is currently 7.9%, and as such 'outcross' sires are used when possible. Once sires have been selected they are reviewed against individual cows using an in-breeding checker on the AHDB website to ensure that levels of inbreeding are not excessive. In the past a target maximum level of in-breeding of 6.25% was adopted. However the current level of inbreeding is currently around 8%, with an inbreeding level of 10% now set as the upper limit. All cows being bred for replacements are bred using sexed semen. Replacements are largely bred from maiden heifers and first lactation cows. Other cows are bred to easy calving beef sires.

Calf and heifer rearing

Calves born from the dairy herd are reared within the young stock facility located at AFBI Hillsborough. Standard operating procedures relating to colostrum management, health plans and hygiene standards have been developed to help reduce the risk of calf ill health. Transfer of calves to the calf rearing accommodation occurs within 12 hours of birth with colostrum feeding continuing for up to 7 days depending on the research requirements.

Individual bucket, group and computerised milk feeding systems are available to the calf research group complimented by bespoke precision concentrate feeding systems and in-pen animal weighing equipment. The nutritional management of the young-stock herd is determined largely by the requirements of ongoing research programmes, with studies being conducted both pre and post weaning. By 12-16 weeks of age the calves are typically relocated to the post-wean calf cubicle house or the grazing platform.

Heifers are reared to calve at 23-24 months of age at approximately 580 kg, and with a body condition score of 3. Breeding is by artificial insemination by a commercial company and commences from 13.5 months of age with weight gain monitored weekly, both indoors and during the grazing season, to ensure heifers achieve their weight for age targets. Heifers are typically transferred to the dairy cow facility 3 - 4 weeks prior to expected calving date.

In consultation with the veterinary team a comprehensive vaccine plan has been developed and is continually reviewed. Vaccines used include those relating to: common pneumonia pathogens such as Bovine Respiratiory Syncytical Virus (BSRV), Parainfluenza3 virus (PI3), Mannheimia haemolytica; clostridial diseases such as blackleg; fungal infections such as ringworm; leptospirosis and salmonella. Bespoke parasite control plans aligned to herd management have also been developed in partnership with the veterinary team.

Milking routine and current herd performance

The herd is milked twice daily though a 50 point rotary milking parlour (Boumatic, Daytona), which was commissioned in 2004. A rotary parlour was chosen for a number of reasons, including the fact that it facilitates ease of management of multiple small groups of cows, and that it allows up to four concentrate types to be offered at a single drop point. Most, but not all cows are offered concentrates in the parlour. Morning and evening milking commences at 5.30 am and 3.30 pm, respectively, and normally takes between 1.5 – 2.5 hours, depending on the number of cows being milked at that time. Each milking is undertaken by three members of staff. One member of staff prepares the cows, a second member attaches the clusters, and a third member brings cows to and from the parlour. Teats are stripped, dipped and dry wiped pre milking, and automatically sprayed post milking. While the parlour has the capacity to milk 220 cows per hour, this maximum rate of throughput is not possible due to the multiple groups of cows that move through the parlour. AFBI also installed a milking robot in 2020. To date the robot has been used exclusively in grazing studies, and is only used when there is a specific need. The herd participates in monthly milk recording, and all cows are automatically weighed after each milking.

Total milk sales from April 2023 – March 2024 were 2.51 million litres, with milk produced having a mean fat content of 4.34% and a mean protein content of 3.30%. Average somatic cell count over the same period was 149, 000 cells/ml, while the average bacto-count was 27. As a consequence of compositional and hygienic quality, the price received for each litre of milk was 2.2 pence per litre above base price. This level of production represents an average annual milk sold per cow of 8500 litres. However, individual cow performance varies greatly depending on experiments that cows are managed on, with average performance within studies involving low concentrate input systems being around 6000 litres, while average performance of cows managed on higher concentrate input systems is around 9500 litres per cow.

