"We have a vision of a sustainable forage-based milk production from a diverse range of systems, with all systems producing milk on a Carbon Positive basis by 2045: Scotland being the first country to do so. Scottish dairy farms are considered part of the solution to climate change and are highly valued for the food they produce and the environmental benefits they bring."

The Dairy Sector Climate Change Group Report

March 2021

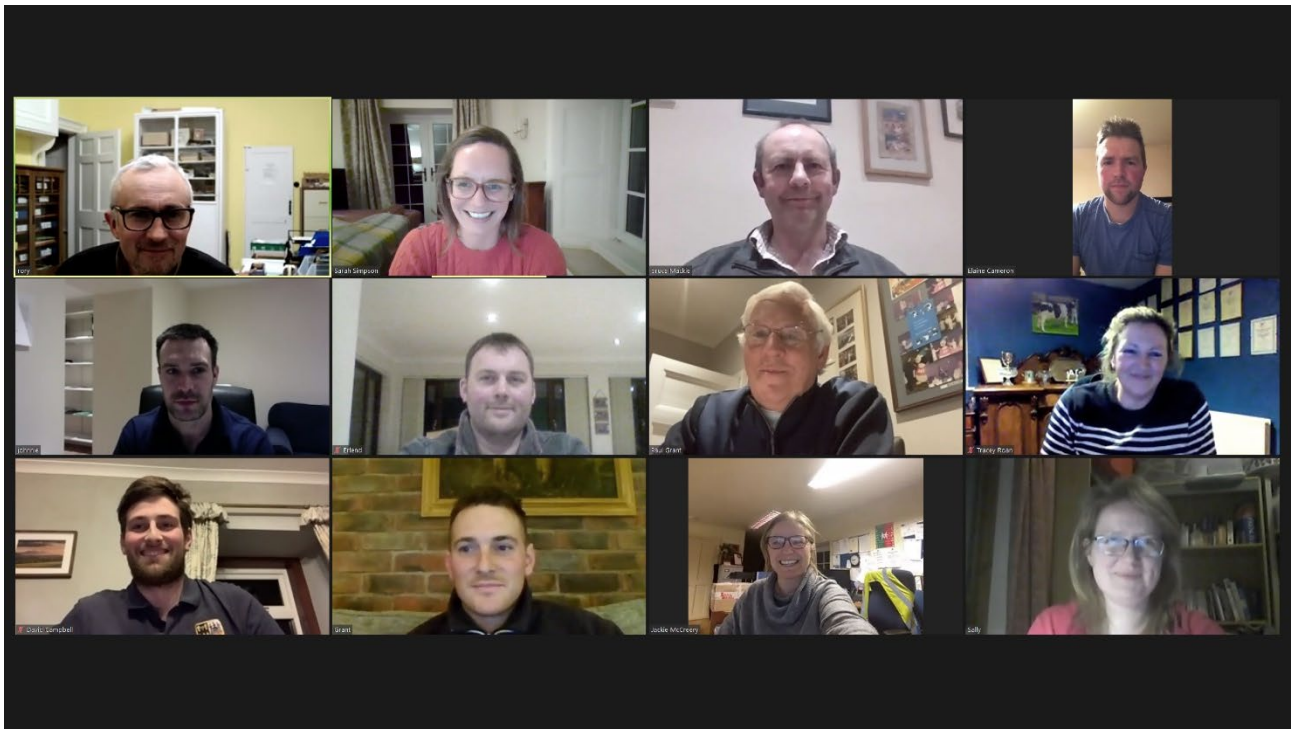
Foreword

I would like to thank each of the members of the Dairy Sector Climate Change Group for their contribution to this process. Their knowledge, enthusiasm and passion for this industry shone through in everything they did. We had a tall task to produce a meaningful report and set of recommendations based on a wide remit in a matter of weeks, but the Group understood the importance of the task. We hope this report will deliver something of real substance for the Cabinet Secretary and officials in developing an integrated Scottish Agricultural Policy in the post-Brexit era which will deliver multiple outcomes for Scotland not least achieving the target of net zero by 2045 whilst maintaining a productive, efficient and profitable dairy sector with a strong domestic market brand and exporting our top quality, climate-friendly dairy produce worldwide.

I would particularly like to thank and acknowledge Sarah Simpson for her enormous contribution to the work of the group and the writing of this report. Her knowledge of all aspects of dairy farming, head for numbers and general tenacity got the job done.

All our meetings took place virtually due to the restrictions of COVID-19 so we very much look forward to meeting in person at some point in the not too distant future.

Jackie McCreery
Chair



Contents

Foreword 1
1. Executive Summary 4
2. Scope of the Report 6
3. Introduction and Background 7
4. The Dairy Sector in Scotland 8
5. Establishing the Baseline 10
5.1. The Inventory and Targets 10
5.2. Carbon Footprint Audits - Standardising the Data Collection 11
5.3. Whole Farm Climate Reviews 13
6. A Balancing Act 15
6.1. Minimising the Negative - Mitigation and Abatement 16
6.1.1. Genetic Efficiency 17
6.1.2. Feeding Efficiency 18
6.1.3. Energy Efficiency 19
6.1.4. Herd Health and Management 20
6.1.5. Grassland Management 20
6.1.6. Nutrient Management 21
6.2. Maximising the Positive - Carbon Sequestration 22
6.2.1. Soil Carbon 22
6.2.2. Afforestation 23
6.3. Biochar and New Carbon Capture Technologies 24
7. Opportunity and Innovation 25
7.1. GWP^{100} vs GWP* 25
7.2. Low emission export opportunities: 25
7.3. Carbon Credits Scheme and Trading Platform 26
7.4. Alternative Supply Chain Marketing 26
7.5. Community/Regional Processing 26
8. Collective Drive for Change 28
8.1. Processors and Retailers 28
8.2. Financial Sector 29
8.3. Farm Suppliers and Advisers 29
8.4. Public Private Partnerships 30
9. Scotland at the Forefront 30
9.1. A Centre of Excellence 31
10. Delivering Change 32
10.1. Capability - Knowledge 32
10.2. Opportunity 33
10.2.1. Basic annual payments 33
10.2.2. Capital Grants 34

10.2.3. Implementation 34
10.3. Motivation 34
10.3.1. Market Drivers 34
10.3.2. Reward Innovation and Success 35
11. Integrated Approach 36
12. Communication 38
13. Conclusions and Next Steps 38
Annex 1 – Scope and Remit of the Group 39
Annex 2 – Contributors to the Group 42
Annex 3 – Farmer Survey 43
Annex 4 – Recommendations and Support Required 44

1. Executive Summary

- The Scottish Government has committed to ambitious legally binding targets to achieve net zero by 2045 to avoid global warming exceeding 2 degrees. All sectors of the economy must adapt in response, including agriculture. In doing so, agriculture can deliver benefit for the whole of society and can justify being rewarded accordingly.

- The climate change challenge does not stand alone. It runs alongside many other, potentially competing, national and international priorities, not least feeding a growing global population with nutritious, affordable food and maintaining the people and landscapes of rural Scotland which are so valued socially and economically, as well as protecting and enhancing our biodiversity.

- The Scottish Government's key policy tool to deliver on Climate Change is its Climate Change Plan (recently updated and referred to as CCPu). The CCPu anticipates that by 2032 the agriculture sector will have adopted and be competently using all available low emission technologies throughout the whole sector and agriculture will reduce its GHG emissions by 5.3 MtCO2e by 2032, a 31% reduction from 2018 levels.

- We have articulated a vision for the dairy sector if the recommendations set out in this report can be embraced (which can be extended to all bovine sectors) of a sustainable forage-based milk production from a diverse range of systems, with all systems producing milk on a Carbon Positive basis by 2045: Scotland being the first country to do so. Scottish dairy farms are considered part of the solution to climate change and are highly valued for the food they produce and the environmental benefits they bring.

- The Scottish Government should instigate an ambitious long term land use, agriculture, food and health strategy for Scotland in collaboration with all stakeholders:

  - Develop a standardised basis for data collection and establish the baseline carbon footprint of Scottish agriculture (see Section 5 Establishing the Baseline);

  - Ensure carbon footprinting is meaningful and delivers real change, facilitate farmers to complete whole farm climate reviews with accompanying management plans which unlock access to funding to enable implementation in a cost effective and efficient way (see Section 5.3 Whole Farm Climate Reviews);

  - Implement, reward and prioritise research into sequestration activities and measures (see Section 6.2 Maximising the Positive - Carbon Sequestration);

  - Engage all those who have influence on the outcomes including academia (research and innovation), farmers, advisers, banks, consumers, processors, retailers and private business and encourage public private partnerships (see Section 8 Collective Drive for Change);

  - Scotland to be at forefront of research and innovation by establishing a Centre of Excellence (see Section 9.1 A Centre of Excellence). This Centre of Excellence should be used, among other things, to influence national outcomes such as:

    - regularly reviewing the smart inventory to enable further mitigation measures and sequestration to be accounted for and to improve the Scottish data are captured thus allowing more efficient targeting and utilisation of public funds;

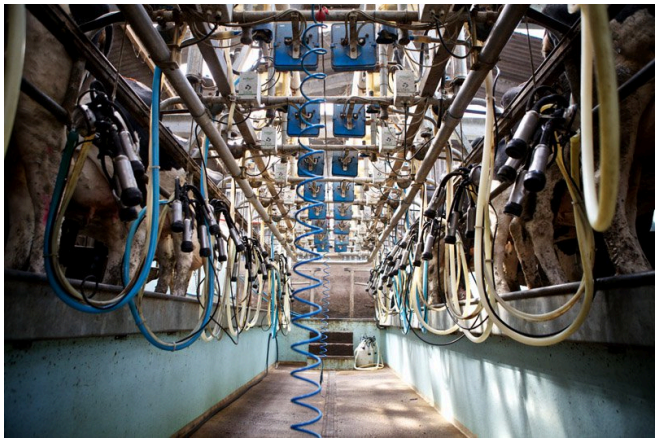
    - investigate the feasibility of a more sophisticated and equitable target system which more accurately reflects the multiple objectives delivered for society by agriculture;

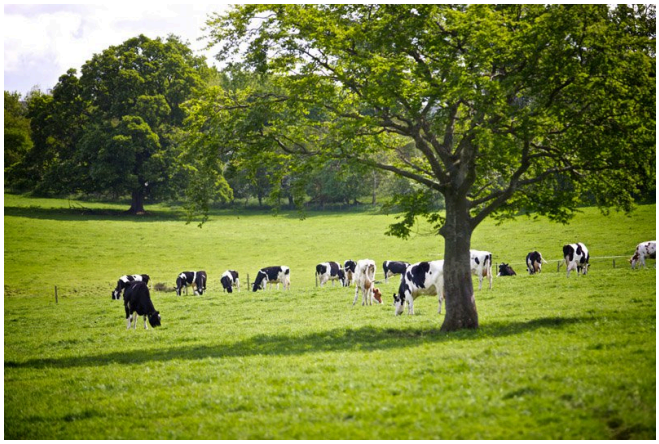
- bringing together public, private and industry expertise to accelerate the pace of innovation and research, as well as inform and educate all sectors of the industry and the wider public.

- Adopt integrated and inclusive approach to delivery – single implementation board of industry and government to develop transformational programme for Scottish agriculture post 2024 (see Section 10.2 Opportunity)

- Develop a Communication Strategy which sets the tone for culture change and empowers farmers to be seen as part of the solution (see Section 12 Communication).








2. Scope of the Report

This report was produced by the Scottish Dairy Sector Climate Change Group (DSCCG), which was appointed by the Cabinet Secretary Fergus Ewing in January 2021, one of five sectoral farmer-led groups. The Group consisted of twelve dairy farmers with a breadth of farming systems, scale and location across Scotland.

The DSCCG was tasked with considering and making recommendations in relation to practical measures as well as support mechanisms to help achieve:

- improved efficiency, productivity and profitability for the dairy sector in Scotland,
- enhanced environmental contribution from the sector through identification of practical ways in which net greenhouse gas emissions from the dairy sector can be reduced,
- mitigation of other environmental impacts of production and enhancing contribution to sustainable agriculture and land use including fertility, breeding and genetics and animal nutrition as well as soil health and grass land management.

The full scope, remit and membership of the DSCCG is set out in Annex 1 to this Report.

The Group held a number of meetings (virtually due to Covid-19 restrictions) and heard evidence from a number of experts in the fields of dairying, wider agriculture and climate change including government, industry leaders and academics. A full list of those who contributed to the Group are listed in Annex 2. We also issued two calls for evidence using Survey Monkey; one to farmers and the other processors. Both had a very tight deadline but we nevertheless had a very positive response to the farmer survey (almost 120 responses). The Farmer Survey Responses are summarised in Annex 3.

Due to time constraints the Group did not commission any new research but it did undertake a review of as much of the available, relevant research as was possible in the time given.

The Groups has also interacted with the other farmer-led groups via a number of meetings of the group Chairs which has enabled the Group to keep appraised of the progress of the other groups and their general direction of travel. A great deal of commonality and overlap exists between the groups.

3. Introduction and Background

The Scottish Government has committed to a legally binding target of net zero greenhouse gas (GHG) emissions by 2045[1], including a reduction of 75% by 2030 from 1990 levels. These targets are a result of the UK being a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) an international treaty signed in Paris in 2015. Other parts of the UK have equally committed to binding targets, albeit differing slightly from each other. The Scottish Government's recently updated Climate Change Plan (CCPU)[2] is the key policy tool used in Scotland to meet the targets and currently focuses on the period to 2032, and sectoral targets are framed accordingly.

The climate change challenge does not stand alone. It runs alongside many other, potentially competing, national and international priorities. In 2019, Scotland's agriculture industry contributed around £1.3 billion to the Scottish economy and employed 67,000 people. Agriculture serves our growing food and drink sector and the Scottish Government supports Scotland's food and drink Ambition 2030 target of doubling the value of the food and drink sector by 2030[3] to £30 billion. The Scottish Dairy Growth Board has set a vision for the Scottish dairy sector to increase from £800M in 2018 to £1.4bn by 2030[4].

The Scottish dairy sector has an important role and is committed to playing its part in helping to achieve climate change targets, whilst continuing to contribute to global food security with demand for food expected to double by 2050[5]. Innovation and further technological advancements will be required if these multiple objectives are to be achieved because achieving significant changes to dietary habits of the global population is not a feasible way to proceed in the timeframe under discussion.

