Efficient Farming cuts Greenhouse Gases

Greenhouse Gas Reduction Strategy and Action Plan – promoting and encouraging the adoption of technical efficiency to improve farm business performance and reduce greenhouse gas emissions.

Greenhouse Gas Implementation Partnership

Phase One Report 2014

The member organisations of the Greenhouse Gas Implementation Partnership are;

Department of Agriculture and Rural Development
www.dardni.gov.uk
AN ROINN Talmhaíochta agus Forbartha Tuaithe
MÄNNYSTRIE O Fairms an Kintra Fordèrin

COUNCIL FOR NATURE CONSERVATION AND THE COUNTRYSIDE
An Advisory Council to the Department of the Environment

THE VOICE OF THE FAMILY FARMER

Confor
Promoting forestry and wood

Northern Ireland Grain Trade Association

afbi Agri-Food and Biosciences Institute

LMC Livestock & Meat Commission

Ulster Farmers' Union

nimea

Dairy UK North Ireland

Ministerial Foreword

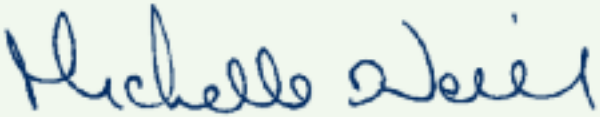
In the agriculture sector, we face two defining global issues; the need to produce more food to sustain a burgeoning world population and the imperative to avoid global warming reaching dangerous levels. I am determined that the local agriculture sector should rise to these dual challenges. I welcome the publication of the Greenhouse Gas Implementation Partnership's (GHGIP) Phase One Report and I am delighted that the GHGIP is setting a template for success in protecting our greatest asset, the natural environment.

I endorse the Partnership's aim to lower the carbon footprint of local food production by implementing a suite of efficiency measures on-farm which are proven to reduce the amount of emissions associated with agricultural production. Efficient farming is sustainable farming. Our collective efforts should promote the most efficient output possible while minimising environmental impacts.

I would encourage all of our farmers to look at this report and implement those efficiency measures that are most likely to grow their farm business. Improved efficiency means fewer emissions and increased farm profits. Reducing the carbon intensity of farming must go hand in hand with the increased production needed to achieve the aspirations of the Agri-Food Strategy Board set out in its "Going for Growth" report.

Agricultural production on the whole island of Ireland has significant potential to produce quality food products with the lowest possible carbon footprint. The global need for food will be ever increasing and we must ensure that the right framework is in place locally so that this demand is met from efficient and sustainable farm systems. Failure to do so could lead to an increase in less efficient production elsewhere and a global increase in carbon emissions.

This report shows that significant progress can be made by a strong voluntary partnership between processor, producer and environmental interests, supported by DARD policy, CAFRE development services and AFBI scientific research. I sincerely thank all the GHGIP member organisations for their efforts thus far. I wish them continued success and look forward to further updates on their vital work.



Michelle O'Neill MLA

Minister of Agriculture and Rural Development

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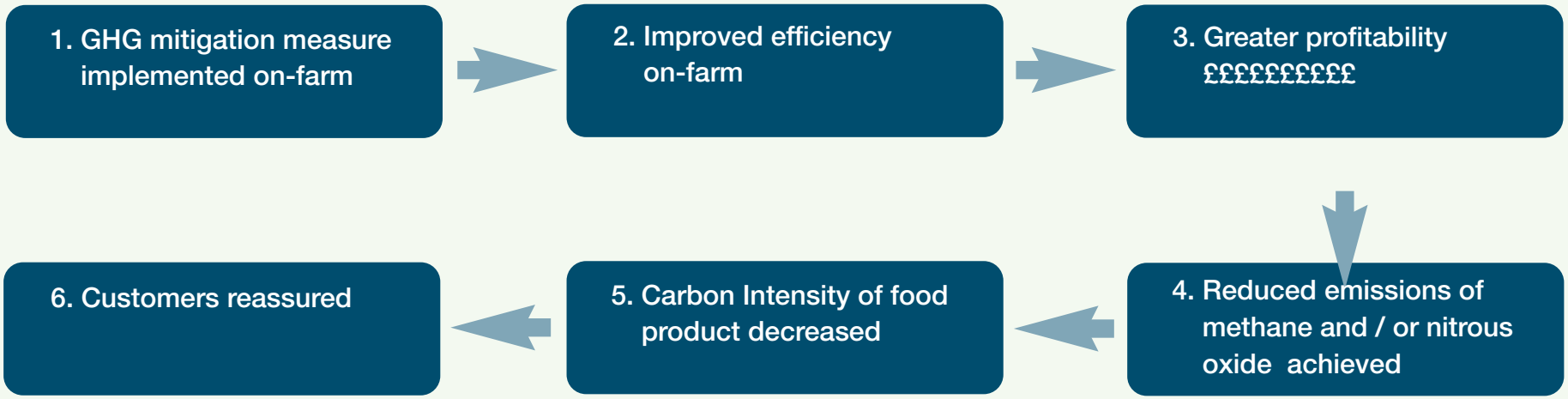
Introduction - Setting the Context

In December 2011 the Agriculture and Forestry Greenhouse Gas Stakeholder Group issued its GHG Reduction Strategy and Action Plan – "Efficient Farming Cuts Greenhouse Gases."[i] Central to this plan was the message that carbon mitigation in the agriculture sector can be achieved through on-farm adoption of efficiency measures.

"Efficient Farming" identified that key to the success of the strategy would be the continuation of the voluntary partnership approach between the agri-food sector, government, scientists and environmentalists. By demonstrating that lowering the carbon footprint of local food production is good for the farmer and good for the environment, the Stakeholder Group wished to set a path towards a sustainable and profitable agri-food industry which is fully committed to lowering the carbon intensity of the valuable food it produces.

> "Agricultural production within Northern Ireland is relatively efficient but there is increased pressure to reduce GHG emissions. Coupled with this is the need to increase global food production to meet the needs of an increasing population. In this context, reductions in the emission intensity of food production will be critical, with greater reductions in intensity required as food production increases." **Efficient Farming Cuts Greenhouse Gases**



"Awareness Raising" was the theme of Phase One of "Efficient Farming" which ran from 2011 to 2013. This document aims to report on the progress made by the agri-food sector towards the goals outlined for Phase One and specifically detail the industry's attempts to reduce the carbon intensity of local food production.

As outlined in "Efficient Farming", integral to successful implementation of Phase One were;

- Establishing a robust delivery partnership
- Improving awareness
- Beginning implementation
- Using scientific research results

1. Establishing a Robust Partnership

Following the publication of "Efficient Farming Cuts Greenhouse Gases" the GHG Stakeholder Group recognised in 2011 that it was vital to take ownership of this strategy and make sustained progress on delivery. The GHG Stakeholder Group therefore rebranded itself as the Greenhouse Gas Implementation Partnership (GHGIP) with the aim of overseeing the efforts of the agri-food sector to engage its producers, processors and other interests on the need to address the carbon footprint of local food. The Implementation Partnership retained its membership and initiated a sub-group structure to provide a platform to focus on emissions from the key agricultural sectors. In 2012, the red meat, dairy and arable sub-groups held their initial meetings and these have continued throughout 2013.

The soil is a natural sink for carbon however the quantities of carbon sequestered vary significantly depending on the manner in which the land is managed. To further investigate this important issue, in 2013 the GHGIP established a sub-group on sequestration tasked to examine how local land can be best managed to enhance carbon storage. This sub-group includes representatives from the agricultural and forestry industries, environmental stakeholders and public bodies.

The Implementation Partnership and its sub groups have met on a regular basis. A key part of their role has been to highlight the importance of lowering the carbon footprint of local food production, as well as disseminating appropriate information both formally and informally. This report represents a summary of the progress made by the Implementation Partnership and the industry at large towards a more efficient and less carbon intensive agri-food sector.

2. Improving awareness

Since the launch of "Efficient Farming Cuts Greenhouse Gases", the Strategy itself, as well as the general issue of carbon efficiency in the agriculture sector, has been publicised in all forms of the local farming media. The entire 24th August 2012 edition of "Farm Gate" was dedicated to interviews with GHGIP sub-group chairmen while there have been numerous references to "Efficient Farming" in the local press.