Nutritional management of the milking herd

The nutritional management of the herd is determined largely by the requirements of ongoing research programmes. Cows which calve in the autumn are predominantly used within winter feeding research programmes, and offered grass silage based diets. Maize silage is not currently used within the herd, while a small amount of whole crop silage may be included when available. Concentrates are offered using either in-parlour feeders, out-of-parlour feeders, via a mixer wagon, or by a combination of these approaches, depending on research requirements. The spring calving component of the herd is normally used within grazing research programmes, with concentrates normally offered in parlour. Total concentrate inputs over the course of any single lactation may range from 0.6 t through to 3.5 t/cow, depending on current experiments. Cows may be managed on 2 – 3 different experiments within the course of a single lactation, and nutritional strategies for any individual cow may vary greatly from one year to the next, and even within a single year. Being able to record individual cow intakes is critical in many research programmes, and at present we have facilities to allows intakes of over 170 cows and approximately 70 youngstock to be monitored at any one time.

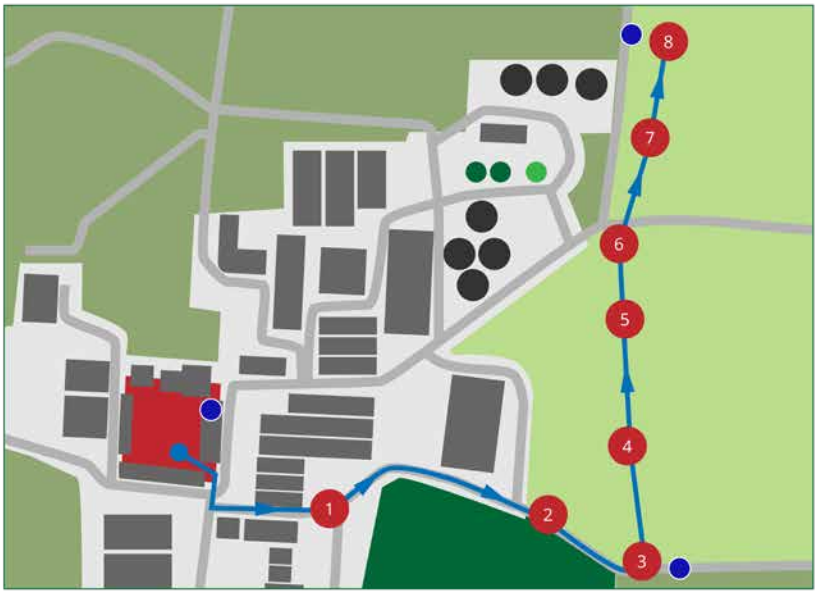
A 48 ha grazing platform is available to the dairy herd. Fields are sampled on a regular basis for soil fertility, with the current platform averaging a pH of 6.2, phosphorus index of 3, and a potassium index of 2+. Swards are predominantly perennial ryegrass – white clover mix (65% diploid, 35% tetraploid) with a target of 15% of the grazing platform reseeded annually. Target fertiliser nitrogen inputs within the grazing system are normally 270 kg nitrogen per ha, applied as protected urea. Grass is measured on a weekly basis to establish a grass wedge with excess grass removed for silage. Target pre- and post-grazing covers are 3200 and 1700 kg DM/ha, respectively. While target turnout is around 15 March, in 2024 partial turnout wasn't achieved until 17 April due to very poor ground conditions. Rotational grazing systems are normally adopted, although these may involve fixed paddocks or flexible herbage allocations, as required by the research programme.

Herd health

Having a herd with a high health status is essential for the success of all research programmes, and as such the herd management team strive to maintain excellent herd health through the combination of good biosecurity practices, and proactive health management. As with the young-stock, in consultation with the herd's veterinary team, a comprehensive vaccine plan has been developed and is continually reviewed. Cows are vaccinated for Salmonella, IBR, BVD and Leptospirosis. The herd is treated for worms during the autumn, with timing year dependent, while all cows are treated for fluke at drying off. Hoof health is maintained through regular foot trimming, and by foot bathing several times weekly when cows are housed, and weekly during the grazing period.
Cows have traditionally been treated with dry cow antibiotics and a teat sealant at drying off. However, over the past few years we have adopted selective dry cow therapy with targeted use of dry-cow antibiotics based on individual cow mastitis history (no clinical cases during the three-month period prior to drying-off) and somatic cell counts (less than 100, 000 cells/ml for three milk recordings prior to drying-off), while all cows continue to be treated with a teat sealant at dry-off.

Dairy Tour Map

COURTYARD DETAIL



DAIRY TOUR