It would be indefensible and counterproductive for a government proceed down a path of promoting domestic dietary change as a means of tackling GHG emissions while global demand for dairy products is rising and they can be more sustainably produced here than in other parts of the world. In effect, Scotland has a duty to meet the demand for sustainably produced nutritious food produced in a climate friendly way. Currently the commitments of the Intergovernmental Panel on Climate Change (the United Nations body for assessing the science related to climate change) are based on GHG arising from a country's production activities. So while globally the ideal may be to reduce cattle numbers in inefficient production systems and exporting meat/dairy to those parts of the world, this will require efficient and fair trade as well as a change in the accountability of individual countries (for example a consumption based inventory and some sort of production benchmarking and export/import accounting).

To achieve the government climate change targets, the Scottish Dairy Sector therefore faces the dual challenge to improve both its emission efficiency (the emissions required to produce a litre of milk or kilogram of beef) and reduce its absolute emissions. This dual challenge will inform and direct the future of support for dairy farming in Scotland and therefore all dairy farmers must be encouraged to get on board, whatever their starting point. Change is required and will need to be made at individual farmer and farm level. Government has an important role in facilitating and supporting that change for the benefit of society as a whole. We do not have the luxury of getting it wrong as time is not on our side.

This report will outline the steps we suggest are necessary for the dairy sector to make its contribution to the development and delivery of the next phase of Scottish agricultural policy.

[1] Climate Change (Emission Reduction Targets) (Scotland) Act 2019
[2] https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/
[3] Ambition 2030: Industry Strategy for Growth | Scotland Food and Drink
[4] Flipbook (scottishdairy.com)
[5] ca2929en.pdf (fao.org)

4. The Dairy Sector in Scotland

In 2019, there were 843 dairy farms in Scotland with a herd of 50 or more dairy cattle. More than a quarter of holdings have 150+ cows.[6] Dairy products (excluding dairy beef) accounted for 11% of agricultural output, mostly in sourthern Scotland with a value of £377 million. The majority of holdings (74%) are located in designated Less Favoured Areas (LFA).

Around 50% of dairy farms in 2018-19 returned a profit without support payments (albeit that profit, on average, was just £26,400 per holding). Even with support payments, only 60% were profitable. While the dairy sector is proportionately less reliant on support than other livestock sectors, the profitablility is still not high enough across the sector for many farmers to be in a position to invest significantly in technology or innovative management techniques without further public support.

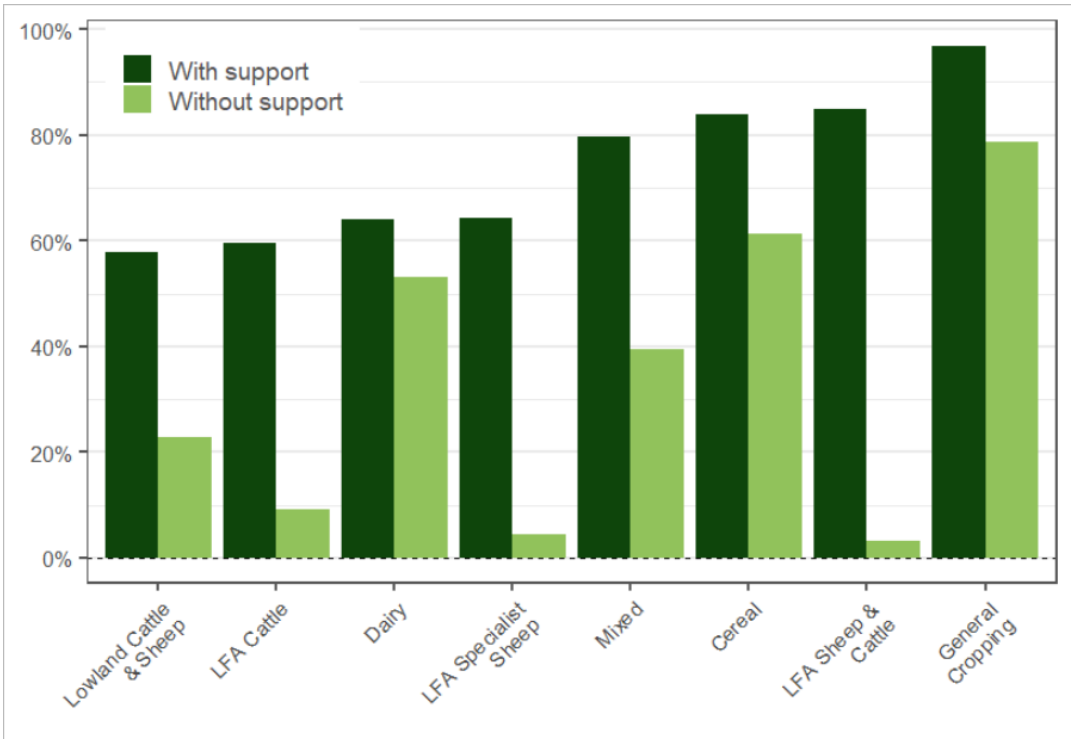


Figure 1 - Percentage of Farms with Profitability from Farming Greater than Zero with and without Support 2018-19 Scotland[7]

Dairy products are a rich source of essential nutrients that contribute to a healthy and nutritious diet. As a source of protein, milk has the lowest GHG intensity of all meat, meat products and fish products (kg CO2e/kg protein).[8] Scotland has some of the best milk fields in the world driven by an ideal climate, good farming practice, investment in on farm technology adoption and innovation[9], producing 1.5bn litres milk in 2019/20. Average Scottish dairy herds are the largest in the UK and the highest average yields.[10] As well as milk, dairy herds also produce over a quarter of Scotland's beef[11], through beef cross calves and cull cows, which has half the global warming potential of beef from the beef herd[12].

[6] Source: ERSA 2020, Table C11 *provisional figures. Available at: https://www.gov.scot/publications/economic-report-on-scottish-agriculture-tables-2020-edition/*
[7] Farm Business Survey 2018-2019: profitability of Scottish farming - gov.scot (www.gov.scot)
[8] Agriculture and climate change (mckinsey.com) p.24
[9] Scottish Dairy Growth Board.
[10] Balancing Scottish milk supplies | AHDB
[11] Stuart Ashworth, QMS.
[12] CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf (cielivestock.co.uk)

As a sector therefore, dairy delivers multiple public benefits but there is no doubt that it could do so in a more climate friendly way and with the right policy, support and funding framework.

Figure 2 - Extract from "Scottish Dairy: Rising to the Top 2030"

5. Establishing the Baseline

5.1. The Inventory and Targets

Accurate assessment of GHG emissions from agriculture is more challenging than for other sectors because of the need to quantify multiple inter-related biological production processes. The data on agricultural GHG emissions are compiled for all parts of the UK by a consortium of independent contractors and recorded in a national inventory which measures progress towards reduction targets. While there are three major GHGs (Carbon Dioxide, Methane and Nitrous Oxide) for ease of comparison, all GHGs are converted into Carbon Dioxide equivalents and split by sector of the economy. In 2018, the estimated emissions from agriculture made it the third largest emitter in the UK, behind transport and business.

As shown in

Figure 3, in 2018, total Scottish emissions were estimated to be 41.6 million tonnes of carbon dioxide equivalent (MtCO2e) and agriculture accounted for 7.5 MtCO2e so an 18% share of total emissions. Only very approximate figures can be provided within the inventory for the dairy sector, which crudely estimate dairy cattle contributed 1.17 MtCO2e or 16% of agricultural emissions.

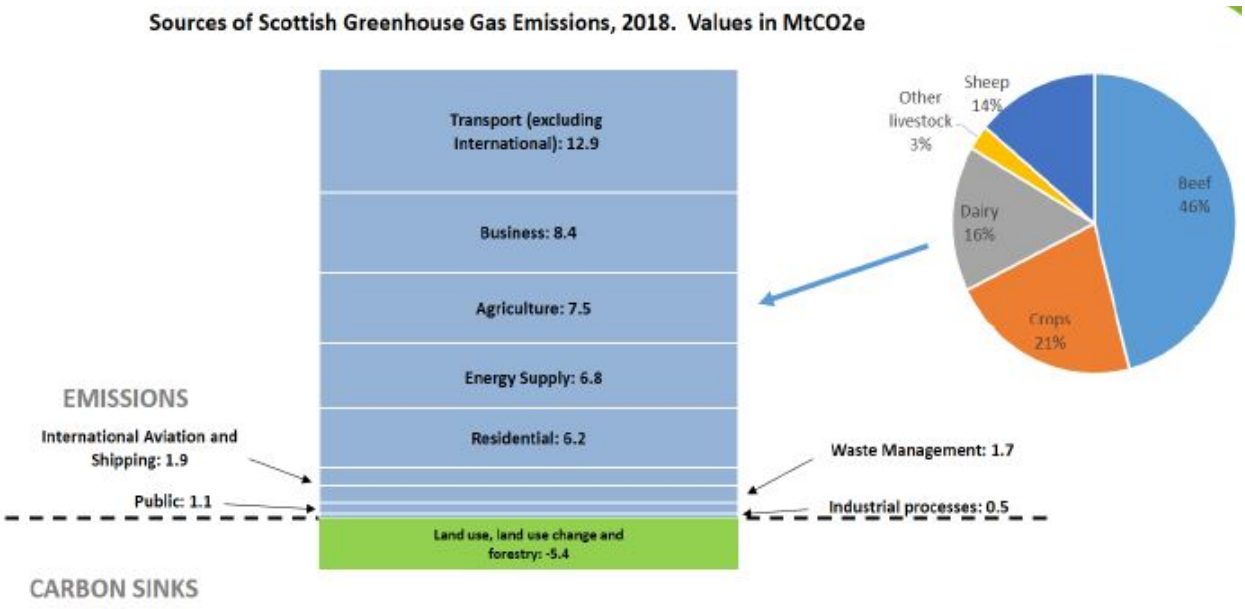


Figure 3- Sources of Scottish GHG Emissions, 2018 values in MtCO2e[13]

The approach by Scottish Government is to disaggregate the total emissions and create industry specific targets accordingly. The sectoral envelope for Scottish agriculture set out in the CCPu requires it to reduce its emissions to 5.3 MtCO2e by 2032, a 31% reduction from 2018 levels (which would require reduction at four times the pace of historic reductions). Whilst such stark targets may increase the urgency of action, we suggest it is too blunt a tool which does not adequately reflect the multiple priorities delivered by agriculture nor the negative outcomes of the alternatives for feeding the population. For example, it may appear in theory a simple solution to drastically reduce cattle numbers to meet an otherwise seemingly impossible target reduction in emissions, but this takes no account of the economic and social significance of livestock farming to Scotland plc, its infrastructure, the health and welfare of its people and landscapes.

[13] https://www.gov.scot/publications/scottish-greenhouse-gas-emissions-2018/pages/3/

In our view, it is only when the industry baseline has been established that sectoral targets could be considered, but not if the complexity incorporates greater uncertainty and undermines confidence in the process. Benchmarking will play an important role in delivering change and target achievement, and as the information will be specific to each farm it will be of the greatest relevance.

Whatever the arguments regarding targets, the inventory is an important tool because it guides us in terms of which emission reduction activities (mitigation measures) will make a difference in terms of reducing the total emissions contributed by agriculture and the UK inventory results are the ones reported to the IPCC, by which compliance with international agreements are evaluated. There is no doubt there is room for improvement. As emissions by other sectors reduce, the spotlight may increasingly shine on agriculture, however, a tendency for reductive bias may increase pressure on dietary change away from meat and dairy consumption as a means of tackling the problem.

Some activities farmers may undertake which improve their carbon footprint, such as renewable energy generation, may not be reflected in the agriculture section of the inventory and therefore those activities are not credited in agriculture target. Equally, the carbon stored in soil contributes towards the positive side of the inventory but this is not offset against the agricultural emissions section.

While the Scottish Government cannot unilaterally amend the inventory, it should influence how it develops to properly reflect Scottish agriculture. The inventory is not a static document and it must evolve with technology and research. For example, the methodology for agriculture has recently changed to reflect management practices and is called the "smart inventory". However, the smart inventory still only reflects mitigation activity for which there is robust data and analysis so further work must be done in this area to properly reflect Scottish agriculture and ensure adequate Scottish data is included. The data collected during the baselining exercise should be made available and feed into inventory reviews.

Recommendations

- Prioritisation of the continuous improvement of the 'smart inventory' to increase accuracy for emissions and sequestration within Scottish agriculture.

Refer to Annex 4 – Recommendations and Support Required

5.2. Carbon Footprint Audits - Standardising the Data Collection

Understanding the contribution to emissions is a first step towards defining low-carbon pathways.[14] Farm level carbon auditing is recognised as one method to achieve this[15]. Within the dairy sector, a significant proportion of dairy farms have carbon audited, some annually for a number of years. However, to date these audits have been carried out using different models (of which over 64 have been identified[16]), with differing comprehensiveness and practicality. Whilst all the models are required to operate to the same international standard (IPPC, PAC2050), there is no standardised collation of this data and going forward this should be a priority.

For the dairy sector, and agriculture as a whole, to measure its improvement there needs to be a standard baseline established. Given the complex interactions between sectors, this cannot be sector specific. For the data to be meaningful and robust, it would need to be a single auditing tool used, in a defined timescale and independently inputted. In addition, further baseline inputs should be considered, such as soil carbon, biodiversity, water quality and ammonia emissions.

[14] ca2929en.pdf (fao.org)
[15] Farm-based carbon audits - FINAL (climatexchange.org.uk)
[16] Farm-based carbon audits - FINAL (climatexchange.org.uk)

Work must be prioritised to increase the level of transparency, accuracy and sophistication of the auditing tools, particularly with regard to mitigation and off-setting. A modular tool which can differentiate between mitigation measures already captured in the smart inventory (see Figure 9) as well as those for this more robust data or analysis is needed is required in terms of achieving multiple benefits from the audits including ongoing improvements to the smart inventory for agriculture.

Carbon footprinting is, like all modelling, based upon assumptions and some will be more accurate than others. We must also acknowledge the limitations within the auditing tools and the confidence intervals of the assumptions. Similarly, there will also be interactions between measures, and the ability of the tools to correctly reflect these interactions needs to be explored.