The Action Plan has also been promoted at a large range of events including;

- Practical On-farm Renewable Energy Events at CAFRE's Greenmount and Enniskillen Campuses in February and October 2012 and 2013

- Research Challenge Fund farm walks
- RUAS Balmoral Show 2012
- Arable Crop Conferences 2012 and 2013
- Potato Conference 2012
- Sheep Conference 2012
- Feed efficiency events for dairying, pigs and beef cattle
- Animal Health Challenge programmes
- Sustainable Farming in the LFAs events
- Cereal workshops
- Mushroom Conference 2013

3. Beginning implementation

The emission of greenhouse gases from livestock farming is a naturally occurring biological process so there will always be a level of GHGs associated with the production of food for human consumption. Future decades will see agriculture faced with the challenge of feeding an ever growing global population. The focus of the GHGIP has been to achieve efficiencies in each farming system so that the average amount of carbon used in producing agricultural output (eg a kilogram of beef, pork or chicken, a litre of milk etc) is reduced. This is known as reducing the **carbon intensity** of local food production. This report describes many of the ongoing efficiency efforts being made by the agri-food sector as it endeavours to reduce the carbon intensity of its food production systems.

4. Using scientific research results

Central to any viable efficiency measure are scientific evidence and the appropriate transfer of such knowledge. A major focus of the work of the Implementation Partnership has been the need to target scientific knowledge to influence farmer behaviour. Farmers can only be expected to implement efficiency measures if they can be confident that they are not risking their farm performance. Efficiency measures captured in this report have been informed by scientific research with AFBI central to this effort in a local context. Robust science is the first step towards developing any efficiency measure with knowledge transfer through farmer training equally important. The case studies highlighted in this report show how scientific understanding is integral to all efforts to lower agriculture's carbon footprint.

What can "efficient farming" do for us?

One of the key messages highlighted by the GHGIP is that implementing efficiency measures on-farm is a "win-win" scenario for farmers. Efficient farmers are more profitable farmers. Increasingly, the consumer market is likely to demand food with the lowest possible carbon footprint so the drive towards efficiency will take on ever increasing importance. Sustainability of food production is vital and it is imperative that the agri-food sector minimises its GHG emissions.

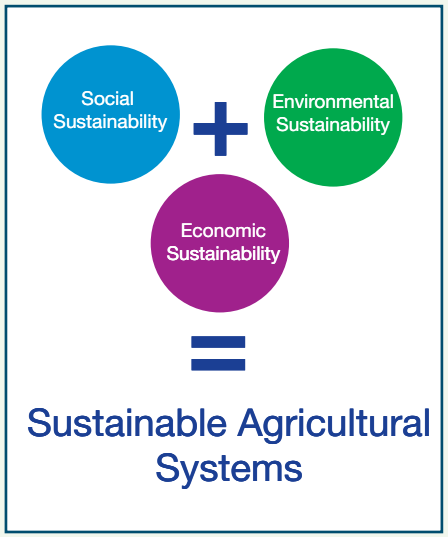
Globally, the need for food is predicted to rise substantially over the coming decades. GHG emissions are a natural result of the farming systems which feed the world so there is a need to farm "smarter," making best use of limited resources to meet the need for food. To ensure a secure supply of food for a growing population, smarter production will be necessary. Efficiency measures can prevent a proportional increase in emissions. Retaining food security will be a key goal while the work of the GHGIP has always been framed in the context that Northern Ireland is a significant net exporter of food. The importance of food exports to the NI economy was recognised by the Agri-Food Strategy Board in "Going for Growth," their strategic plan for the Agri-Food sector[ii]. Meeting the worldwide need for food through production in relatively efficient areas such as Northern Ireland is good for the battle against global warming and climate change. Reducing production in Northern Ireland to meet arbitrary targets on aggregate emissions has the potential for unintended consequences and could increase global emissions as the need for food is met from farming in other, less efficient countries and regions.

The Road to Sustainability

What is Sustainable Intensification?

"Increasing food production while simultaneously reducing environmental impacts and enhancing the wide range of interlinked ecosystem services that society needs from land."

Reducing our food's carbon footprint is key to sustainable agriculture but there are many other aspects which incorporate the concept of sustainability in the agri-food sector.



Sustainability comprises economic, environmental and social concerns and within each component exist various measures of sustainability. For example, environmental sustainability is not exclusively concerned with carbon footprint since the imperative to protect and enhance biodiversity must also be incorporated into decision making. Similarly, policies designed to enhance the economic sustainability of the agri-food sector must be framed in a manner which takes into account social impacts within the wider rural area.

Fundamental to the drive towards sustainability is the need to make the most effective use of our available resources. As detailed in this report, the agri-food sector is already implementing efficiency measures which enhance environmental and economic sustainability whilst protecting social sustainability. Similarly, where it makes best sense to manage land to protect biodiversity, farmers have risen to this challenge, often supported by DARD through Agri-environment schemes. Farmers are also committed to improving animal health and welfare, complying with all regulation where necessary and also driving forward voluntary initiatives to improve the quality of life experienced by the animals which produce our food. This commitment ensures that our food production systems are socially acceptable.

As noted in the Agri-Food Strategy Board's "Going for Growth" report, Northern Ireland's natural advantages of land quality, abundant water, proximity to market and a high quality, committed workforce mean that it is well positioned to be a world leader in sustainable and efficient food production. Yet sustainability can only be achieved through the effective management of these resources. This issue was identified by the Agri-Food Strategy Board which recommended that a strategic regional land management policy should be developed. DARD is committed to leading implementation of this recommendation. Such a strategy will identify how agricultural land can best be utilised to secure a sustainable future for our countryside, recognising that healthy fertile land is good for farming and good for the environment.

FAO Report: Tackling Climate Change through Livestock

In September 2013, the United Nations' Food and Agriculture Organisation (FAO) issued a report[iii] outlining their assessment of GHG emissions from the agriculture sector. An important conclusion reached in this report was that technologies and practices which would mitigate emissions do exist but are not as widely used as they could be. More extensive implementation of these practices, many of which are outlined within this report, could achieve a significant reduction in the carbon intensity of food production. The way forward suggested by the FAO mirrors the approach of GHGIP by advocating increased adoption of the efficiency measures already in place on industry leading farm systems. The message is quite clear; every farm in Northern Ireland, and indeed the world, has the potential to lower the carbon footprint of the food it produces and improving practices will achieve cost savings. A partnership approach between all parts of the agri-food sector is advocated as the most effective means of achieving these cost and carbon savings.

"These new findings (outlined in "Tackling Climate Change through Livestock") show that the potential to improve the sector's environmental performance is significant – and that realising that potential is indeed do-able. These efficiency gains can be achieved by improving practices, and don't necessitate changing production systems. But we need political will, better policies and most importantly, joint action." ***Ren Wang, FAO Assistant Director-General for Agriculture and Consumer Protection.***

"The majority of abatement measures identified will enable famers to save money as well as reduce emissions." **UK Committee on Climate Change – *Agriculture Fact Sheet.***[iv]

"Emission intensities (emissions per unit of animal product) vary greatly between production units, even within similar production systems. Different farming practices and supply chain management explain this variability. Within the gap between the production units with the lowest emission intensities and those with the highest emission intensities, lies an important potential for mitigation." ***FAO Report – Tackling Climate Change Through Livestock.***

Carbon intensity explained;

Greenhouse Gas emissions are a natural consequence of farming systems. The digestive systems of ruminants such as cattle or sheep produce methane as part of a biological process while some emissions of nitrous oxide are unavoidably associated with the use of fertiliser required for efficient arable farming.

Therefore producing food will always cause some GHG emissions. Each unit of agricultural output (i.e. every litre of milk, kilo of beef, lamb, pork or poultry or tonne of vegetables) will have a certain amount of GHG emissions associated with its production. This is known as the carbon intensity or emissions intensity of that unit of agricultural output or food product. By lowering the amount of carbon it takes to produce that unit of product, farmers can lower the carbon intensity of the food they produce.

By focusing on lowering carbon intensity and making the “efficient farming” choices to achieve this, the farmer can potentially reduce the overall carbon emissions from his farm whilst still growing his business and increasing production, effectively producing “more from less.”

A central principle outlined in “Efficient Farming Cuts Greenhouse Gases” was that increased efficiency should be the aim of every farming system, regardless of type or size. Every farmer in Northern Ireland should be encouraged to join the industry on the road to efficiency and sustainability, regardless of their starting point. Every farming system has developed for valid business reasons and the aims of the GHGIP are best achieved by focusing on the efficiencies which can be achieved within each system, rather than comparing the performance of one type of system against its counterparts.