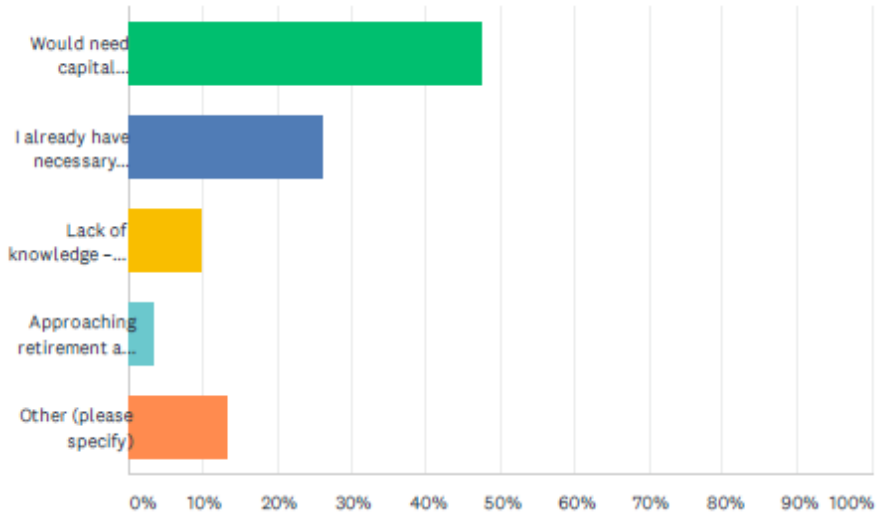
While acknowledging there is ongoing work to be done in terms of the auditing tools, the process of setting the baseline should be commenced as soon as possible. A pilot scheme should be initiated selecting one of the currently available tools, informed by an updated review of the main carbon footprinting tools[17]. For many farmers already participating in carbon auditing, for example in conjunction with their milk buyer, this would result in duplication of effort. However, with action to standardise the data and assumptions of available tools, this duplication could be minimised thereafter. An analogy could be the health care system where the freely available national system is open to all but others may choose to bolt on or adapt an enhanced tool if they wish, although all should meet a standard.

Experience from other parts of the world should be drawn upon – for example New Zealand has developed the Overseer tool which feeds into a database the government can access[18] as well as a user-friendly suite of documents and standardised carbon calculator tool for use by farmers[19]. However, to ensure the robustness of the data and credibility of the baseline, a suitably trained third party should be used to collect and input the data on farm, at least initially. As knowledge transfer and training programmes progress, then a system could be considered where data is primarily collected by the farmer but with spot checks and inspections for a random sample to ensure accountability and credibility is preserved.

The baseline data for each farm should also be presented in an adaptive way to allow farmers to carry out scenario analysis, so they can measure the impact implementation of possible measures would make. Thereby focussing efforts on the measures that would have most impact for their system.

Our farmer survey revealed that around two thirds of dairy farmers had already carried out a carbon audit (although for nearly 20% more than a year ago) or were planning to do so. Most had done so as a requirement of their milk buyer's contract but worryingly, half of those who had carried out an audit had not made any changes as a result. Of those, the main reason for lack of action was the need for capital investment/ lack of funding but lack of knowledge was also a factor (Figure 4).

[17] Farm-based carbon audits - FINAL (climatexchange.org.uk)
[18] https://www.overseer.org.nz/
[19] https://www.mfe.govt.nz/climate-change/guidance-measuring-emissions



ANSWER CHOICES	RESPONSES
Would need capital investment/lack of funding	47.54%
I already have necessary practices and measures in place	26.23%
Lack of knowledge – don't know where to start	9.84%
Approaching retirement and not planning to make any changes	3.28%
Other (please specify)	13.11%

Figure 4 - Responses from DSCCG Survey

The results of our survey confirm that setting the baseline should be accompanied by the appropriate support, training, planning tools and funding to ensure targeted action is taken at farm level and that the carbon audit does not simply become a tick box exercise.

Recommendations

- Standardisation and transparency of existing carbon footprinting tools.
- Consistent and widespread whole industry carbon auditing, to provide a baseline from which to measure improvement and help improve the inventory.
- Development of scenario planning within the auditing tool to enable farmers and advisers to measure impact of measures on their footprint before implementation, and benchmarking of results.

Refer to Annex 4 – Recommendations and Support Required

5.3. Whole Farm Climate Reviews

A carbon audit is a good start to assessing the baseline carbon footprint for Scottish agriculture but if the exercise is to result in real change at farm level then we believe the carbon audit should be one part of a wider suite of training, planning and measures that every farm should undertake as a gateway to further funding. We have called this a "Whole Farm Climate Review". Adopting a strategy that considers the entire production system leads to cumulative gains across multiple areas and results in a more significant reduction in carbon footprint[20].

A whole farm approach also considers interaction between measures, some providing enhanced benefits when implemented jointly (e.g., genomics and breeding), others mutually dependent to deliver mitigation (e.g., covering slurry stores must be accompanied by low emission spreading

[20] DairyGlobal - Redefining efficiency: More milk, lower carbon footprint

techniques) and some non-additive in their mitigation potential (e.g., 3NOP feed additive and breeding for low methane emissions). There is a lack of quantitative evidence of the cumulative and interactive effects of implementing multiple mitigation strategies on GHG emissions[21], but this can be informed by life cycle analysis[22] to provide a holistic framework and consider the wider supply chain implications, e.g., sustainable purchased feed sources, efficiency of purchased replacements.

Significant reductions in emissions and improvements in emissions intensity can be achieved through best practice and increasing efficiencies across a farm business no matter what the system. The cumulative effect of a particular combination of mitigation and efficiency measures needs to be understood at individual farm level. The optimum position will be different for each farm.

Figure 5 - A Holistic Approach - The Whole Farm Climate Review

There are integrated farm management tools already available so many farmers are familiar with the concept, but we believe that a Whole Farm Climate Review tool should be developed in a modular way so that each farm can adapt the review to its own circumstances and produce the optimum plan

[21] Science report highlights challenge in meeting UK net zero carbon goals for livestock | CIEL (cielivestock.co.uk)
[22] Comparing Carbon Footprint and Life Cycle Analyses (thebalancesmb.com)

for the business to achieve its best outcome in terms of emission reductions and emission intensity and help identify business and funding opportunities.

Once the farm level situation is understood and measured, farmers must be able to benchmark their emissions with others and forecast the effect of possible interventions both for emission reductions and offsetting. With farm assurance and cross compliance requirements focussing on the delivery of soil/silage/slurry analysis, animal health plans and nutrient budget, consideration needs to be given as to the collation and benchmarking of this data. The benefit to the farmer needs to be at the heart of the objective, by avoiding a tick box list of reports and focussing on delivering meaningful information to enable change.

The Whole Farm Climate Review would also provide the gateway to future capital funding with mitigation priorities identified as part of the strategic review. It would be a living document with periodic reviews and updating, with continued funding to support the process.

A full life cycle analysis of a selection of dairy farms would consider the wider interactions between sectors and supply chains.

Recommendations

- Whole Farm Climate Review available to all farms to analyse the baseline data, provide benchmarking, and identify areas for action. This would be the gateway to future capital funding.
- Full life cycle analysis of a selection of dairy farms to consider the wider interactions between sectors and supply chains, and international comparisons.

Refer to Annex 4 – Recommendations and Support Required

6. A Balancing Act

Achieving net zero will require realigning the balance between the negative (GHG emissions and emissions intensity) and the positive (carbon storage and sequestration). We need to look at the activities across the whole farm as well as collaboration and interactions on a community and regional basis to realign the balance.

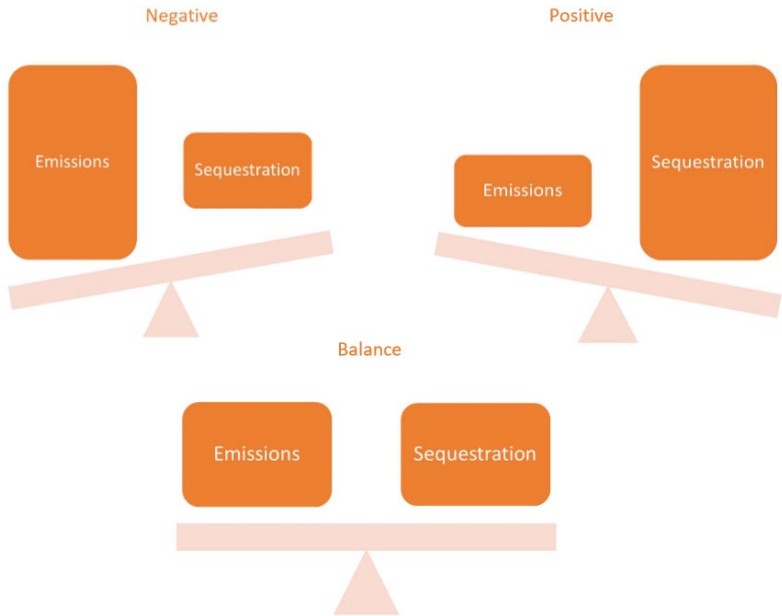


Figure 6 - The Carbon Balance (AHDB, ADAS) [23]

[23] AHDB - Dispelling the myths about carbon sequestration

6.1. Minimising the Negative - Mitigation and Abatement

Figure 7 below illustrates how the emissions from dairy break down by source. Enteric fermentation (the process in which livestock produce methane via digestion) is the largest source contributing to 45% of dairy emissions. The next largest source is manure management.

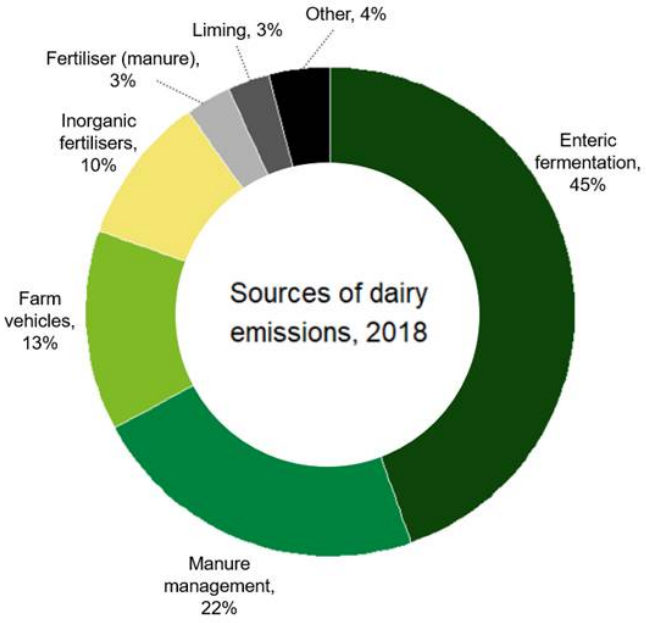


Figure 7 - Emissions from Scottish Dairy 2018 Gov.Scot

According to the CCPu, the Scottish Government anticipates that by 2032 the agriculture sector will have adopted and be competently using all available low emission technologies throughout the whole sector. Scottish Dairy's "Rising to the Top 2030"[24] supports this ambition and sets staged targets along the way (**Error! Reference source not found.**). This will require full buy-in from the dairy sector as well as alignment of policy, funding and other forms of advice and support.

Figure 8 - Extract from Scottish Dairy, Rising to the Top 2030

There are numerous potential ways of reducing emissions in the agriculture and land use sector. A review in 2015, identified 181 separate mitigation measures[25]. Of these, 71 measures were reviewed by a group of experts considering the likely abatement potential, practical feasibility, and

[24] https://scotlandfoodanddrink.blob.core.windows.net//media/4211/scottish-dairy-brochure-21.pdf
[25] OECD iLibrary | Cost-Effectiveness of Greenhouse Gas Mitigation Measures for Agriculture: A Literature Review (oecd-ilibrary.org)

the risk of negative co-effects and 24 measures were selected for further analysis, along with 7 additional measures.[26].

Most recently, the Climate Change Committee in their 6th Carbon Budget[27], published in December 2020, and with reference to ongoing research by Defra (Delivering Clean Growth through Sustainable Intensification), this has been further focussed into 18 measures, with 15 of these relevant to dairy farming. These measures are summarised in Figure 9 below (shown in grey). Additional measures have been included from work commissioned by AHDB[28] and the Climate Exchange Report into mitigation technologies and practices in Scotland[29] (both shown in white). The measures in Figure 9 outlined in green have been identified as not included in the 'smart inventory' or more Scottish data is required to improve accuracy.[30]

Reports form the other farmer led sector groups will also summarise various mitigation measures with varying eight attributed to them depending on the sector. There is a significant degree of overlap therefore between the sectors when it comes to mitigation. We have tried to focus on those measures most relevant to the dairy sector but knowledge can be drawn from the other farmer led reports too.