A number of key areas were identified upon which the GHGIP wished to structure its report. Some of these represent sectoral interests while other topics have relevance to all systems of farming. The key areas to be reported on are;

Farmer Awareness	Nutrient Management	Beef & Sheep	Dairy
Arable	Sequestration	GHG Inventories	Energy Efficiency
	Renewable Energy	Agri-Environment	

For an efficiency measure to make a significant impact at regional or national level, it must be supported by three vital components;

- Robust scientific evidence establishing its merits
- An effective means of communicating the benefits of the measure
- A farming community inclined towards innovation and enhanced efficiency

The GHGIP are firmly of the view that each of the above facets is in place locally and that the NI agri-food sector are equipped with the competencies needed to make further improvements on an existing efficient food production system. Huge efforts have already been made but there will always be more to be achieved as our agriculture industry strives towards being a world leader on farm efficiency and carbon intensity.

With Phase One of the “Efficient Farming” strategy focussing on farmer awareness and beginning implementation, further strategic direction will be required in a Phase Two “Efficient Farming” Action Plan which should outline a direction of travel for the rest of this decade. The GHGIP intend to issue this strategy in 2014, recognising the importance of the Rural Development Programme 2014 – 2020 as a central driver towards improved farm efficiency and enhanced environmental outcomes.

Farmer Awareness

- Phase One of "Efficient Farming Cuts Greenhouse Gases" has focussed on spreading the message amongst farmers that efficient farming is profitable farming which will reduce the carbon intensity of local food production.
- The strategy was launched on 8th December 2011 by Agriculture Minister Michelle O'Neill and representatives of the agri-food industry[v]. Further specific events to publicise "Efficient Farming" have been ongoing since December 2011 including presentations to the Guild of Agricultural Journalists, the Soil Association, Dairy Processors and Agricultural Feed Advisers.
- Initially three sub-groups were established to assist in the implementation of the GHG reduction plan within specific sectors of the agri-food industry. These sub-groups, representing the dairy[vi], red meat[vii] and arable[viii] sectors, produced sector specific leaflets highlighting practical ways for farmers to reduce the carbon footprint of their food production system.
- Since the launch of "Efficient Farming Cuts Greenhouse Gases", the Strategy itself, as well the general issue of carbon efficiency in the agricultural sector, have been publicised in all forms of the local farming media. The entire 24th August 2012 edition of "Farm Gate" was dedicated to interviews with GHGIP sub-group chairmen while there have been numerous references to "Efficient Farming" in the local press.
- Since the GHG Action Plan was published, CAFRE have conducted surveys to ascertain the level of awareness amongst farmers on how GHGs affect their farm business. 91% of those surveyed are aware of greenhouse gases, around half are aware of publicity surrounding agricultural greenhouse gases while the large majority believe Climate Change will affect their farm business in the next ten years.
- The reduction framework has been promoted at a large range of events including;
    - Practical On-farm Renewable Energy Events at Greenmount Campus in October 2012 and Enniskillen Campus in February 2012 and 2013
    - Research Challenge Fund farm walks
    - RUAS Balmoral Show 2012
    - Arable Crops Conferences 2012 and 2013
    - Potato Conference 2012

- Sheep Conference 2012
- Feed efficiency events for dairying, pigs and beef cattle
- Animal Health Challenge programmes
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- Cereal workshops
- Mushroom Conference 2013

"Awareness-raising and extension are important first steps towards the adoption of better technologies and practices." ***FAO Report – Tackling Climate Change Through Livestock***

"Customers and processors are becoming more and more concerned with the sustainability and environmental impact of the food we eat. Local farmers are increasingly aware of this issue and have risen to the challenge by implementing a significant number of efficiency measures on-farm which will lower the carbon footprint of local food production." ***Richard Moore, Linden Foods and GHGIP Red Meat Sub-Group Chairman***

"Farmers have made significant efficiency gains over the past 50 or 60 years but there is always more that can be done. Like their forefathers, today's farmers will look at on-farm efficiency and the opportunities to make those cost and GHG savings." ***Harry Sinclair, UFU President – Farm Gate, BBC Radio Ulster 20th September 2012***

"Livestock is the best way we can contribute to feeding the world. The only way to convert grass to food that humans can use is through livestock. In pursuing this we have a responsibility to minimise our emissions through the most sustainable production systems possible as the industry has been doing for the past three years."
Phelim O'Neill, "Industry Insight", Farming Life 1st June 2013

Efficient Farming by Numbers

76% of farmers believe climate change will affect their business in the next 10 years.

Over 3,000 dairy farmers received specific information from the GHGIP on suggested efficiency measures.

11,000 red meat farmers were targeted with written advice on how to reduce carbon footprint of food in their sector.

16,000 farmers are represented amongst the 10 member organisations of the Greenhouse Gas Implementation Partnership.

Nutrient Management

- Key to any attempt to achieve on-farm efficiency is the successful management of nutrients. The use of nitrogen is vital to successful farming but some of this nitrogen will be emitted as nitrous oxide and lost to the farming system. Nitrous oxide is a potent greenhouse gas, more than 300 times more powerful than carbon dioxide. Farm systems can replenish themselves through the recycling of valuable nutrients such as nitrogen.
- Slurry is a vital source of nutrients for local farming systems however this resource needs to be utilised as effectively as possible.[ix] AFBI research has shown that enhanced spreading techniques can improve grass yield by up to 26% compared to the traditional "splash plate" method.[x] To encourage this efficiency, DARD launched the Manure Efficiency and Technology Scheme (METS)[xi] which has financed two rounds of grant assistance towards advanced slurry spreading equipment.
- Application of chemical fertiliser above the recommended rates, at inappropriate times or in unsuitable weather conditions can be costly to farmers and also lead to harmful impacts on crops and the environment. Hundreds of farmers each year receive Nutrient Management Plan training delivered by CAFRE, which enables them to both save money on fertiliser bills and reduce their farm business' nitrous oxide emissions. Delaying fertiliser application until at least four days after slurry application reduces the potential for unproductive nitrous oxide emissions.
- Knowledge of nutrient requirement is key. Local farmers are increasingly adopting soil analysis as a key aid in helping to improve soil fertility by effectively targeting nutrient applications. For a cost of as little as 54 pence per hectare per year[xii], farmers are gaining access to vital information on soil characteristics such as phosphorus, potassium and pH levels.
- The pH of soil declines over time as the soil becomes more acidic, and in Northern Ireland 50% of soils have a pH less than 6 and 25% of soils have a pH less than 5.5. It has been shown that grass yields will increase by up to 30% when the pH is raised to 6.0 from 5.0 - 5.5.[xiii]
- To help farmers complete their Nutrient Management Plans and realise the full potential of soil analysis CAFRE have developed a Crop Nutrient Recommendation Calculator.[xiv] This online program helps the farmer determine crop requirement for inorganic fertiliser and select a fertiliser type and application by taking into account the crop type, soil analysis, previous cropping, soil type and organic manure applied.

"Soil analysis allowed me to identify the precise nutrient status of my land and with the help of CAFRE's Crop Nutrient Recommendation Calculator, I am able to target fertiliser and manure inputs effectively and avoid applying costly excess fertiliser." **Mark McCollum, arable farmer, Coleraine.**

"Understanding your soil pH is the first step in any soil management system. If your pH isn't correct, you are underutilising all the fertiliser you are applying, causing unnecessary GHG emissions and, crucially, wasting a lot of money." **John Best, chair of the GHGIP Arable sub-group – BBC Radio Ulster Farm Gate, 24th September 2013.**

"Replacing calcium ammonium nitrate (CAN), with urea amended with Agrotain®* (a urease inhibitor) has been shown to be an effective mitigation strategy to reduce nitrous oxide emissions under Northern Ireland's climatic conditions and soil types, whilst maintaining grass production." **Dr Catherine Watson, AFBI** *The use of a trade name is for clarity only and does not necessarily imply endorsement of the product.

Efficient Farming by Numbers

690 farmers have attended nutrient management training since 2011.

196 farmers have used crop nutrient calculators since 2011.

20,000 soil samples have been sought through DARD since 2011.

£7.32- the fertiliser saving per acre by using a trailing shoe to apply slurry as opposed to a splash plate.