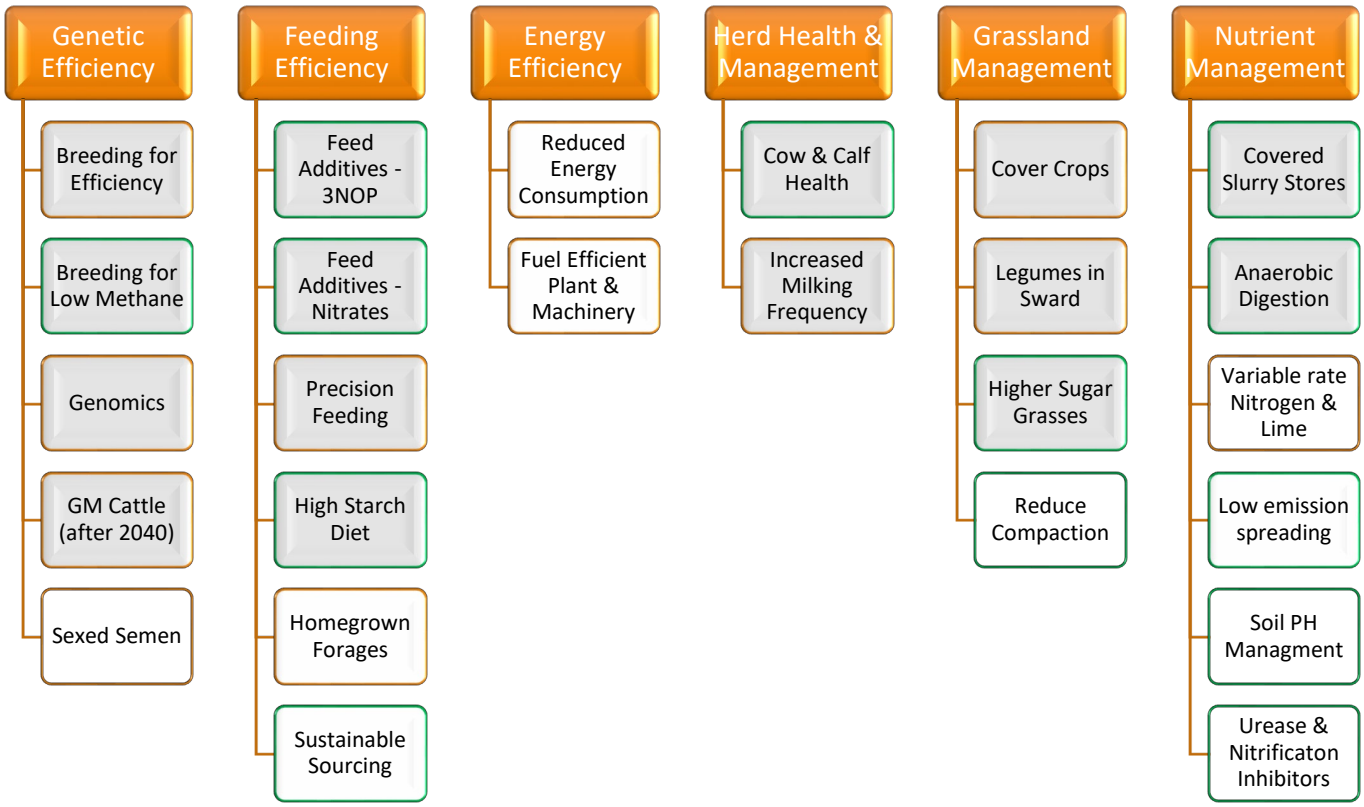


Figure 9 - Summary of Mitigation Measures for Dairy

6.1.1. Genetic Efficiency

[26] Review and update of the UK agriculture marginal abatement cost curves (SRUC, Ricardo Energy) - Climate Change Committee (theccc.org.uk)
[27] Sector-summary-Agriculture-land-use-land-use-change-forestry.pdf (theccc.org.uk)
[28] AHDB, Promar – Evidence for Farming Initiative Greenhouse Gas Reduction and Carbon Storage on Dairy Farms (November 2020)
[29] Marginal abatement cost curve for Scottish agriculture (climatexchange.org.uk)
[30] Mitigation measures in the 'smart inventory': Practical abatement potential in Scottish agriculture (climatexchange.org.uk)

Genetic improvement of cattle produces permanent and cumulative changes in performance, by improving productivity and efficiency, reducing wastage in the farming system and directly selecting on emissions. Selecting on traits that improve the efficiency of the system (e.g., feed conversion efficiency, longevity) will also have a favourable effect on the overall emissions, assuming no increase in production.

There has been widespread uptake of genetic improvement in the Scottish dairy herd, with the use of artificial insemination, increasing use of sexed semen and more recently genomic testing. This improvement in genetic potential has led to a decline in the national herd and an increase in milk output. Direct selection for reduced GHG emissions continues to rely on selection of traits that have a correlated effect on emissions, but increased research into direct methane emissions will help improve this.

The increasing use of sexed semen is improving efficiency by reducing wastage (male dairy calves), increasing the proportion of pure dairy calves that are female and increasing the number of beef cross calves for rearing as beef animals. Increasing the number of beef cross calves means that fewer suckler cows are required to produce the same total beef output, thereby reducing the total emissions and the emissions per kg of beef produced.

Genomic testing of youngstock gives greater accuracy in selecting youngstock from which to breed replacement heifers, allowing evaluation of the mixture of genes that have been passed down from both parents. Gene editing for production traits, health/resistance traits and potentially GHG emissions would speed up the traditional gene selection, and has been identified by the Climate Change Committee as a mitigation measure post 2040.

Recommendations

- Consideration of support for genomic testing as part of a breeding programme
- Prioritised research into breeding selection for GHG emissions including an examination of any barriers to use breeding indices e.g. not matching farming goals.

Refer to Annex 4 – Recommendations and Support Required

6.1.2. Feeding Efficiency

Enteric emissions of methane are the largest source of GHG emissions from dairy herds, contributing to 45% of their emissions. Adapting feeding strategies can help reduce emissions through:

- Precision Feeding – In-parlour/robot feeding and/or out-of-parlour feeding, targeted at individual cow dietary requirements (e.g., stage of lactation). Solutions likely to be system and farm specific.

- High Starch Diet – A high starch diet increases the digestible energy content of the diet and is achieved by feeding more maize silage and reducing grass silage. However, maize cultivation area in Scotland is limited so more work is required to explore alternatives such as whole crop or other starch sources suitable to Scotland.

- Feed Additives - 3NOP is a chemical that reduces the excretion of enteric methane by ruminants when added to their feed ration or introduced via a bolus, however, is not yet approved for use. Nitrates can also be added to TMR (total mixed rations) to reduce emissions. More recent research into feeding the seaweed *Asparagopsis taxiformis* has had very positive methane reduction results, although the environmental effects of sourcing the seaweed needs to be

looked at too[31].

- Improving Home-Grown Feed Quality – Improving the digestibility and quality of home-grown forages will increase feed conversion efficiency and in turn increase emissions efficiency and increase profitability.

- Sustainable Sourcing of Feeds – Sustainability of purchased feed will improve the life cycle analysis of dairy products and dairy beef. Sourcing locally will reduce transportation, utilisation of co- and bi-products will reduce waste and sustainable sourcing of imported feed will reduce environmental costs. However, local sourcing will only improve GHG emissions if the feed is produced as GHG efficiently as the non-local alternatives, given that transportation emissions are small part of the emissions.

- With the urgency of delivery on emissions abatement and the evolving science, contingency should be made for some new measures to have negative productivity outcomes e.g. feed additives, methane inhibitors, rumen microbiome adjustments. This would reduce emissions efficiency but may reduce absolute emissions and compensation for income foregone in these circumstances should be allowed for.

Recommendations
- Capital support for feeding efficiency measures
- Robust research into feed additives for reduced methane emissions in Scottish herds
- Prioritise research into alternatives to maize such as whole crop or other varieties suitable to Scotland.

Refer to Annex 4 – Recommendations and Support Required

6.1.3. Energy Efficiency

Dairy unit power requirements are generally high. Since electricity production emits carbon dioxide as opposed to more potent climate change gases such as methane and nitrous oxide, the impact on the dairy unit carbon footprint is less. However, there does remain some opportunity to reduce emissions from the dairy unit and potentially significant cost savings, such as more effective milk cooling, heat recovery units, matching equipment size to demand, checking insulation and thermostat settings, variable speed vacuum/milk pumps, LED lighting etc.

There are also opportunities to reduce fuel consumption on farm with fuel efficient machinery, efficient use of machinery (e.g., reduced idling time, optimising power bands) and in the future, use of alternative fuel sources e.g., electric, biofuel, hydrogen etc. The role of contractors in delivering the fuel efficiency outcomes also needs to be considered. Smart recording apps for machinery and contractors will help measure outcomes.

Recommendations
- Capital support for energy efficiency investments
- Removal of barriers to renewable energy investment on farm

Refer to Annex 4 – Recommendations and Support Required

[31] Red seaweed (Asparagopsis taxiformis) supplementation reduces enteric methane by over 80 percent in beef steers (plos.org)

6.1.4. Herd Health and Management

Improving herd health is a very broad measure, encompassing a variety of livestock management, disease prevention and treatment options. Endemic cattle diseases have a negative effect on dairy cattle production and productivity, and consequential impacts on GHG emissions. This typically stems from: increased mortality, depressed milk production, increased waste from discarded treatment milk and reduced reproductive performance. IBR (Infectious Bovine Rhinotracheitis), Salmonellosis and Johne's disease all present challenges for the dairy sector.

Mastitis is globally the most economically significant disease of dairy cattle, and if controlled has the potential to reduce GHG intensity in UK herds by 6% on average, and 12% for the worst affected of herds. Similarly, improved reproductive performance through managing infertility could reduce GHG intensity in UK herds by 7% on average and 16% on the worst affected herds.[32] Successful treatment of lameness has also been shown to reduce emissions intensity by 1-8%, depending on the prevalence of disease[33]. Aside from the obvious welfare gains, improved cow health also increases its longevity, reducing replacement rates and improving its climate efficiency.

Health of youngstock is also important to ensure heifers calve down at 24 months and beef cross calves finish as early as possible, thereby reducing their emissions intensity.

There are very significant challenges in accounting for animal health improvement measures within current inventory reporting methods. However, authenticated key performance indicators could be collated to allow the effects to be included[34].

Improving herd health improves productivity and profitability. Similarly, increasing the milking frequency from twice to three times a day can reduce nitrous oxide emissions. More milking increases the nitrogen utilisation of the cow, which leads to a fall in nitrogen excretion[35]. Milk yields would increase, although components could reduce partially offsetting the gains when expressed as kgCO2e/litre energy correct milk (ECM).

Recommendations

- Capital support for health and fertility improvement measures.
- Capital support for robotic milking systems and parlour improvements to allow 3x milking.
- Development of key performance indicator matrix and collation to inform inventory and measure improvements.

Refer to Annex 4 – Recommendations and Support Required

6.1.5. Grassland Management

Improved grassland management to increase grass yields will reduce emissions intensity and potentially reduce the land requirement for grass, providing opportunity for sequestration and biodiversity land use. In addition, specific mitigation measures have been identified for grassland:

- Cover crops – These are crops sown after harvest of cereals, oil seed rape and other arable crops harvested in late summer. Catch/cover crops may be grown to reduce the risk of nitrate leaching over winter, reduce the risk of soil erosion, improve soil structure, increase carbon sequestration and provide a source of N to the subsequent spring-sown crop.

- Legumes - N fixing crops (legumes) form symbiotic relationships with bacteria in the soil that allows them to fix atmospheric N and use this in place of N provided by synthetic fertilisers. In

[32] Dairy-Cattle-Health-and-GHG-Emissions-Pilot-Study-Report.pdf (dairysustainabilityframework.org)
[33] Marginal abatement cost curve for Scottish agriculture (climatexchange.org.uk)
[34] Dairy-Cattle-Health-and-GHG-Emissions-Pilot-Study-Report.pdf (dairysustainabilityframework.org)
[35] Sector-summary-Agriculture-land-use-land-use-change-forestry.pdf

the legume-grass mixtures the leguminous crops (e.g. white clover) can provide a substantial part of the grass's N requirements, reducing the need for N fertilisation. This measure is about increasing the legume-grass mix areas on grasslands and increasing the proportion of legumes in the mixture. The benefits of multi-species swards should also be explored, not only for potential carbon benefits but also biodiversity.

- High Sugar Grasses - Perennial ryegrass diploids with elevated concentrations of water-soluble carbohydrate (WSC), commonly termed 'high-sugar grasses' (HSGs), have been promoted as a tool for increasing the efficiency of the use of protein (N) in the rumen and thus offering scope for increasing milk production and animal growth rates, while reducing N losses (in the form of urine) to the environment.[36]

- Soil Compaction – Compaction of soils has been reported to increase N2O emissions and strongly reduce the soil's ability to sequester carbon (see Carbon Sequestration). Prevention of soil compaction requires better planning of field operations to avoid traffic on wet soil, avoiding or strongly reducing tillage of wet soil and reducing stocking density.

Recommendations
- Research and demonstration of best grassland management practice within different dairying systems in Scotland, with capital assistance for equipment needed.

Refer to Annex 4 – Recommendations and Support Required

6.1.6. Nutrient Management

Organic manures applied to agricultural land are valuable sources of organic matter and plant nutrients. Careful storage, sufficient capacity and precise application to land allows their nutrient value to be used for the benefit of crops and soils, and significant reduction in the use of inorganic fertilisers.

- Covered Slurry Stores – Animal excreta stored in liquid systems is a source of substantial ammonia and methane emissions. Several factors affect the rate of ammonia, methane and nitrous oxide emissions, including the airflow over the manure; by covering the stores these emissions can be reduced. The presence of a slurry cover increases the ammonia concentration in the slurry, and hence its nitrogen and fertiliser value.

- Anaerobic Digestion - Anaerobic digestion (AD) of slurries has a GHG reduction potential outweighing that from improved storage of slurries and manures. Methane emissions from the storage of slurries and manures are reduced and the methane generated from livestock manures during AD can be used to produce heat and power to replace fossil fuel use. In addition, there is the potential to increase nitrogen use efficiency and reduce the required quantity of manufactured fertiliser if the digestate is subsequently spread to the land. However, significant start-up and running costs are barriers to uptake. [37]

- Variable Rate Applications - The use of techniques such as variable rate fertiliser and lime spreading and GPS soil testing can lower the amount of excess nitrogen applied to fields. This in turn can reduce the GHG emissions as well as reducing risk of nitrates entering watercourses through run off and limit the impacts on air quality through reduced ammonia emissions.[38] Precision lime application takes account of often large gradients in pH within fields, applying lime with variable rate applicators on a spatial basis according to pH balancing requirement.

[36] (PDF) High-sugar grasses (researchgate.net)
[37] GHG indicator 9 (publishing.service.gov.uk)
[38] Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3) - gov.scot (www.gov.scot)

- Low Emissions Spreading – Slurry application using techniques such as bandspreading and injection, reduce emissions compared to splash plate spreading. Ammonia emissions are mitigated, although direct emissions of nitrous oxide can increase.

- Soil pH Management – Soil surveys in Scotland show that many areas have soils that are too acidic, which compromises crop growth, reducing yield and increases the proportion of nitrogen fertiliser emitted as nitrous oxide. Soil pH requires regular soil testing and lime applications where necessary.