232 advanced slurry systems have been funded by DARD.

£2 million in grant assistance provided through the NIRDP for enhanced slurry spreading equipment.

Beef and Sheep

- Improving cow and ewe fertility will decrease carbon intensity by reducing "unproductive" emissions. Farmers are increasingly aware of the need to minimise the period of time each year during which a cow is not in calf. This is being addressed through CAFRE's Suckler Cow Fertility Challenge.
- Parasitic diseases such as liver fluke are a threat to farm efficiency and increase the carbon intensity of production. Backed by AFBI science, CAFRE have embarked on an Animal Health Challenge to educate farmers on this threat to their farm system.
- Scientific evidence has shown that lowering the age at which suckler cows are first in calf to 24 months will increase efficiency and benefit both the farmer and the environment.[xv] The average age at which heifers born in Northern Ireland in 2007 had their first calf was 988.08 days. Increased farmer uptake saw this drop to 939.22 days for the 2009 born batch of calves. AFBI research funded by farmers through AgriSearch is identifying how artificial insemination (AI) can contribute to lowering calving age.[xvi]
- For 24 month old first calving heifers, selecting proven AI bulls with high Estimated Breeding Values (EBV) for calving ease and low birth weights is an excellent way to reduce calving difficulty and calf mortality.
- Improved grassland management can potentially double the utilisable yield of grass. This would allow for significant efficiencies in feed supply. During 2012 and 2013 17 Grass/Clover monitor farm groups have been established on beef and sheep farms to promote efficient grassland management. This involves nutrient management planning, implementing rotational grazing systems and sward improvement.
- Accurate assessment of on-farm carbon performance helps identify further efficiencies. Linden Foods have worked with McDonald's to produce a free online carbon tool for beef farmers called "What If?"[xvii]
- In 2011, local meat processors introduced a revised grading system for beef carcasses which increased the number of possible grades to 225. This system incentivises increased efficiency in beef farming and therefore lowers carbon intensity. Early, more efficient slaughter of beef cattle has been encouraged by higher proliferation of traditional breeds such as Hereford and Angus in recent years.

Animal Health | Batch Weaning | Bull Management | Condition Scoring

Efficient Grassland Production | Fertility | Finishing Systems | Forage Crops

Nutrient Management | Performance Recording of Sires | Winter Feeding

The CAFRE beef and sheep development team have provided advice and training to farmers in the above priority areas. Farmers are encouraged to make the simple and important efficiencies in these areas which suit their farming system and will therefore improve profitability and reduce the carbon intensity of beef production.

Northern Ireland Suckler Beef Programme[xviii]

This programme has implemented the following efficiency measures on 8 farms;

- early finishing of beef cattle at 16 and 20 months
- rotational paddock grazing
- soil analysis
- improving herd fertility
- genetic selection

By making these farms more efficient, the carbon intensity of beef produced is lowered. Crucially, this money saving information is disseminated to other farmers through weekly features in the Irish Farmer's Journal and public walks through participating farms. The programme is also supported by meat processor ABP, the Irish Farmer's Journal and CAFRE, the government's farming development service.

"By working with the NI Suckler Beef Programme and identifying on-farm efficiencies, I have increased my gross margin per hectare to £793 in 2012 which is 50% above the NI average. By becoming more efficient, I am also responding to the market's desire that I should lower the carbon intensity of my beef product." **John Milligan, Farmer, Castlewellan, County Down.**

Efficient Farming by Numbers

278 farmers have completed the Suckler Cow Fertility Challenge.

353 farmers undertaking the Beef and Sheep Animal Health Challenge.

503 – Technologies adopted on-farm in 2012/2013 following CAFRE advice.

460 – Beef and Sheep farmers involved in benchmarking their farm business performance.

1300 – attendees at 80 farm walks organised through Grass / Clover Monitor Groups.

14483 – Number of grass silage samples from local farms analysed by AFBI in 2012 & 2013.

Dairy

- Key to the "Efficient Farming Cuts Greenhouse Gases" strategy has been the message that on-farm efficiencies will reduce both costs and carbon and therefore improve profit margins. 3,000 dairy farmers have received information outlining the cost savings which can be achieved by reducing their carbon footprint.
- Accurate measurement of performance is vital to improved efficiency and reduced carbon intensity. Through CAFRE's benchmarking programme, farmers can identify means by which to lower costs and make improvements in milk yield and replacement rate.
- Recent AFBI research has shown that crossbreeding the traditional Holstein-Friesian dairy herd with Jersey sires can enhance fertility, reduce health problems and increase longevity with a positive subsequent financial impact of £39 per cow.[xix]
- Updated and efficient milking technology can improve cow comfort and udder health, increase safety for farmer and animal and also significantly reduce labour. The GHG benefits are considerable with energy savings of up to 65%, a possible 40% reduction in water and less detergent used.[xx]
- A modern Dairy Unit has recently been installed for educational purposes at CAFRE, Greenmount. It incorporates a number of features designed to reduce the dairy carbon footprint such as enhanced slurry management, rainwater harvesting, cubicle mats to reduce lameness and milk cooling through energy "recycling".
- Selecting sires through the Profitable Lifetime Index (PLI) will improve the genetics of a dairy herd and increase performance and efficiency. CAFRE have increased understanding of PLI through a dedicated training programme outlining the benefit of long term breeding decisions.
- Bovine Viral Diarrhoea (BVD) is a highly infectious disease which is a threat to the health and efficiency of the dairy herd. Infected cattle thrive poorly, costing the farmer money and emitting excess GHGs. A voluntary scheme aimed at eradicating BVD from the local herd is now in place.
- Sexed semen is available for use in local herds and has potential to increase the efficiency of dairy farming when used appropriately.

- The Bovine Information System (BovIS), located within DARD Online Services, contains a carbon calculator freely available to farmers. This will allow dairy farmers to assess their current emissions and identify means of achieving improvement.

GHGIP - Partnership in Action

In October / November 2012, CAFRE, AFBI, AgriSearch and the UFU joined forces to promote the "Efficient Farming Cuts Greenhouse Gases" message at three events at dairy farms in Counties Antrim, Down and Tyrone. Over 150 farmers attended each event with AFBI and the UFU outlining the need for farmers to be aware of the carbon footprint of their food. Advice was also provided on improving cow health post-calving and the importance of feed efficiency, particularly in the winter months.[xxii]

"When selecting sires farmers should make use of the Profitable Lifetime Index (PLI) which takes account of milk output, fertility, health and longevity. High PLI sires produce more profitable offspring, and their improved fertility, health and longevity will reduce the carbon intensity of milk production systems." ***Stephen Montgomery, Dairy Farmer-Gorticross, Drumahoe.***

"It is estimated that the eradication of BVD virus from NI herds would result in GHG savings equivalent to 134,500 tonnes of carbon." ***AFBI Report on the prevalence of BVD virus amongst the Northern Ireland suckler and dairy herd.***

Efficient Farming by Numbers

£38 per cow- the saving that can be achieved by eradicating BVD.

447 farms contributed to CAFRE dairy benchmarking in 2011/2012.

82 local Feed Advisers signed up to Feed Adviser Register[xxi].

£45 per cow per year represents the potential saving associated with reducing replacement rates by 5% through genetic improvement.

1481 herds have taken part in the voluntary element of the BVD scheme.

1400- the number of farmers visiting the new dairy unit at Greenmount.

£100 per cow per year – the saving possible with increased feed efficiency through better quality grass and silage. Reduced concentrate feed or increased milk yields will lower carbon intensity.

Arable

- Key to any successful arable enterprise is the efficient use of nutrients. Where the nutrient requirements of a crop can be met through a farm's own resources, this displaces some chemical fertiliser, therefore reducing farm costs and avoiding nitrous oxide emissions.
- Enhancing knowledge is key to efficient nutrient management. Since April 2011, CAFRE have trained 266 farmers on how best to utilise nutrients. Knowing the characteristics of your soil is vital to ensure effective use of valuable nutrients. GPS soil mapping and guidance can be utilised on arable farms to improve the efficiency of machinery and inputs. This was highlighted during a major Arable Crops Conference in January 2013.[xxiii]
- There is a direct correlation between improved crop yield and lowering the carbon intensity of arable farming. CAFRE benchmarking suggests that the most efficient local farms have yields almost 40% greater than lower performing farm businesses. These high performing farms make best use of technology and training and focus on timeliness.
- Selecting appropriate crop varieties is crucial to maximising yield and thus lowering the carbon intensity of arable production. Ongoing annual AFBI trials allow government to produce recommended lists of the most efficient crop varieties[xxiv]. Advice and workshops disseminate this knowledge to arable growers.
- Waterlogged and wet soils emit excess nitrous oxide and reduce crop yields. Improving the condition of a soil will increase productivity. Advice on how to improve soil drainage was delivered at two "Soil and Sward Improvement" events in July 2013 at CAFRE.
- By training potato farmers in how to manage their crop to control blight, CAFRE reduce the risk of this disease impairing crop yield.
- Agronomy workshops organised by CAFRE allow arable growers to learn together how their valuable inputs can be most effectively utilised for maximum yield with minimum cost. The Crop Nutrient Recommendation Calculator helps arable farmers to understand the value of their own nutrient sources such as organic manures and thus reduce their bill for chemical fertiliser. The arable sector is ideally placed to utilise excess organic material produced by other farming systems.

- Mash Direct, a Comber based farming and food production enterprise, seek to increase efficiency by implementing a "field to fork" approach, sharing agronomy advice with producers to ensure that their potatoes and vegetables are efficiently produced.
- A local register of Sprayer Operators is supported by the Ulster Farmers' Union and CAFRE as part of a voluntary initiative to ensure that sprayers are operated by competent professionals. Efficient application practice reduces costs and mitigates GHG emissions.

"Yield is always an important concern as an arable grower. We choose crop varieties from the DARD recommended list based on yield performance and disease resistance. Crop rotation, efficient crop establishment techniques and the accurate utilisation of both organic manures and chemical fertiliser form an important part of our arable enterprise. Applying plant protection products in accordance with the Sustainable Use Directive is vital and ensures that we are farming in an environmentally sustainable manner. This is good for business and reduces the carbon intensity of the food we produce." ***Gerald Erwin, Arable Farmer.***

"We always encourage our growers to be as efficient as possible and provide them with expertise to assist in this quest. Sourcing locally grown food which has maximised its yield reduces our carbon footprint, cuts costs and allows us to produce a sustainable and tasty local product." ***Martin Hamilton, Mash Direct.***

Efficient Farming by Numbers

85% of the certified Spring Barley seed produced in NI is of varieties on the DARD Recommended List.

1100 – Number of Farmers attending "Soil and Sward Improvement" events in July 2013

91 arable farmers attended agronomy workshops in 2013

200 – Number of attendees educated on the "Efficient Farming Cuts Greenhouse Gases" message at CAFRE cereals conference

120 arable growers aim to improve efficiency through benchmarking their business

Sequestration

- The agriculture sector is unique in its ability to store carbon in its systems. The soil is a natural sink for carbon however the quantities of carbon sequestered vary depending on how the land is managed.
- Installing and managing woodland is an effective way to ensure carbon storage within the soil. DARD has seven separate grant schemes in place to encourage development of new woodland and to support the management of existing woodlands. In 2010, AFBI and CAFRE jointly staged a "Trees store Carbon" seminar which outlined the potential for trees to sequester carbon and therefore reduce overall GHG emissions.
- There are significant sequestration benefits to the establishment of woodland within traditional agricultural systems. In silvopasture, grazing stock and trees are combined on the same land base. In AFBI trials at Loughgall, sheep were grazed within planted trees but there was no appreciable reduction in livestock grazing capacity until the trees were about 12 years old.[xxv] Agroforestry systems can store up to 3.8 times more carbon than ryegrass pasture.[xxvi] These systems will be supported under the next round of Agri-Environment funding.
- White and red clover are legumes that are capable of "fixing" atmospheric nitrogen. This nitrogen is then released into the soil and can be taken up by the accompanying grass plants. This can increase carbon storage in farming systems and reduces the amount of expensive chemical fertiliser used on-farm. Clover can also improve stock performance resulting in increased milk yields, and improved lamb and beef performance.
- Red and white clover are capable of fixing up to 300kgs and 200kgs of nitrogen per hectare respectively. This amounts to a saving of 9 bags of N fertiliser per acre in the case of red clover and 6 bags per acre for white clover. Increased levels of protein are also available in swards which include clover. Local farmers use clover swards to reduce their production costs. Indirect GHG emissions in grassland systems can be reduced by 25% or more when relying on clover rather than N fertiliser.
- DARD issue fortnightly Clover Check Bulletins with details of current growth and clover content data that has been collected from monitor plots laid down on grass / clover swards at the CAFRE Organic unit at Greenmount Campus and on a commercial beef / sheep farm at Ballymena. In addition to data from plots, the bulletins also focus on the use of grass/clover swards at the CAFRE Beef and Sheep Development Centre and on 12 conventional beef and sheep farms in Northern Ireland.

- Peatlands (ie bogs and fens) are a vital aid for carbon storage. In NI, 12% of our land surface supports peat soils. This makes a significant contribution to the globally important UK total. Peatlands are the single most important terrestrial carbon store at UK level, storing at least 3,200 million tonnes of carbon.[xxvii] Around 80,000 hectares of peatland is managed under DARD Agri-Environment Schemes.

Trees for Mourne

The Mourne Heritage Trust (MHT) and local farmers work in partnership to enhance agroforestry within the Mourne Area of Outstanding Natural Beauty (AONB). Mourne provenance Oak and Hazel are grown by the Trust for 4 years before being transferred for planting to local sites at no cost to the farm business. MHT staff and conservation volunteers carry out the planting and help maintain them for the first 2 years, and the farmer contributes by making the land available and providing an ongoing commitment to protect the trees whilst maintaining existing livestock grazing. In recent years, 40 acres have been planted with trees as part of this voluntary partnership approach which provides multiple environmental benefits while protecting food production in the AONB.

> "Incorporating clover into my swards has been good for the environment and good for my farm business. Clover is an excellent source of nutrients and relatively easy to establish in my fields. By effectively managing my clover, I have reduced the need for chemical fertiliser on my farm. This has saved me money and reduced the carbon footprint of the beef and lamb I produce." ***Roger Bell - Grass/Clover Monitor Farmer, Kells.***

> "Grassland carbon sequestration could significantly offset emissions..... However, affordable methods for quantifying sequestration, as well as a better understanding of institutional needs and economic viability of this option, are required before it can be implemented at scale." ***FAO Report – Tackling Climate Change Through Livestock.***

Efficient Farming by Numbers

252 hectares of new woodland planted in 2012/13.

0.4 to 0.7 tonnes of carbon per hectare per year are estimated to be sequestered by grassland systems in Northern Ireland.

11,043 – number of hectares in Northern Ireland covered in woodland.

GHG Inventories

- Accurate assessment of emission levels is vital to inform government policy and ascertain whether the relevant carbon reduction targets can be achieved.
- NI emissions are currently measured as part of an inventory at Member State level. DARD is supporting and part-financing a UK-wide project to improve the accuracy of GHG measurement.[xxviii] This project will adapt the current inventory to take into account local farming practices, soils and climate, reflecting adoption of mitigation practices. As well as DARD funding, a local link to this ongoing work is provided through AFBI who are part of the consortium undertaking the project.
- Key to the success of this project is knowledge transfer. Two well attended knowledge exchange workshops took place in May 2012 and June 2013. Five publications have also been issued outlining the results of scientific projects on methane and nitrous oxide emissions from agriculture.
- Crucially the revised inventory will capture mitigation practices which the existing inventory does not currently identify. It is important that due credit is given to the efficient farming practices which have already been implemented locally.
- The inventory project has developed and tested a number of novel technologies that have potential on-farm application in tracking methane emissions from livestock. These include the online monitoring of milking cows, feeding station headspace hoods, GreenFeed automated head chambers, laser methane detectors and portable methane sampling units (“Methcollar”).
- AFBI research undertaken as part of the Inventory Project suggests that enteric methane emissions from hill replacement ewes can be predicted from feed intake.
- A similar project is underway to improve and reduce uncertainty in the Land Use, Land Use Change and Forestry (LULUCF) GHG Inventory.[xxix] Land use has a unique and important part to play in reducing emissions of greenhouse gases because in this sector they can potentially be removed from the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC) have identified three methods or tiers by which emissions can be measured;

- **Tier 1:**
  - Simple first order approach
  - spatially coarse default data based on globally available data
  - large uncertainties
- **Tier 2:**
  - A more accurate approach
  - country or region specific values for the general defaults
  - relatively smaller uncertainties
- **Tier 3:**
  - Higher order methods
  - detailed modelling and / or inventory measurement systems
  - data at a greater resolution
  - lower uncertainties

These projects aim to improve the information used to compile the GHG Inventories associated with local farming from tier one towards tiers two and three.