- Urease and Nitrificaton Inhibitors – Nitrous oxide emissions from nitrifying bacteria can be inhibited by certain chemical compounds, which increased the nitrogen availability in soils and reduces nitrous oxide emissions. Similarly, ammonia emissions can be generated by bacterial action on urea-based fertilisers. Inhibitors applied with fertilisers or mixed into slurry prior to application can reduce emissions.[39]

Recommendations
- Capital support for increased slurry storage, slurry store covers, low emission spreading equipment, variable rate application equipment, flexible tyres.
- Support for soil sampling to enable field mapping and soil carbon measurement.
- Capital support for removal of barriers to anaerobic digestion for slurry and establishment costs.

Refer to Annex 4 – Recommendations and Support Required

6.2. Maximising the Positive - Carbon Sequestration

Mitigation alone will not achieve net zero in dairy farming. Gross emissions from cattle cannot be reduced to zero due to the natural biological processes such as enteric fermentation. However, carbon sequestration by the natural landscape and other approaches to remove GHG from the atmosphere can contribute to balancing the emissions[40]. This sequestration needs to be included in carbon auditing, recorded in the inventory and credited to the agriculture industry. However, it is widely acknowledged that more research and agreement on measurement is needed.

Recommendations
- Prioritisation of research into methods of including measurement of carbon sequestration in carbon auditing tools, which could also inform inventory reporting.

Refer to Annex 4 – Recommendations and Support Required

6.2.1. Soil Carbon

Soils hold three times the amount of carbon currently in the atmosphere or almost four times the amount held in living matter. Because soils have such a large storage capacity, enhancing soil storage by even a few percentage points makes a big difference[41]. There are knowledge gaps and challenges that hinder the upscaling and widespread deployment of soil carbon management, as acknowledged by the IPPC, and addressing these issues must be an urgent priority[42].

Opportunities exist to use agricultural management to increase carbon storage in agricultural soils[43], for example through conservation management practices such as reduced cultivations and compactions. However, there are uncertainties in the amount of carbon that can be sequestered by

[39] Marginal abatement cost curve for Scottish agriculture (climatexchange.org.uk)
[40] CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf (cielivestock.co.uk)
[41] Fact Sheet: Soil Carbon Sequestration | American University, Washington, DC
[42] Summary for Policymakers — Special Report on Climate Change and Land (ipcc.ch)
[43] soil-carbon-and-land-use-in-scotland.pdf (climatexchange.org.uk)

restoration of organic soils, rotational grass, the future carbon sequestration potentials of long-term grasslands and arable soils[44], and further research is needed.

There is some evidence that suggests there have been no significant changes in the storage of carbon taking place in arable or grassland soils in 40 years. However, soil carbon can accumulate for over three decades with no evidence within permanent pastures, highlighting the complexity of the issue and the urgent need for greater understanding[45].

Nevertheless, it must be acknowledged that Scottish soils on many dairy farms are relatively rich in carbon, so the opportunities for further sequestration are more limited, although protection is vital. Opportunities to transfer organic carbon produced on dairy farms to soils with depleted levels, for example in more arable areas, need to be explored (see Figure 10)

Figure 10 - Typical Soil Carbon Content (Approximate), AHDB, ADAS

Figure 10**Error! Reference source not found.** also demonstrates that restoration of peat soils has the opportunity to sequester large amounts of carbon, and as such their protection and restoration is also vital. This measure will be restricted to those dairy farms with peatland soils.

Aside from the uncertainties, it is widely accepted that enhancing soil health through improved physical structure and microbial activity, will improve productivity and reduce inorganic inputs, as well as improved drought resistance and water retention. Research has shown that animal manures are the best approach to return carbon and improve soil health[46].

Recommendations

- Demonstration of best practice in soil carbon management and soil health.
- Funding for restoration and protection of peat soils (where applicable).
- Prioritisation of research into soil sequestration measurement and improvement techniques on farm.

Refer to Annex 4 – Recommendations and Support Required

6.2.2. Afforestation

Enhanced carbon sequestration by trees on agricultural land can be achieved by afforestation, woodland management, agroforestry and hedgerow planting. Additional benefits of woodland on agricultural land can be the provision of shade and shelter, the reduction of ammonia emissions, enhancement of biodiversity, improved water management and potential additional income from fuel and timber production[47].

There is a strong evidence base for the sequestration potential from planting trees. However, as demonstrated in Figure 10 demonstrates it is important that trees are planted in the right places to

[44] soil-carbon-and-land-use-in-scotland.pdf (climatexchange.org.uk)
[45] Sites — ECOLOGICAL CONTINUITY TRUST -
[46] Effects of recent and accumulated livestock manure carbon additions on soil fertility and quality : Rothamsted Research
[47] CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf (cielivestock.co.uk)

ensure carbon is not lost (e.g., not on peatland or unimproved permanent grassland). Tree planting on more productive arable and improved grassland delivers greater carbon benefits but is in competition with the agricultural productivity of the land and has long-term implications. Hedgerow planting and agroforestry can offer mutually beneficial outcomes.

Recommendations

- Greater incentivisation of smaller scale tree and hedgerow/corridor planting, with the sequestration captured in the carbon audits and inventory for agriculture.
- Demonstration and practical advice for planting, for both biodiversity and carbon sequestration benefits.

Refer to Annex 4 – Recommendations and Support Required

6.3. Biochar and New Carbon Capture Technologies

Biochar is produced by treating organic matter with heat in low or zero oxygen environments (pyrolysis or gasification) to create a charcoal like product which can stabilise organic matter when added to soil. However, there are concerns of its use in UK soils and climate, and the feasibility of incorporating biochar into soils to the extent that it would have an impact on climate change, e.g. accumulation of heavy metals and other compounds[48].

Innovations in carbon capture technology and storage offer huge potential[49], for example, Direct Air Capture and Carbon Storage (DACCS) and Bioenergy with Carbon Storage (BECCS). They offer strong potential for carbon capture but at high relative cost[50], with further research needed before they offer viable solutions.

Recommendations

- Research into the viability of the use Biochar in Scotland for climate change mitigation.
- Participation in international efforts to explore new and develop existing carbon capture technologies.

Refer to Annex 4 – Recommendations and Support Required

Photo credit: FAS.Scot

[48] Biochar and climate change - House of Commons Library (parliament.uk)
[49] Carbon Capture and Storage Technology - an overview | ScienceDirect Topics
[50] CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf (cielivestock.co.uk)

7. Opportunity and Innovation

7.1. GWP^{100} vs GWP*

GWP^{100} is a system to try to level the global warming potential of greenhouse gases over a 100-year period, becoming the industry-standard approach (IPPC). Carbon dioxide has a score of 1; methane, 28; nitrous oxide, 265, i.e., methane is 28 times more potent than 1kg of carbon dioxide over 100 years. However, carbon dioxide is a long-lived climate pollutant and a stock gas, accumulating continuously in the atmosphere. Whereas methane is a flow gas, as it is being destroyed as it is being added that is broken down in the atmosphere within 10 – 15 years. The warming impact of methane is not determined by how much is being emitted, but by how much more or less methane is being emitted over a period of time. Consequently, warming is neutral if methane emissions stay constant. However, there is growing evidence supporting an alternative to GWP100 to measure short-lived greenhouse gases, referred to as GWP*, taking into consideration the differences in how short-lived climate pollutants and long-lived climate pollutants warm the atmosphere.[51]

However, it is important to note that, under GWP*, even a minor sustained increase in methane emissions over short periods of time will exponentially increase the climate change related burdens associated with methane relative to what would be expected under GWP^{100} calculations.[52] The decision on whether to use GWP* instead of GWP^{100} values is due to be debated at the upcoming COP26 Climate Summit in Glasgow.

Recommendations

- Active participation by government and industry in the GWP* debate, with further research into the implications for the dairy sector and the supply chain.

Refer to Annex 4 – Recommendations and Support Required

7.2. Low emission export opportunities:

Emissions arising from goods produced in Scotland and exported overseas for consumption are counted in the Scottish GHG inventory. Conversely, emissions arising from goods produced overseas and imported into Scotland for consumption are not in the Scottish inventory. This presents a challenge in terms of achieving global emissions targets and the tensions between that and national inventories and targets. The proposed Life Cycle Analysis of a sample of dairy farms (Section 5.3) would help to quantify these challenges for the dairy sector and highlight opportunities for resolution.

To meet both the 2030 Scottish Dairy ambitions and meet the emission targets of the country, Scottish dairy farmers must be able to take advantage of emerging low-cost logistics and low emission technological advances in milk processing. It is likely that export opportunities will soon emerge that Scotland could take. However, to do so Scotland must have available milk and although we currently export over 18% of our milk to England most of that milk is tied up in exclusive contracts that do not allow farmers to take advantage of new opportunities. The Scottish Government should therefore support change to allow farmers to hold non-exclusive contracts so opening the way for them to sell to more than one buyer easily and without undue burden or develop local and regional processing.

Joint ventures and co-operative opportunities for dairy farmers should be supported towards any inward processing investment opportunity that allows low emissions exports to flourish. If a positive commercial environment is created to allow low emission exports and farmer cooperative

[51] For methane, GWP100 not measuring up | CLEAR Center (ucdavis.edu)

[52] https://www.cielivestock.co.uk/wp-content/uploads/2020/11/CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf

ownership of such investments, then a significant contribution will be made towards meeting both emissions targets and wider socio-economic benefits.

Recommendations
- Explore opportunities for low emission logistics and milk processing technology to secure export opportunities.
- Review legislation surrounding fair trading terms and exclusivity of milk contracts.
- Support for joint venture and co-operative processing investment.

Refer to Annex 4 – Recommendations and Support Required

7.3. Carbon Credits Scheme and Trading Platform

Carbon credits could be an output of improving the carbon balance on Scottish farms. With the proposed national baseline carbon auditing, and the improvements identified on measurement in sequestration, farmers would be able to substantiate their carbon balance sheet. The opportunity for trading these carbon credits should be explored. It is a complex area but one in which farmers should be at the forefront of exploring the opportunities.

Recommendations
- Commissioning of commercially focussed research into opportunities for carbon trading within Scottish agriculture.

Refer to Annex 4 – Recommendations and Support Required

7.4. Alternative Supply Chain Marketing

Opportunities exist to build alternative supply chains that enable stronger 'business to customer' direct relationship selling. This would allow farming businesses to access customers who are prepared to pay for high value local foods that bring environmental, welfare and social improvement. Initiatives have developed successfully using social media-based community-owned digital selling platforms, with access to the platform restricted to those producers meeting UN Sustainable Goals, for example in the Netherlands via the Local-to-Local Co-operative[53].

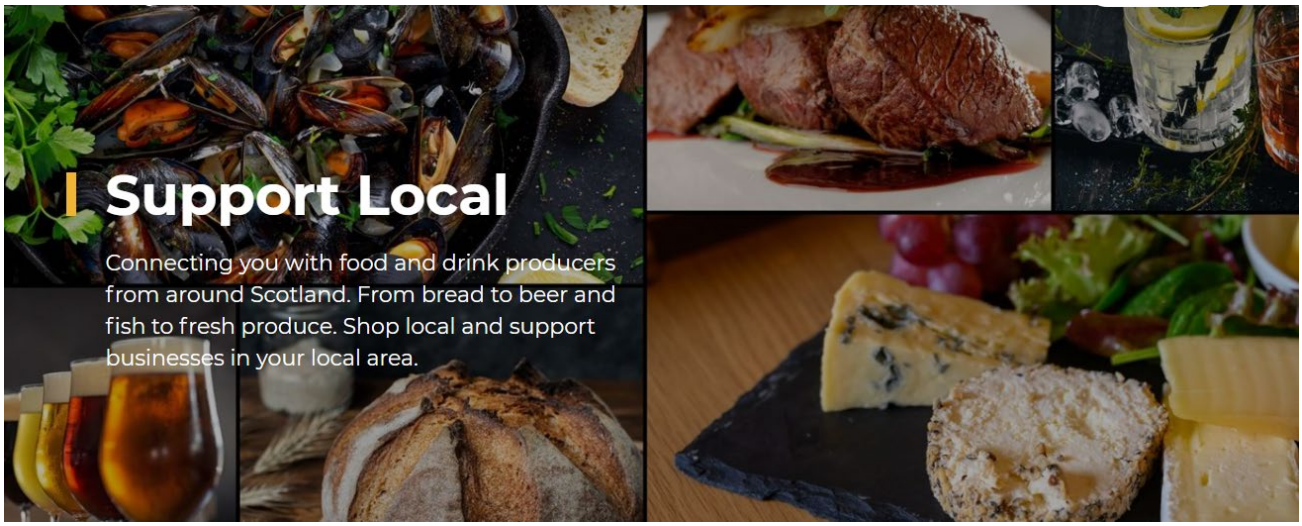


Photo credit: Scotland Food & Drink[54]

7.5. Community/Regional Processing

[53] https://local2local.nl/, https://www.smartchain-h2020.eu/
[54] https://foodanddrink.scot/support-local/

The CCPu[55] recognises the need to keep people on the land to produce food as the basis for a thriving Scottish food and drink sector, even to the extent of repopulating parts of rural Scotland where population has dwindled. It identifies more localised and regionalised supply chains as one means of achieving this objective. As the experience of empty supermarket shelves during severe weather events such as "the Beast from the East" and the demand for local food during the COVID-19 pandemic has demonstrated, short, localised supply chains can build resilience to disruption and provide market support to high quality sustainable food production. However, currently in Scotland five major processors account for 94% of milk collection.

Rising to the Top 2030 outlined that growing the capacity and capability of Scottish dairy processing on all scales over the next 5–10 years will be key to the long-term sustainability of the sector. There needs to be appropriate support in place for continued process investment, product innovation and responding to climate change challenge pressures in manufacturing.

Recommendations

- Encourage investment in processing (including local and regional) to increase supply chain and milk field resilience.

Refer to Annex 4 – Recommendations and Support Required

[55] The Climate Change Plan update (CCPu) - Parliamentary Business : Scottish Parliament

8. Collective Drive for Change

All sectors of agriculture need to work together; this is a collective response to a global problem. The complexity of the issue needs collaboration. Government has a direct role in influencing farming businesses, but similarly regulation and consumer pressure on the supply chain is also generating change. Within the dairy sector there are many drivers for carbon efficiencies on farm, as illustrated in Figure 11.