> "It is likely that emissions reported in the current agricultural inventory are overestimates, since efficiency of production is not taken into account."
> ***Government response to the Fifth Annual Progress Report of the Committee on Climate Change.***

Efficient Farming by Numbers

2015 – Date by which the revised Agricultural Inventory will be available.

2,000- number of cows on which an online monitoring system for methane emissions has been tested.

Energy Efficiency

- Utilising heat and electricity is vital to every farm business but costs money and causes carbon emissions. It therefore makes environmental and financial sense to utilise energy in the most efficient way possible. A little time or money invested at the right time can result in significant savings in the long term.
- CAFRE's ongoing benchmarking programme is an effective means by which farms can measure the efficiency of their energy use and identify practical ways to improve their farming practices by incorporating energy saving techniques.[xxx] Over the past three years CAFRE has carried out energy audits on a wide range of agricultural businesses.
- Machinery plays an integral role in the vast majority of farm businesses however its inefficient use reduces profitability. Practical measures being adopted on-farm include matching equipment to the correct horse power and monitoring tyre pressure to ensure optimum levels. Regular servicing and maintenance is also important.
- Farmers can use a fuel consumption database established as part of the EU Efficient20 project to record their own fuel usage and benchmark this against what other farmers are achieving.[xxxi] Farmers can also see the impact of implementing specific fuel-saving solutions (such as adjusting ballast, tyre pressures or working depth). A collection of energy efficiency case studies and an advice brochure have also been developed.[xxxii]
- Energy efficiency is a key feature of the advice and training delivered by the CAFRE Energy team. The message that energy efficiency cuts costs and reduces carbon has been delivered at a series of industry conferences.
- Energy efficiency was an important consideration in the development of the new dairy unit at CAFRE Greenmount. A number of features were installed to ensure that energy was utilised as effectively as possible, saving the taxpayer money and lowering the unit's carbon footprint. These measures include harvesting and filtering rainwater to be used in a plate cooler which pre-cools the milk. The heat recovered from the second phase of milk cooling provides warm water for cleaning the plant while the UV-treated harvested rain water is also used for livestock drinking water.[xxxiii]
- Local farming and food production enterprise, Mash Direct invested in their business by replacing an aging oil system with a new efficient gas system. This has reduced their energy costs by 30%.

- Energy efficiency was one of the drivers for DARD's recent Farm Modernisation Programme under the Rural Development Programme. Items eligible for grant support included 32 products aimed at improving on-farm energy efficiency.

30,000 litre storage tank holding rain harvested water to feed the plate cooler in the new dairy unit at CAFRE, Greenmount.

Plate heat exchanger used to cool the milk.

Efficient Farming by Numbers

£50 – the daily cost saving[xxxiv] achieved by using wider tyres over 10 hours ploughing.

14%- the average fuel saving[xxxv] achieved by pilot groups of farmers implementing fuel efficiency measures across 9 EU countries, including the UK.

20% - Over inflation of tyres by this amount can reduce fuel efficiency by 30%.

50%- the amount of heat lost within uninsulated water heaters in 17 hours. Only 5% is lost with good insulation.

350- Number of farmers taking part in CAFRE energy efficiency benchmarking in 2012 / 2013.

Over £250,000 was offered in financial support for energy efficiency equipment under Tranche Three of the Farm Modernisation Programme.

Renewable Energy

- By producing renewable energy, agricultural businesses can utilise their own resources effectively to benefit from a secure supply of energy not subject to the fluctuating costs associated with fossil fuels.
- CAFRE, in cooperation with the agriculture industry, host twice yearly Practical On-Farm Renewable Energy (POFRE) events. These events provide farmers with advice and training on how renewable energy technologies can assist their business and how farm businesses can overcome the likely challenges to implementation.[xxxvi]
- An External Stakeholder Group (ESG) has reported on progress towards achieving the goals outlined in the DARD Renewable Energy Action Plan.[xxxvii] The ESG were satisfied that the vast majority of actions remained relevant and should continue, with some modification where appropriate.
- The DARD Biomass Processing Challenge Fund (BPCF) (co-funded by the EU through the ERDF) provided grant support to farm businesses that wish to use their biomass resources such as animal slurry and energy crops to produce renewable heat and electricity.
- Prior to launching tranche two of the BPCF, Agriculture Minister Michelle O'Neill visited a Biogas Plant which had been successfully installed under tranche one.[xxxviii] She noted the potential of such projects to make effective use of farm resources and reduce running costs.
- Cré- the Composting and Anaerobic Digestion Association of Ireland launched ADNI in 2012, the first AD conference[xxxix] held north of the border. DARD provided keynote speakers at the 2012 and 2013 events.
- Feasibility studies and installation costs for renewable energy technologies linked to farm diversification were supported under the Rural Development Programme 2007 - 2013.
- Renewable Energy training is available through CAFRE's renewable energy team and these courses have been very popular amongst farmers. Training is available in relation to a range of renewable energy technologies including Biomass Boilers, Wind Turbines, Solar PV and Solar Thermal, AD, Heat Pumps and Micro-hydro. This training advises farmers on issues such as Finance, Grid Connection, Planning and statutory support measures.[xl]

- The Renewable Heat Incentive (RHI) launched in 2012. Farmers can utilise this scheme to receive a financial incentive for the production of heat for their business.[xli] CAFRE have teamed up with a number of industry partners to advise farmers of the benefits of biomass as a carbon friendly fuel source.

"Northern Ireland is in a unique position to position itself as a centre of excellence for specific Renewable Energy technologies and solutions." ***Renewable Energy External Stakeholder Group.***

Efficient Farming by Numbers

28,000 - estimated tonnes of carbon to be saved through Tranche 2 BPCF Projects.

3,100 – number of attendees at PoFRE events since 2011.

19 – the number of Letters of Offer issued under tranche 2 of the BPCF.

£3 million – grant offered under the Biomass Processing Challenge Fund.

£4.3 million- the amount of grant assistance provided for Renewable Energy projects under the NIRDP (£1.8 million paid as of October 2013).

£29,800 – potential financial savings per year to be achieved by installing biomass heating in a poultry unit.

3,951 – the number of farmers attending CAFRE renewable energy training since April 2011.

£8,300 - annual financial benefit from installing an 11kW wind turbine on-farm.

Agri-Environment

- Agri-environment schemes provide funding to farmers to support management of land to achieve enhanced environmental outcomes. The schemes aim to produce a thriving landscape supporting vibrant levels of biodiversity and also improve the quality of water, air and soil. A further objective of the schemes is to mitigate agricultural GHG emissions and help reduce the impact of climate change.
- Around 10,000 farmers had active agri-environment agreements in 2013. These were delivered through the NI Countryside Management Scheme and other (older) legacy schemes.[xlii]
- Agri-environment schemes provide funding which encourages the planting of woodland outside the forest setting. Native trees planted within 600 hectares of buffer zones were managed as part of agri-environment schemes as of 31st December 2012. This enhances the potential of the soil to sequester carbon.
- Agri-environment schemes also play a vital role in maintaining and enhancing the conservation value of existing woodland, scrub and parkland. This, in turn, maintains their sequestration function. 8,900 ha of woodland, 3,400 ha of scrub and 2,800 ha of parkland are managed under agri-environment agreements. Maintaining productivity and improving the sequestration potential of managed grasslands is being considered as part of the development of agri-environment grassland prescriptions.
- Farmers in agri-environment schemes may receive funding to manage riparian zones. These zones aim to enhance biodiversity and improve the water quality of farm waterways. In addition, native tree planting along these zones contributes to carbon sequestration.
- Informed and effective nutrient management aids farm productivity and reduces the need for inorganic fertiliser, thus decreasing nitrous oxide emissions. It is anticipated that agri-environment schemes from 2014 to 2020 will offer advice and training on nutrient management.
- Appropriate management of moorland maximises carbon sequestration. 77,900 hectares of moorland are managed under agri-environment agreements.

- Organic farming systems were supported under the Agri-Environment Programme 2007-2013. Organic farming systems do not depend on chemical N fertilisers and so have low nitrous oxide emissions.

- The future agri-environment programme will include carbon sequestration measures aimed at reducing overall GHG emissions by protecting and enhancing the amount of carbon stored within our soils. It will also support increased resilience on farm systems as they adapt to a changing climate.

"Managing my land under an agri-environment scheme has helped sustain my farm business and enabled compliance with regulations. I have maintained production in a way that complements the environment and enhances biodiversity on the farm. The areas of native woodland that I have established on the farm will store carbon as the trees grow. This will help reduce the carbon footprint of the production on the farm." ***Karl Mullan, Garvagh.***

“Measures to address climate change and the carbon intensity of farming will be integrated within all Agri-environment scheme agreements.” ***Consultation on the Rural Development Programme 2014 to 2020.***

Efficient Farming by Numbers

£171 million funding has been provided to Agri-Environment farmers through the Rural Development Programme from 2007 to 30 September 2013.

10,000 farmers in Agri-Environment Schemes during 2013.

36% of the total farmed land in Northern Ireland was managed under an Agri-Environment Scheme in 2013.

From the Lab to the Farm Gate: Scientific excellence reaping on-farm rewards

The quest to lower the carbon intensity of food production is a focus for a significant volume of scientific effort and funding, both locally and globally. Before farmers can be encouraged to implement any particular efficiency, the impact of the measure on both farm performance and carbon footprint must be established. This can only be done through independently validated and robust scientific research.

The GHGIP have always recognised that establishing an evidence base is key to the success of their local reduction strategy. Farmers need assurance of the merits of an efficiency measure before they can be expected to adapt the manner in which they manage their farm business. Nor is it enough that scientific research is simply undertaken and conclusions reached. Scientific research is only of benefit when that knowledge is transferred to the farmer in a manner which influences their behaviour, i.e. when the farmer makes a business decision based on evidence communicated to them which shows that the measure will improve farm performance.

Positive changes in farm behaviour can also be achieved by establishing best practice on government facilities which are publicly accessible. High quality public sector facilities benefit the wider agri-food sector not just in respect of the research and training delivered there, but also as a working example to farmers of efficiency measures which they could consider for their own farms.

The case studies below highlight specific examples of how scientific research conducted at AFBI is providing an evidence base for the uptake of viable efficiency measures on-farm. These measures have verified benefits for GHG reduction and have also been shown to improve farm performance.

Similarly, the state of the art dairy unit at CAFRE's Greenmount campus serves as a demonstration facility, displaying the efficiency benefits of many of its technologies to the hundreds of farmers who have visited it.

Case Study 1

Dairyman

DAIRYMAN is a farmer focussed initiative which aims to strengthen rural communities in the regions of North West Europe where dairy farming is a main economic activity. It is co-funded by INTERREG through the European Regional Development Fund with AFBI (along with CAFRE) acting as the sole UK representative, working alongside institutions and farmers from Ireland, Belgium, Germany, the Netherlands, Luxembourg and France.[xliii]

As part of the project, farm development plans were prepared for 9 pilot dairy farms in Northern Ireland (in conjunction with CAFRE). The objectives of these plans were to improve the economic, environmental and social performances of the farms. The environmental objectives included reducing the potential impact of GHG emissions from farms.

For 8 of the 9 farms, the development plans included measures and technologies aimed at decreasing methane and nitrous oxide emissions and reducing the carbon footprint of dairying. The development plans were drawn up with input from AFBI scientists, CAFRE advisors and dairy technologists and the pilot farmers themselves. For each objective, indicators were selected with target values that the farmers were required to reach within the 3 years of the project. By 2012, the targets relating to GHG emissions had been partially if not fully achieved on most farms.

Some of the measures successfully implemented on-farm in Northern Ireland were;

- **Automated (Heat) Oestrus detection equipment**

  Benefit on-farm- Provides an accurate assessment of oestrus enabling servicing of animals at optimal times, thus fewer (not-in-calf) cows culled, resulting in reduced replacement rate, shortened calving interval and lowered methane emissions per litre of milk.

- **Out-of-parlour feeding system**

  Benefit on-farm- Improves feed use efficiency thus increasing milk production per cow and reducing methane emissions per litre of milk produced.

Case Study 1

- **Select sires with high Profitable Lifetime Index (£PLI), Fertility Index (FI) and Lifespan (LS) Predicted Transmitting Abilities (PTAs):**

  Benefit on-farm- Improved cow profitability, longevity and fertility, and hence reduced calving intervals and reduced methane emissions per litre of milk produced.

- **Delaying N fertiliser application until 4 days after slurry application**

  Benefit on-farm- Reduced potential for unproductive emissions of nitrous oxide.

- **Land-spread slurry by using trailing shoe spreader**

  Benefit On-farm- Reduced potential for wasted emissions of ammonia and nitrous oxide.

- **Heat recovery system**

  Benefit On-farm- Reduces electricity costs of heating water for parlour washing, thus improving farm profitability and reducing the carbon footprint of milk production.

At the final Dairyman meeting in July 2013, the conclusion reached was that innovative measures, such as those outlined above, result in fewer nutrient losses and reduced emissions of greenhouse gases, while production costs are reduced. This was achieved by a more efficient use of feed and manure on dairy farms. The key to the success of the project was the positive interaction between scientists, farmers and government advisors with Dr John Bailey of AFBI describing the farmer-led knowledge transfer as integral to achieving the project's aim of making a tangible contribution to reducing the carbon intensity of food from the dairy herd.

Case Study 2

Manure Efficiency and Technology Scheme (METS)

Purpose

The Manure Efficiency and Technology Scheme (METS) is a capital grant scheme to assist farmers to invest in equipment which will improve efficiency and reduce environmental impact.

The purpose of the scheme is to encourage uptake of advanced slurry spreaders and slurry separators. These technologies will help farmers to achieve greater nutrient efficiency from manures and slurry.

The objectives of the METS scheme were to;

- Protect and enhance the environment by improving the management of manures on farm.
- Reduce farm input costs by decreasing chemical fertiliser requirements through improved nutrient efficiency of manures.
- Improve water quality in rivers and lakes and help to achieve compliance with the EU Nitrates Directive and EU Water Framework Directive.
- Lower greenhouse gas emissions by reducing chemical fertiliser use.
- Reduce the odour from slurry spreading.

Slurry Spreading method

In Northern Ireland most slurry is land spread by tankers with a splash plate. This method of application can result in up to 80% of the available Nitrogen (N) applied in the slurry being lost to the atmosphere in the form of ammonia.

This results in a loss of a valuable plant nutrient and also causes atmospheric pollution. Following surface spreading, approximately 30% of the total ammonia loss takes place in the first hour and the 80% above within the first 12 hours.

A basic concept to minimise such losses is to reduce the surface area of the spread slurry that is exposed to the air. This is achieved by applying slurry by trailing shoe, trailing hose or soil injection methods.

Case Study 2

AFBI Research into Alternative Slurry Spreading Systems

Research at AFBI-Hillsborough has compared slurry application by splash plate, trailing-shoe and band spreading methods in May after the first, second and third silage harvests. The slurry was 73.6 g/kg dry matter on average.

Slurry was applied between 3 and 34 days following the first silage harvest. Average application rate was around 50 m^3 / ha. Compared with the conventional splash plate method, the band spreading and trailing-shoe methods increased grass yield by 18% and 26% respectively (averaged over all spreading occasions).

The increased yields obtained with the band spreading and trailing-shoe methods were equivalent to applying inorganic fertiliser N at, on average, 69 kg/ha compared with 25 kg/ha when slurry was applied with the splash plate.

In addition, the ability to apply slurry up to 4 weeks after silage harvest is a major advantage, allowing flexibility in farm management practice.

Benefits of Enhanced Slurry Spreading Systems

- Reduced ammonia losses
- Better Nitrogen utilisation
- Produces higher grass yields
  - Trailing Shoe + 26%
  - Band Spreading + 18%
- More even spread pattern and crop response
- Reduced grass contamination
- Results in less odour
- Slurry has been successfully spread up to 3-4 weeks after cutting
- Compared to splash plate application, trailing-shoe application gave a 26% increases in grass DM yield. This is equivalent to 44 kg/ha fertiliser N.
- Provides a wider window of opportunity for spreading

Case Study 2

Current Position and potential uptake

- There have been two tranches of the METS scheme to date with some 232 advanced slurry systems funded.
- Over £2m of grant aid has been paid out to date. This equates to a total investment of £5.8m by NI farmers and government in advanced slurry spreading equipment. A third Tranche of the Manure Efficiency Technology Scheme is planned for 2014.
- Training on Nutrient Management Planning for all successful METS Tranche Two applicants has also been provided by CAFRE. METS illustrates an integrated approach beginning with research and carrying through to technology transfer, grant aid and training.