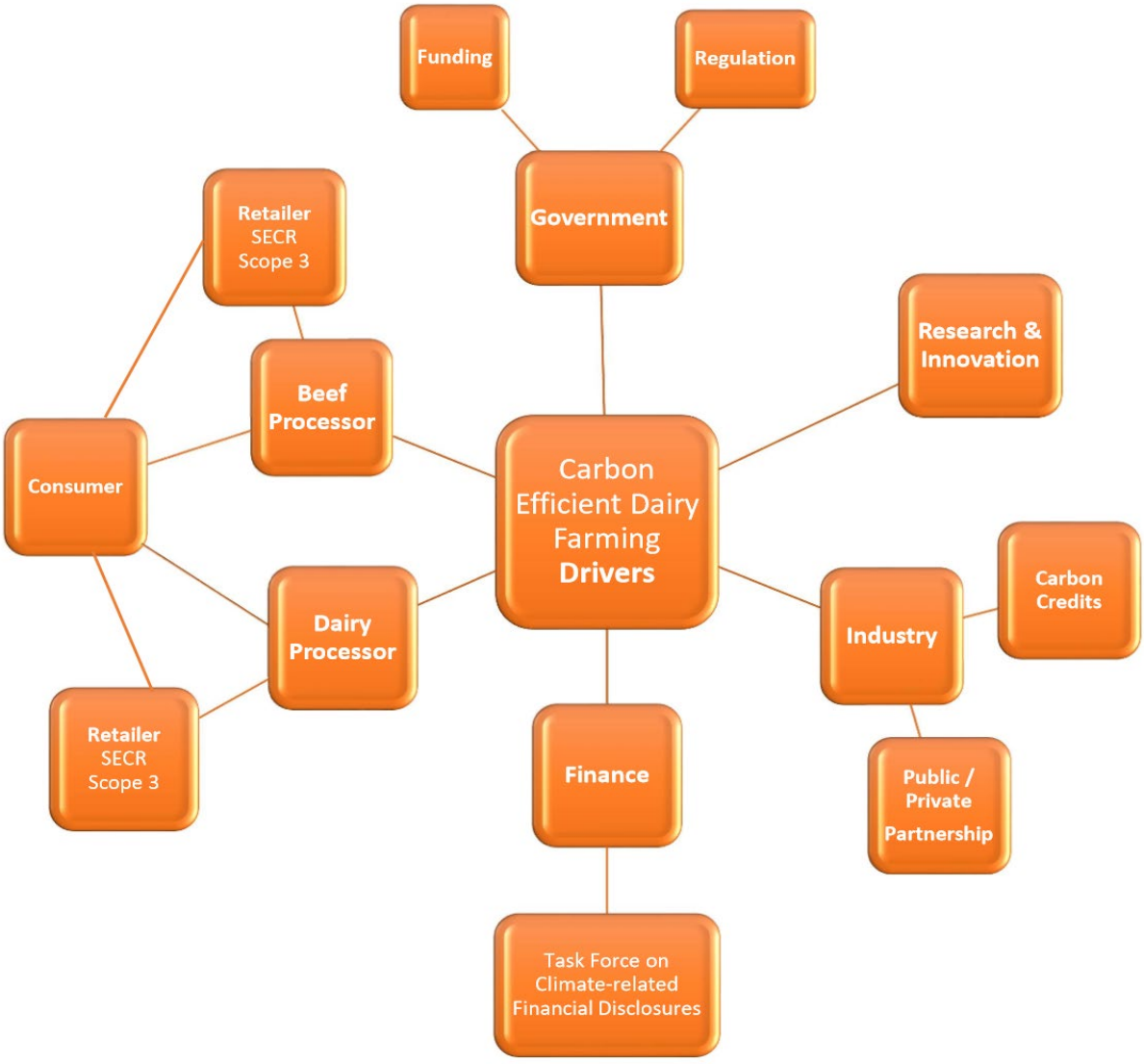


Figure 11 - Illustrative Representation of Drivers for On-Farm Carbon Efficiency

8.1. Processors and Retailers

The dairy supply chain, most notably through retailer-aligned contracts, has been a forerunner in delivering carbon reduction on farms in return for premium price. There are lessons which can be learned from the delivery of such initiatives, and through collaboration and sharing of best practice it could help shape delivery going forward and reduce duplication. Increased returns to the producer for delivering the carbon reductions should also be delivered to all producers.

The requirement for increased carbon efficiency from processors and retailers will increase with the UK Government policy on Streamlined Energy and Carbon Reporting (SECR) which was implemented in April 2019. The SECR requirements mean that there has been an almost seven-fold increase in

the number of companies required to comply with energy and carbon reporting legislation (c.11,900). SECR involves 3 scopes of reporting – Scope 1 includes direct business GHG emissions, Scope 2 covers indirect emissions and Scope 3 covers all emissions in a company's value chain that they do no own or control[56].

Presently under Scope 3, it is only mandatory to report energy use and emissions from business travel. Whilst it is voluntary to report other Scope 3 emissions, it is strongly encouraged where this is a material source of emissions. Many large food businesses and retailers are focussing on voluntary Scope 3 data collection with a view to future annual reporting (and improvements)[57]. However, there is no standardised methodology or reporting guidelines, which could lead to different reporting for each retailer/processor, with competitive advantage prioritised over collective industry response.

Recommendations

- Improved climate collaboration within the dairy supply chain, with government facilitation, to deliver greater transparency and sharing of best practice to deliver improved carbon efficiency.
- Collaboration within the dairy supply chain to try to standardise Scope 3 reporting to ensure aligned objectives and the avoidance of duplication, working with the proposed Centre of Excellence to ensure it is informed by the latest scientific advice.

Refer to Annex 4 – Recommendations and Support Required

8.2. Financial Sector

The Task Force on Climate-Related Financial Disclosures (TCFD) was created in 2015 by the Financial Stability Board (FSB) to develop consistent climate-related financial risk disclosures for use by companies, banks, and investors in providing information to stakeholders.[58] The TCFD recommendations and its framework are now universal across the financial sector as the method for embedding climate change into governance, strategy and risk management.[59] In November 2020, the government announced that from 2025 the UK will be the first G20 country to require mandatory reporting aligned with the TCFD[60]. Many UK banks have made commitments to work with customers, government and the markets to reduce carbon emissions. This will feed through to lending to farming businesses, with climate reporting and improvements a likely requirement in the future.

Recommendations

- Collaboration within the banking sector on TCFD reporting to ensure aligned objectives and the avoidance of duplication, working with the proposed Centre of Excellence (Section 9.1) to ensure it is informed by the latest scientific advice.

Refer to Annex 4 – Recommendations and Support Required

8.3. Farm Suppliers and Advisers

There also a role in bringing together the suppliers to dairy farms, for example agronomists, nutritionists, vets, machinery manufacturers, to ensure their service innovation and delivery is working towards the same objective. This should also be included with the scientific community to deliver fast and practical roll out of research outcomes. (See 9.1 - A Centre of Excellence)

[56] What are Scope 3 emissions, and should you report them under SECR? (secrhub.co.uk)
[57] Greenhouse gas measurement and reporting (brc.org.uk)
[58] TCFD for Banks – United Nations Environment – Finance Initiative (unepfi.org)
[59] Chapter 3: Climate governance and TCFD - GOV.UK (www.gov.uk)
[60] Chancellor makes climate-related financial disclosures mandatory | Transform (iema.net)

8.4. Public Private Partnerships

Collaboration between private business levering support for public benefits delivered by farmers and land managers can deliver opportunities. UK Projects such as the LENs (Landscape Enterprise Networks) programme[61], pioneered by Nestle, links management and investment in landscapes to the long-term needs of business and society. It does this by helping businesses to work together to influence the quality and performance of the landscapes in which they operate. Business interests can range from resilient crop production, flood risk, carrying capacity of water catchments, management of carbon or biodiversity, to health and quality of life for their workforce. LENs mobilises those business interests by building a series of place-based chains of transactions which enable groups of businesses to co-procure landscape outcomes from land-based organisations that can make things happen on the ground.

Recommendations

- Further exploration of opportunities for public private partnerships through supply chain collaboration and the Centre of Excellence (see 9.1 - A Centre of Excellence)

Refer to Annex 4 – Recommendations and Support Required




[61] Landscape Enterprise Networks – A 3Keel initiative to support resilient landscapes.

9. Scotland at the Forefront

The DSCCG recognises that existing technologies and adaptation measures alone are not likely to be enough to meet the current targets set by the Scottish Government for the emissions reductions by the agriculture industry. Notwithstanding our recommendations elsewhere in this report regarding the methodology of setting agricultural emissions targets, the DSCCG believes that by embracing innovation Scotland could be a world leader in how its agriculture industry contributes towards a carbon neutral economy.

The DSCCG believes that there can be a win-win scenario because the dairy sector can not only meet climate change obligations but benefit the industry by being able to access premium 'carbon positive' markets within Scotland, UK and export markets.

9.1. A Centre of Excellence

Scotland has the benefit of world leading climate change academics and research facilities for agriculture. The DSCCG recommends the bringing the various assets we have together into an Agricultural Climate Change Centre of Excellence. By creating a forum which brings together public, private and industry expertise in this area we could accelerate the pace of innovation and research, as well as inform and educate all sectors of the industry.

The Centre would have scientific research and innovation at its heart, but with close links to farmers, advisers, suppliers, processors and retailers, with a multi-way flow of information and ideas sharing. There should also be a significant designated role in communication with the media, to counter the tendency for reductive bias in the agricultural climate debate and provide a science-based approach to communication. The Centre of Excellence should not replicate the work of existing bodies but provide a single platform for communication and collaboration to accelerate the change needed.

In addition to the funding of new research which will fill the gaps in knowledge on carbon mitigation and sequestration in agriculture, there are many measures which have known benefits. Transferring the knowledge of this research in an effective and practical way is critical. Practical demonstrations will play a vital role, with a combination of net zero demonstration farms, events to share best practice, training days etc. Training and knowledge transfer is also imperative for advisers to farmers and should be incorporated into their CPD requirements. This will be an effective way to disseminate the knowledge by generating a pyramid structure of information flow.

Recommendations

- Creation of an Agricultural Climate Change Centre of Excellence as a single entity with scientific research and innovation at its heart, but with close links to farmers, advisers, suppliers, processors and retailers. Improved cross-industry communication, collaboration, knowledge transfer would be its core function, together with media communication.

Refer to Annex 4 – Recommendations and Support Required

10. Delivering Change

Scotland (like many nations) is measuring progress to net zero by adopting national targets which have been disaggregated into industry and sectoral targets. While targets are one way of accelerating change and allowing measurable progress, they should form one tool in a wider toolkit of incentives.

The survey of farmers carried out by the Group demonstrated the motivation for change, with 86% of respondents feeling that climate change presented a serious or the biggest single challenge for Governments. This suggests that dairy farmers are open to the challenge and will respond positively to the correct incentives.

To deliver change there needs to be motivation, opportunity and capability.

Figure 12 - Strategic Communications: A Behavioural Approach[62]

10.1. Capability - Knowledge

As indicated in Section 9.1, a Centre of Excellence could incorporate a knowledge hub or knowledge transfer centre. As the DSCCG discovered when delving into this topic in more detail, there is a confusing array of scientific papers, pilot schemes, advice notes and other resources available. However, it is time consuming and daunting to try to pull out the relevant information for an individual farm business, even for advisers. What is required is a one stop shop for dissemination of academic research and the newest ideas from around the world. Time-poor farmers can seek out practical answers to complex questions and be supported to resolve issues faced, this kind of help can be an unblocker to enabling ideas and overcoming on-farm problems in an efficient manner.

Such a facility would also provide a managed peer-to-peer learning and idea swapping centre. It would be used to filter and moderate peer to peer YouTube style reviews of innovative, novel ideas and practices, so capturing often passed-by practical on-farm improvements and solutions.

[62] https://ic-space.gcs.civilservice.gov.uk/news/kicking-the-habit-changing-behaviour-with-communications/

In addition, a network of environmental-improvement farmer-led co-ops should be created and supported. This can be done on a similar basis as the very successful Scottish Enterprise led "Planning to Succeed" financial benchmarking groups.

The further step of enabling and supporting by the Rural Innovation Support Service[63] network and funding along the lines of the Knowledge Transfer and Innovation Fund should be made.[64] Key to these is professional facilitation and project management that keeps the focus and provides the resource that allows projects to go forward that would not otherwise happen.

10.2. Opportunity

10.2.1. Basic annual payments

As demonstrated in Figure 1, even with support payments, only 60% of dairy farms were profitable in 2018. While the dairy sector is proportionately less reliant on support than other livestock sectors, it has the highest the capital intensity required.

As put forward by the Suckler Beef Climate Group [65], the DSCCG acknowledges the need for increased conditionality for existing public funding arrangements, moving away from the language of "support" to delivery of societal needs. The requirement for activity-based support will continue, and the conditionality of this support must be measurable and deliverable. Whilst Brexit has provided the opportunity for the delivery of farming support outwith the confines of the Common Agricultural Policy, it must not create an unlevel playing field for Scottish farmers.

Any change to support requires a just transition period. This transition should be used to establish the industry baseline carbon auditing (with full cost recovery), along with animal health plan, nutrient management plan, feed plan, soil testing and biodiversity assessment. Most of these are already actively being undertaken on dairy farms (see Figure 13).

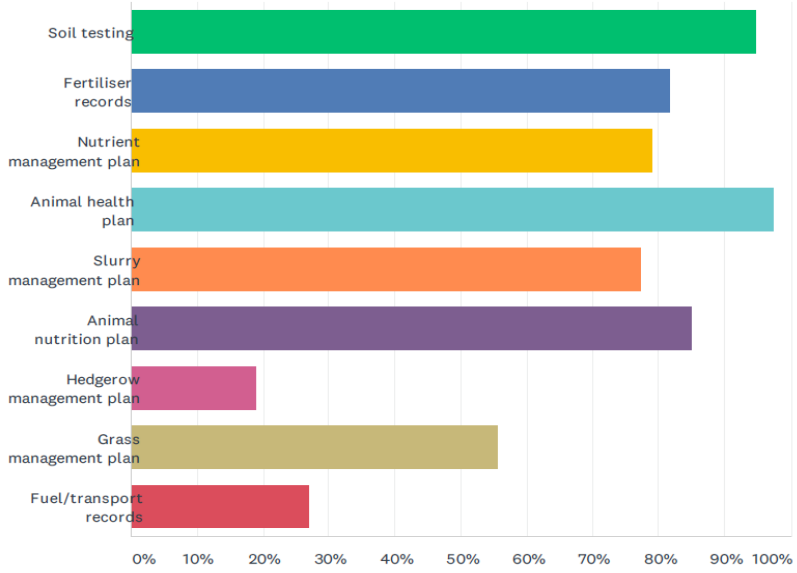


Figure 13 - Survey Results: Management Activities Undertaken on Farm

[63] https://innovativefarmers.org/welcometoriss/
[64] https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/knowledge-transfer-and-innovation-fund/
[65] Suckler Beef Climate Scheme: final report - gov.scot (www.gov.scot)

For the conditionality to be meaningful rather than a tick box list of reports, the focus must be on delivering meaningful information to enable change. The outline data should form part of the baseline establishment. The information must be in standardised format and collated centrally, and accessible to all participants.