Case Study 3

Low Carbon Beef Project

Driving forward efficiency in production systems is a key way of reducing the carbon footprint of beef production. Funded by DARD and AgriSearch under the Research Challenge Fund, AFBI have worked with local farmers in a "Low Carbon Beef Project" to identify means of reducing the carbon intensity of local beef.

As part of the programme, an online greenhouse gas benchmarking application has been developed and is available through the Bovine Information System (BovIS). This greenhouse gas calculator has the potential to play an important role in providing an accurate assessment of carbon emissions from a range of beef production systems. It will supply solid evidence on the effects of GHG mitigation measures on beef systems.

Farmers participating in the project have their cattle individually weighed every three months. A monitoring programme has been developed which facilitates the monitoring of performance against age. The programme enables the age of individual animals to be determined automatically with the target live weight for age automatically flagged. Based on the performance of the animal, appropriate management advice is provided with particular focus on feeding regimes and ensuring that meal, silage and other inputs are provided in an efficient method that ensures optimum nutrition. The online growth tool, now incorporated into the DARD BovIS system, allows food rations such as meal and silage to be effectively targeted. A similar growth tool has been developed in respect of the dairy bred beef herd. Key to the success of these efficiency measures is the accurate recording of nutritional inputs.

Fundamental to this project is the desire to promote the benefits of lowering the age at which suckler cows are first in calf to 24 months. Adoption of this measure on-farm will increase efficiency and benefit both the farmer and the environment. The average age at which heifers born in Northern Ireland in 2007 had their first calf was 988.08 days. Increased farmer awareness, assisted by CAFRE training, saw this drop to 939.22 days for the 2009 born batch of calves. Features of herds where 24 month calving has been implemented include greater productivity and proportionally less need for housing.

Based on a 100 cow suckler herd, the project found that an 8-10% saving in GHGs was achieved by utilising these measures. The successful completion of this project reiterates the message that efficient farming is profitable farming which will have a resultant positive impact on carbon intensity.

Case Study 3

"There is significant room to reduce age at first calving for suckler replacements. With appropriate management, replacements can calve at 24 months of age leading to significant financial and greenhouse gas savings. From working with our farmer co-researchers, we already see the benefit of using the monitoring tool."[xliv] Steven Morrison, Low Carbon Beef researcher, AFBI.

Case Study 4

Animal Health and Welfare NI

BVD is a contagious disease of the bovine which reduces the productivity of affected cattle, as well as compromising their welfare. Such a disease can have a negative economic impact on industry and a significant bearing on productivity. BVD is commonly referred to as a production disease. A recent economic study estimated that a "tag and test" programme designed to eradicate BVD in the Republic of Ireland would give a cost benefit of 10:1 over the six years of the programme i.e. a return of ten euro for each one spent.[xlv]

An AFBI study in 2011, funded by DARD and AgriSearch, found that BVD was widespread in both the Northern Ireland dairy and suckler herds with 66% of herds tested showing some degree of exposure to the virus. The report suggested that BVD eradication was a viable goal which could produce a 2% improvement in milk production per animal and a 3% reduction in replacement rate. However it was also stated that any BVD eradication programme would require the full support of industry.[xlvi]

The AFBI study went on to estimate the carbon savings which would be associated with the eradication of BVD in Northern Ireland. Based on combining a 2% improvement in milk production per animal with a 3% reduction in replacement rate, eradicating BVD from the daily herd alone would result in GHG savings equivalent to 91,000 tonnes of carbon. Based on the analysis of the dairy sector, it is estimated that a 3% improvement in replacement rate in the beef industry will lead to a 1.5% reduction in GHG emissions. This amounts to an estimated 43,500 tonnes of carbon savings from the beef sector.

An industry-led, not-for-profit partnership between livestock producers, processors and animal health advisers known as Animal Health and Welfare Northern Ireland (AHWNI) was launched in 2012. It initiated voluntary BVD testing programme from 1st January 2013.[xlvii]

The voluntary BVD programme is based on testing ear punch samples for BVD virus collected using tissue sample-enabled official identity tags. It is designed to identify calves persistently infected (PI) with BVD virus as soon as possible after birth to enable their rapid culling. The programme seeks to prevent spread through trade, including imported cattle.

The programme requires that each herd keeper will carry out tissue tag testing of calves for a three year period which is a model designed to identify all the PIs that exist in the entire herd. The model also includes a further three years of lower intensity surveillance. In addition, a PI animal must not be moved off farm (sold) and should be isolated from other cattle until it is culled or slaughtered.

Case Study 4

Within the first nine months of the scheme, almost 1500 farmers were participating on a voluntary basis. In December 2013, Agriculture Minister Michelle O'Neill announced her intention introduce legislation to support the farming industry in working together to eradicate BVD.[xlviii] These efforts showcase how the local agricultural industry is willing to take steps to eradicate this disease because it recognises the benefits likely to accrue with increased sector profitability and reduced GHG emissions from livestock, thus lowering the carbon intensity of local food.

Animal Health & Welfare NI
www.animalhealthni.com

Case Study 5

New Dairy Unit at CAFRE Greenmount

The new dairy unit at Greenmount Campus, opened by Agriculture Minister Michelle O'Neill in June 2013[xlix] is a world class resource provided to support present and future generations of dairy farmers. It aims to best meet the education and training needs of agriculture students and the dairy industry, enable the delivery of knowledge and technology transfer and provide an example of good practice for the dairy industry at large.[l] Prior to construction, one of the major objectives for the unit was to provide a "best in class" demonstration facility addressing greenhouse gas mitigation measures, animal health and welfare, as well as energy efficiency. Successful adherence to these principles has provided a template for the reduction of carbon intensity throughout the local dairy herd.

The dairy unit reinforces the message that "Efficient Farming Cuts Greenhouse Gases" as it seeks to reduce the carbon footprint of livestock farming by incorporating a number of GHG mitigation technologies in its design. These include;

- Milk cooling using high flow rate plate cooling
- Heat recovery from milk cooling
- Variable speed vacuum pump
- Biomass fueled space heating
- Ammonia volatilization emission reduction slurry management technologies
- Rapid removal of fresh slurry for anaerobic digestion in future
- Rainwater harvesting

The key principle underlining the construction is that no potentially useful output should be wasted or utilised inefficiently. Rainwater is harvested and recycled to conserve energy and resources. The heat produced naturally in milking is captured and "put to work" providing energy for a cooler to prepare the milk for market. The slurry management system is also designed specially to prevent ammonia emissions which can act as a catalyst for greenhouse gases. Use of many of the technologies incorporated into the dairy unit has been informed by AFBI's ongoing scientific research.

Case Study 5

Energy efficiency is also of central importance. The lighting system within the cubicle building has been designed to minimize energy use while providing 16 hours of effective daylight equivalent (200 Lux) with 8 hours of effective darkness. This has been achieved through the installation of 16 No. AgriLights fitted with 400W high pressure sodium bulbs. Alternate lights incorporate red LED lamps to allow animal inspection at night while simulating darkness for the cows. The roof cladding incorporates 15% by area of light sheets to provide a high level of natural light into the building during daylight hours.

Detailed performance targets have been set for the future herd utilising the dairy facility. These targets incorporate efficiency measures such as milk yield, nutrient management and concentrate use but also include a specific carbon intensity target of 1 kg of carbon per litre of milk produced from the unit. There are also ambitious plans for future development which include the installation of an Anaerobic Digestion system. This would provide heat and electricity for use on-site while also reducing the farm's need for chemical fertiliser by producing a digestate with nutrient content more bioavailable than fresh slurry.

Already the unit has proved very popular amongst the local industry with farmers very eager to learn from this world class demonstration facility and find out what elements of the construction are best suited for adoption on their own farms. Over 1400 visitors have been welcomed into the facility within four months, each receiving the message that investment in efficiency is worthwhile, profitable and good for the environment.

Ammonia emission reduction flooring systems

Milking Parlour

Maternity Wing

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