10.2.2. Capital Grants

To improve emissions efficiency, productivity gains will be required. Many of these would have the dual benefit in increasing profitability, however, the capital cost is often a barrier which grant assistance would help overcome. There are other mitigation measures, e.g., slurry pit covers, which helps reduce emissions but delivers very limited profitability gain. As a result, the level of grant support would need to be greater. The Whole Farm Climate Review would be the gateway to the capital grants and ensure that the funding is being prioritised where it is needed most and will deliver the greatest impact within each farm business. Annex 4 – Recommendations and Support Required outlines the priorities for capital funding, which would sit alongside continued annual activity-based support.

10.2.3. Implementation

The DSCCG strongly supports a whole agriculture approach to the delivery of change. Following the reporting of all the sector farmer-led groups, a Joint Implementation Group should be formed and a pilot phase 1 of the programme opened to all sectors. The industry needs to capitalise on current momentum and not allow stagnation to undermine the work of the respective groups.

It is also important to recognise that net zero carbon does not equate to sustainability. A single focus on carbon can compromise gains needed in other sustainability metrics, such as biodiversity, water quality, food security, animal welfare, viability of rural communities and long-term farm profitability.[66] The Joint Implementation Group must not be restricted in its remit to climate change as its only objective. This has been recognised, particularly in reference to biodiversity, by all the farmer-led groups and the DSCCG has not sought to duplicate this work.

10.3. Motivation

10.3.1. Market Drivers

Business activity and management decisions should not be driven primarily by public funding. While specific outcomes desired by society can be encouraged this way, farmers need to be able to respond to market signals and to trade profitably if they are to be sustainable. Where the market cannot deliver an adequate return to allow this to happen then public intervention is justified. Many dairy farmers supply direct to the end user but most supply via a small number of processors who dominate the market. In turn, processors supply a small number of major retailers who both drive and respond to consumer demand (Section 8.1 - Processors and Retailers).

The environmental impact of dairy farming is often portrayed as a negative, and as AHDB has demonstrated in Figure 14Figure 12 below, where consumers have thought about reducing dairy intake, nearly half of those cited environmental concerns as a reason. This narrative must be reversed, and farmers must respond to what the consumer is telling them. Public funding should assist with this process but the shift must start with the individual farmer.

[66] https://www.cielivestock.co.uk/wp-content/uploads/2020/11/CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf

For farmers to be motivated to change, they also need to be sure that the changes they make will be credited to their industry and sector, notably within the national inventory, and ultimately with the consumer and public. The accuracy of the inventory in recording the changes made on farm will be critical (see 5.1 The Inventory and Targets) to enabling change.

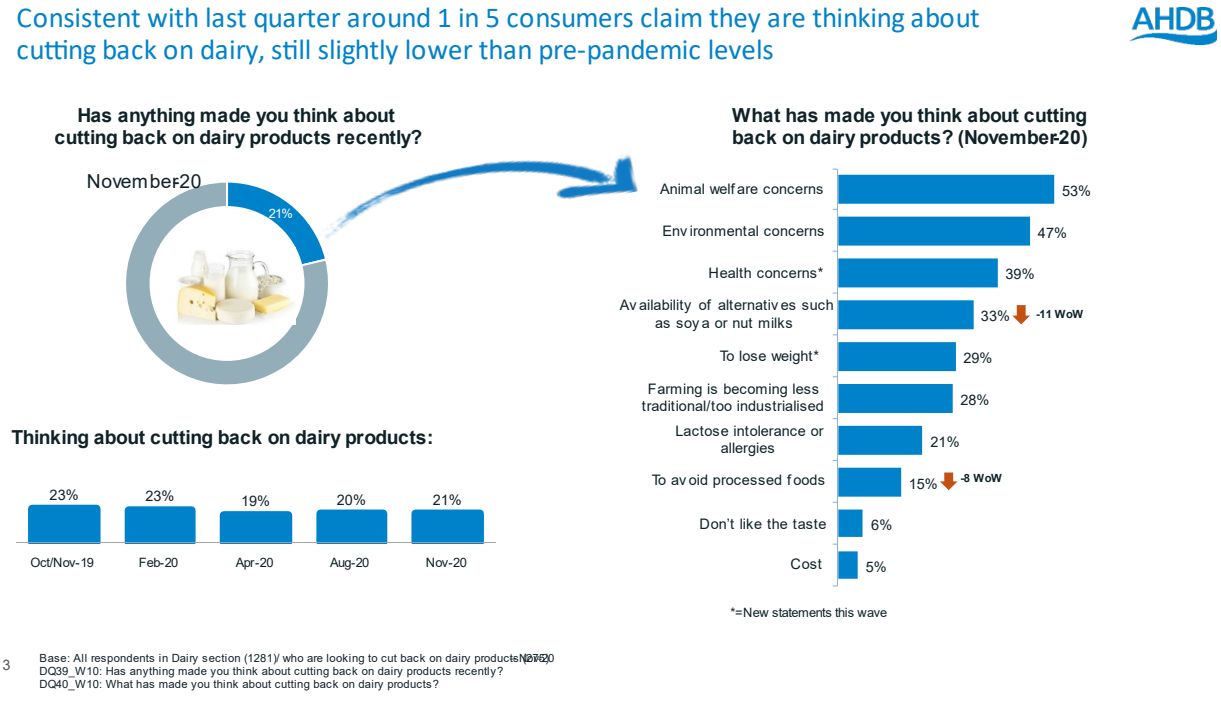


Figure 14 - Consumer Insights on Dairy (AHDB, November 2020)

This issue is clearly not just a domestic one. Global forces will also influence the domestic consumer and national policies. In the context of the failure of UN nations achieving their Sustainable Development Goals (SDGs)[67], the United Nations Food Systems Summit taking place this September marks a point when decisions will be taken about the future production and consumption of food. The Summit Secretariat has called for game changing solutions to pick up the pace to delivery of the SDGs. One of the workstreams underway relates to the "shift to sustainable consumption patterns". There is both a threat and an opportunity here and farmers must engage to ensure a positive outcome. We would also urge the Scottish Government to make robust representations to the ongoing UK contribution to this Summit.

10.3.2. Reward Innovation and Success

Any changes to support must reward innovation and success. The drive to deliver improvements should not be at the expense of those already achieving emissions efficiency, otherwise there is a disincentive to deliver too soon, which is counterproductive. Opportunities for mentorship and demonstration to other farmers and advisers should be rewarded.

[67] Sustainable Development Goals | UNDP

11. Integrated Approach

This is not a single sector issue and very few farms have only one output. The outcomes and solutions will be interlinked. This report must link together with other farmer-led groups and provide momentum for a whole industry approach. We must also recognise that a focus on climate change must be viewed in the wider context of sustainability, including biodiversity, animal welfare, water quality, rural employment and supply chain viability[68].

The Scottish Government's Climate Change Plan update (CCPu) recently identified 6 outcomes for Scottish Agriculture. These outcomes are not sector specific and will involve an integrated approach from the whole industry if we are to deliver. We have identified that in respect of all proposed outcomes, every sector should have commonality of objective and approach. Any agricultural policy and funding programme which replaces the CAP should build upon the farmer led initiative and be developed in partnership with the whole industry and be as inclusive as possible from the outset.

Outcome 1 Productive, sustainable agriculture sector: Across all sectors of agriculture, there is need for an optimum level of production to be achieved which addresses GHG emissions targets but also maintains critical mass so that the whole infrastructure around Scottish agriculture is maintained and secures the future of the food and drink industry in this country. Any policy which would simply reduce livestock numbers as a means of achieving emissions reduction targets is not an option because this risks simply importing protein products to feed the nation from countries, many of whom are less suited to producing the products and in turn more damaging to the climate. Cattle numbers can be reduced through the multiple efficiencies and productivity measures that are well documented by SRUC and others and summarised in this and the other farmer led group reports. Enterprises should, however, have the ability and support to grow in a sustainable way with increased awareness and focus on carbon sequestration measures and biodiversity as well as embracing all available technology as it emerges.

Outcome 2 – Awareness of farmers: Very few farming enterprises are single sector so this element of upskilling farmers must be totally inclusive from the outset to maximise impact. Farming advisers should also be upskilled so training of farm advisers, SGRPID staff, consultants and others should be a priority.

Outcome 3 – Nitrogen emissions: One factor that is common across all sector of agriculture is dependence on the land and our soils. Reducing emissions of nitrogen therefore warrants an integrated approach. Measures such as conservation tillage techniques, precision farming, nitrogen use efficiency, soil testing, and new crop varieties all have cross sectoral significance and should therefore be implemented in an integrated way.

Outcome 4 - Reduced Emissions from meat and dairy: A collaborative approach is essential, involving cross sector bodies such as QMS, ScotEID, Red Tractor, AHDB etc. We must also work with the supply chains to avoid duplication of effort as they seek to deliver on SECR (Streamlined Energy and Carbon Reporting) – Scope 3 and reporting emissions of their suppliers, with government taking a role in facilitating this collaboration. The baseline will provide the springboard from which the industry can measure its progress. Peer benchmarking of performance and sharing of best practice will be key drivers to success. Emissions efficiency should drive the reduction in emissions. Scotland should not seek to export its emissions when it has the ability to provide a growing global population with climate efficient protein sources.

Outcome 5 – Reduced emissions form manure/slurry: The livestock sectors can contribute most to this outcome by adopting specific management practices which reduce emissions. However, it is collective solutions between sectors that also need to be explored. An integrated programme for

[68] CIEL-Net-Zero-Carbon-UK-Livestock-FINAL-interactive-low-res-APP-revised-reference-Oct-2020.pdf (cielivestock.co.uk)

delivery of these outcomes should be flexible enough to allow enterprises to adopt mitigation measures and techniques which apply to their enterprises.

Outcome 6 – Carbon Sequestration: Soils hold three times the amount of carbon currently in the atmosphere or almost four times the amount held in living matter. Because soils have such a large storage capacity, enhancing soil storage by even a few percentage points makes a big difference[69]. There are knowledge gaps and challenges that hinder the upscaling and widespread deployment of soil carbon management, as acknowledged by the IPPC, and addressing these issues must be an urgent priority[70]. In the interim, implementing measures known to deliver positive outcomes in soil carbon sequestration should be the focus.

Land use change may be a challenging area for farmers and government to tackle but it is an issue which must be debated and discussed within the joint implementation group. There is wide support for agroforestry and where this can complement productivity and optimise use of land across the country. There must also be acknowledgement of the contribution of agriculture to land use change gains within the smart inventory under the LULUCF sector (Land use, Land use change and Forestry).

We urge government to support exploration of public/private partnerships which allow farmers to benefit from the Corporate Social Responsibility and sustainability agendas of private businesses and the opportunities for carbon credits within agriculture.

Photo credit @ScotGovClimate

[69] Fact Sheet: Soil Carbon Sequestration | American University, Washington, DC

[70] Summary for Policymakers — Special Report on Climate Change and Land (ipcc.ch)

12. Communication

In the survey by the Dairy Climate Change Group, 95% of respondents were aware of the Scottish Government target of net zero, but there were varying degrees of awareness about what this meant for them and not clear as to the role they play.

The narrative often used in the media, is that "farming is the problem", which invokes a defence response. There needs to be a reframing of the debate to "farming is part of the solution". The complex issues of flow gases vs stock gases, sequestration and offsetting, are lost in the media soundbites, with a tendency for reductive bias as complex concepts are over simplified inhibiting the development of sophisticated understanding. The intricate interconnected nature of agriculture and the developing science of climate change is lost in the drive for simplification and single agendas. Dairy farmers are wanting to play their part in delivering climate change targets, but not at the expense of importing food and exporting emissions.

By reframing the debate and trying to address the disconnect, farmers will be invested in the outcome and have confidence in the process. The objectives of any programme of delivery must meet the standard - specific, measurable, achievable, realistic and time related.

It is important that the programme is non-competitive. The objective must be to achieve collective change, not create competition and divisions between farming sectors and within sectors (dairy system, size, contract etc) which would be counterproductive.

There is a key role for scientists to help inform and shape the debate, sharing the uncertainties and priorities for change. The urgency for delivery of change in what is an evolving science, has parallels with the current pandemic, and lessons can be drawn from this.

13. Conclusions and Next Steps

The challenges facing agriculture in this post Brexit, post COVID era are multi-faceted and complex. There are multiple objectives which may seem at odds with each other. How can we meet the demands of feeding a growing global population while reducing absolute emissions? How can farmers become market led and market driven if they must also provide public benefits for which there is no market reward?

The Scottish Government has set legally binding targets for GHG emissions reductions which appear to be unachievable if overall targets are bluntly disaggregated by industry and sector. We suggest that there must be recognition that agriculture delivers a plethora of societal benefits ranging from healthy, nutritious food and biodiversity to the health and wellbeing of the nation and so crude targets do not adequately capture the contribution farmers make.

Notwithstanding the wider context however, the dairy sector acknowledges that there is much room for improvement and stands ready and willing to tackle the multiple challenges it faces. If given the right policy environment dairy farmers will adapt and embrace change. Scottish dairy farmers are proud of what they produce, and they want to do it in a climate sensitive way. They have demonstrated that they are adaptable to change and are willing to embrace innovation. They do not want to be recipients of public funds as income support. They want to deliver public benefits and to be rewarded fairly for doing do, with the outputs of their efforts properly recognised and valued by society.

Dairy farmers are part of the solution to climate change and look forward with optimism to a facilitative, inclusive policy climate in Scotland that will enable all sectors of agriculture to come together to develop a cohesive and integrated agricultural policy.

Annex 1 – Scope and Remit of the Group

DAIRY SECTOR CLIMATE CHANGE GROUP

Purpose

1. The Scottish Government has committed to take action on climate change with legally binding targets to reduce greenhouse gas emissions. It also has committed to contributing towards biodiversity targets. It is important that agricultural businesses play their part in achieving these objectives. The Scottish government acknowledges that many farmers will need to adapt their farming practices and in turn may need to access appropriate support where necessary to improve their environmental performance, whilst maintaining quality food production and the associated economic benefits the Scottish food and drink sector brings to Scotland.

2. This Group will consider practical measures as well as support mechanisms which will help the dairy sector achieve:

    - improved efficiency, productivity and profitability for the dairy sector in Scotland;

    - enhanced environmental contribution from the sector through identification of practical ways in which net greenhouse gas emissions from the dairy sector can be reduced

    - mitigation of other environmental impacts of production and enhancing contribution to sustainable agriculture and land use including fertility, breeding and genetics and animal nutrition as well as soil health and grass land management.

3. The group may wish to review the outputs from all or some of the other farmer-led groups including any proposed scheme framework and management options and consider whether or not it would be appropriate for the dairy sector to adapt an existing scheme in whole or part and /or whether a new or additional scheme should be considered for the dairy sector.

4. The group should consider the financial implications and deliverability of its proposals and consider the timespan over which any proposals should be implemented. These should build on existing regulatory requirements and accepted good industry practice.

5. The group should consult as widely as is feasible in the time given taking advice from specialists and academics where necessary, as well as consulting with SG policy teams in relation to deliverability and complexity of measures proposed.

Remit

1. The Group will develop proposals for the sector taking account of production and marketing based improvements focussed on a number of areas, including but not limited to:

    - sustainable management practices such as :-
        - slurry and manure management
        - grassland management
        - soil improvement and health
        - energy use
        - precision farming and use of technology

    - production based improvements including nutrition, breeding, fertility, animal health and fertiliser use
- baseline and ongoing data collection and measures of progress such as:-
    - carbon audits and action plans;
    - biodiversity scoring and monitoring;
- scope for increased efficiencies
- role of Dairy Beef as a subsector
- carbon sequestration
- potential requirement for capital investment/improvements
- deliverability and monitoring of measures
- supply chain improvements encouraging producer groups with the potential to improve market development
- Farm Assurance and market driven incentives

2. The Group may also offer advice regards the costs of the necessary actions and how these might be met, with an estimate of the budgetary implications of any support measures that might be required to be introduced.

3. The Group will provide a report to Scottish Ministers in 2021 setting out its conclusions to feed into the Scottish Government's response to action on the Climate Change challenge. The report should focus on how to reduce greenhouse gas emissions within the dairy sector while maintaining and improving productivity and efficiencies and make recommendations on what will be required to deliver that including but not limited to any support scheme(s).

Chair, Secretariat, Membership and Ways of Working

1. The Group will be chaired by Jackie McCreery and the Group's Secretariat will be provided by the Scottish Government.

2. The Group will include a diverse range of representatives from across the sector with suitable experience and skill.

3. All members of the Group will be required to register their interests.

4. The group members are: -
    - Jackie McCreery (Chair)
    - Thomas Cameron
    - David Campbell
    - Rory Christie
    - Bryce Cunningham
    - Robert Dodds
    - Paul Grant (Dairy Growth Board)
    - Bruce Mackie
    - Tracey Roan
    - Sarah Simpson
    - Johnnie Sloan
    - Grant Walker
    - Sally Williams
    - Erlend Wood

    The group may appoint further member(s) if it is deemed necessary to fill a gap in knowledge or expertise that becomes apparent during the process.

5. The Group will take an evidence-based approach to its work; can co-opt the support of academics, industry bodies or others to aid its deliberations and will acknowledge the work of others, where appropriate.

6. While members are drawn from a range of interests and expertise from across the agri-food system, their involvement is based on their experiences and views rather than representing the views of any organisations. Members will share relevant industry and/or skills related knowledge/expertise as appropriate and be expected to lead on specific actions where appropriate. In order to be transparent in taking forward work, membership and declared interests will be a matter of public record.

7. The Scottish Government will provide a secretariat to the meetings. While the group's discussions will be summarised and publicly available to ensure transparency, specific content will not be attributed to individual participants.

8. If a member has any conflict of interest on any matter and is present at a meeting at which the matter is the subject of consideration, the member should prior to any consideration of the matter, disclose the interest and the general nature thereof.

Farmer Led Dairy Sector Climate Change Group

Annex 2 – Contributors to the Group

The DSCCG is very grateful to the following individuals and organisations who submitted evidence or presented to the Group:

- Paul Flannagan, AHDB
- Dr Judith Bryans, Dairy UK
- Andrew Griffiths, Nestle UK and Ireland
- Prof Dave Roberts, SRUC
- Dr Vera Eory, SRUC
- Paul Grant, Dairy Growth Board
- Kirsten Beddows, Scottish Government Head of Agriculture Transformation for the Environment and Climate Change
- Andrew Bowles, Visiolac
- Rodney Wallace**,** Agriculture Director, HSBC UK Bank plc
- Farming for 1.5 Group
- Stuart Martin, NFUS/ Scottish Dairy Hub
- NFUS Milk Committee
- Claire Simonetta, Sucker Beef Implementation Board
- Tim Bailey, SAOS Ltd
- Scottish Government, Rural & Environmental Science and Analytical Services (RESAS)

Annex 3 – Farmer Survey

Click on image to open the Adobe Acrobat document

Dairy Sector Climate Change Group

Farmer Call For Evidence: Survey results Summary

Table of Contents

1. Introduction 2
2. Awareness of Scot Gov's net zero greenhouse emission targets 2
3. Views on Climate Change 2
4. Carbon Audits 2
5. Actions flowing from Carbon Audit 3
6. Businesses who have not undergone a Carbon Audit 4
7. Farm Management Activities 4
8. Attitudes to Governments imposing Carbon footprint targets 5
9. Business Investment 6
10. Additional Views 8

1

Figure 15 - Farmer Call for Evidence: Survey Results Summary (ScotGov DSCCG Secretariat)

Annex 4 – Recommendations and Support Required

5 Establishing the BaselineEstablishing the Baseline

Recommendation	Actions / Examples	Type of Support
Comparison of Carbon auditing tools to develop modular calculator using standardised set of assumptions and data.	Scottish Government to commission Research	
Pilot programme to carbon audit all farms in Scotland	Phase 1 of new agricultural programme - full cost recovery for farmers Training and advice for farmers and advisers	 
Ensure data collected from baseline exercise is useable and fed into the smart inventory to influence development and reflect Scottish agriculture.	Scottish Government to fund research institutes	
Development of scenario planning within the auditing tools	Scottish Government to fund research institutes	
Life Cycle analysis of a sample of Scottish Dairy Farms	Scottish Government to fund research institutes	
Develop a Whole farm Climate Review tool to enable farmers to identify the optimum set of plans and actions required to address the carbon balance on farm.	Phase 2 of agricultural programme - full cost recovery for farmers	
Undertake Life Cycle Analysis of a sample of Scottish Dairy Farms	Scottish Government to fund research institutes	

6.1.1 Genetic Efficiency

Recommendation	Actions / Examples	Type of Support
Support for genomic testing as part of a breeding programme	Subsidise genomic testing of heifers Training and advice on developing breeding programmes Capital items, e.g. ○ On farm sensors ○ Data loggers ○ Precision measurement techniques	  

6.1.2 Feeding Efficiency

Recommendation	Actions / Examples	Type of Support
Encourage adoption of low emission feeding strategies; Support for feeding efficiency measures including precision feeding and feed additives:	○ In parlour feeders ○ Robot Feeding ○ Out of parlour feeding ○ Feed ration emission measurement / monitoring tools ○ Subsidise use of 3NOP once available ○ Further research into feed additives e.g. Asparagosis taxiformis, linseed, microbiome tech. ○ Training and advice for development of low emissions feeding strategies	  
Encourage increased feed efficiency and reduce feed waste (should be below 10%) through monitoring and improving intakes	○ Feed scales ○ Feed cameras ○ Weighted bins	

6.1.3 Energy Efficiency

Recommendation	Actions / Examples	Type of Support
Capital support for energy efficiency investments	○ Variable speed vacuum and milk pumps ○ Heat exchangers to pre-cool milk prior to entry to bulk tank ○ Heat recovery units and water storage tanks ○ LED lighting ○ Solar thermal heating	
Encourage and enable renewable energy investment on farm by removing barriers	○ Funding for anaerobic digestion plant (farm or community level) ○ Removal of barriers for grid connection ○ Training and advice for famers and contractors on fuel efficiency and	 

	alternative fuel sources ○ Smart recording apps	

6.1.4 Herd Health and Management

Recommendation	Actions / Examples	Type of Support
Enable farmers to improve herd health including disease prevention, reduction in lameness and other general welfare measures to reduce mortality rates.	○ Herd health plans and recording of mortality as part of a Whole Farm Climate Review ○ Foot trimming equipment ○ Increased feed space ○ Footbaths ○ Hoof sprayers ○ Cattle tracks ○ Cubicle upgrades to allow more space	 
Develop key performance indicator matrix and collation to inform inventory and measure improvements	○ Encourage use of authenticated Key Performance Indicators	 
Capital support for improved efficiency	○ Livestock sensors ○ Monitoring technology ○ Robotic milking systems ○ Parlour improvements to allow 3x day milking	
Encourage farmers to develop herd fertility plans which maximise longevity and efficiency and reduce replacement numbers and include targets for improvement year on year	○ Lowering age of first calving ○ Increase average number of lactations ○ Body condition scoring	
Reduce number of heifers failing to get to first calving (target 10%)	○ Improved Heifer accommodation - additional pens, ventilation, pasteurisers	
Reduce age at first calving (reduction in % calving over 24 months)	○ self locking yokes for bulling heifers,	

Encourage rearing healthy and robust youngstock	○ heat detection for heifers, ○ Colostrum quality testing ○ Blood sampling to test calf immunity ○ Calf jackets to maintain body temperature ○ Automatic calf feeders	

6.1.5 Grassland Management

Recommendation	Actions / Examples	Type of Support
Demonstration of best grassland management practice within different dairying systems in Scotland	Funded monitor and demonstration farms developing best practice and transferring knowledge to farmers	 

6.1.6 Nutrient Management

Recommendation	Actions / Examples	Type of Support
Facilitate better storage, management and application of organic manures	○ Slurry storage capacity and slurry store covers ○ Research into health and safety aspects of covering slurry ○ Low emission spreading equipment (slurry) ○ Flexible tryes	  
Encourage better soil pH management	○ Support regular soil testing as part of Whole Farm Climate Change review ○ Variable rate application equipment (fertiliser and lime)	 
Facilitate on farm anaerobic digestion of slurry by supporting establishment and running costs	○ Capital funding for AD and subsidised running costs	

6.2 Carbon Sequestration

Recommendation	Actions / Examples	Type of Support
Prioritisation for achieving recognition of the role of farmland in the sequestration and storage of carbon and enabling this to be taken into account in the smart inventory for agriculture. Demonstration of best practice in soil carbon management and soil health Encourage restoration and protection of peat soils	○ Research into measurement and inclusion of carbon sequestration in carbon auditing tools, which could inform inventory reporting ○ Funded monitor and demonstration farms developing best practice and transferring knowledge to farmers ○ Targeted funding for peatland restoration and management projects.	   
Incentivise small scale tree and hedgerow/corridor planting with sequestration captured in the carbon audits and inventory for agriculture Encourage planting for both biodiversity and carbon sequestration Investigate the viability of other climate change mitigation techniques and technologies not yet widely adopted in the UK but used elsewhere in the world	○ Funding for planting ○ Support research into further refinement of the smart inventory and development of carbon auditing tools to include sequestration ○ Advice and training for farmers ○ Practical demonstration of the benefits through monitor farms and knowledge sharing ○ Include afforestation options in the Whole Farm Climate Review tool ○ Fund further research and piloting of biochar, and emerging	   

	Carbon Storage technologies	

7 Opportunity and Innovation

Recommendation	Actions / Examples	Type of Support
Active participation by government and industry in the GWP* debate	○ Research into the implications for the dairy sector and the supply chain.	
Capitalisation of low emission logistics and milk processing technology to secure export opportunities	○ Investment in low emission technologies within the supply chain	
Enable non-exclusive contracts to allow greater flexibility for farmers	○ Regulation of the supply chain to promote equitable trading conditions for all participants	
Support joint ventures and co-operative opportunities	○ Prioritise funding for collaborative and co-operative projects	
Enable farmers with carbon positive balance sheet to trade assets and develop income stream	○ Commissioning of commercially focussed research into opportunities for carbon trading and the regulatory framework needed. ○ Develop a regulated digital trading platform	 

0 Collaboration

Recommendation	Actions / Examples	Type of Support
Improved climate collaboration within the dairy supply chain, with government facilitation, to deliver greater transparency and sharing of best practice to deliver improved carbon efficiency. Collaboration within the dairy supply chain to try to standardise Scope 3 reporting to ensure aligned objectives and the avoidance of duplication, working with the proposed Centre of Excellence to ensure it is informed by the latest scientific advice.	○ Centre of Excellence	

Collaboration within the banking sector on TCFD reporting to ensure aligned objectives and the avoidance of duplication, working with the proposed Centre of Excellence (Section 9.1) to ensure it is informed by the latest scientific advice.	○ Centre of Excellence	
Further exploration of opportunities for public private partnerships through supply chain collaboration and the Centre of Excellence (see 9.1 - A Centre of Excellence)	○ Centre of Excellence	
Prioritisation of investment in local and regional processing and increasing supply chain and milk field resilience.	○ Funding for capital projects with priority given to collaborative projects	
Creation of an Agricultural Climate Change Centre of Excellence as a single entity with scientific research and innovation at its heart, but with close links to farmers, advisers, suppliers, processors and retailers. Improved cross-industry communication, collaboration, knowledge transfer would be its core function, together with media communication.	○ Centre of Excellence