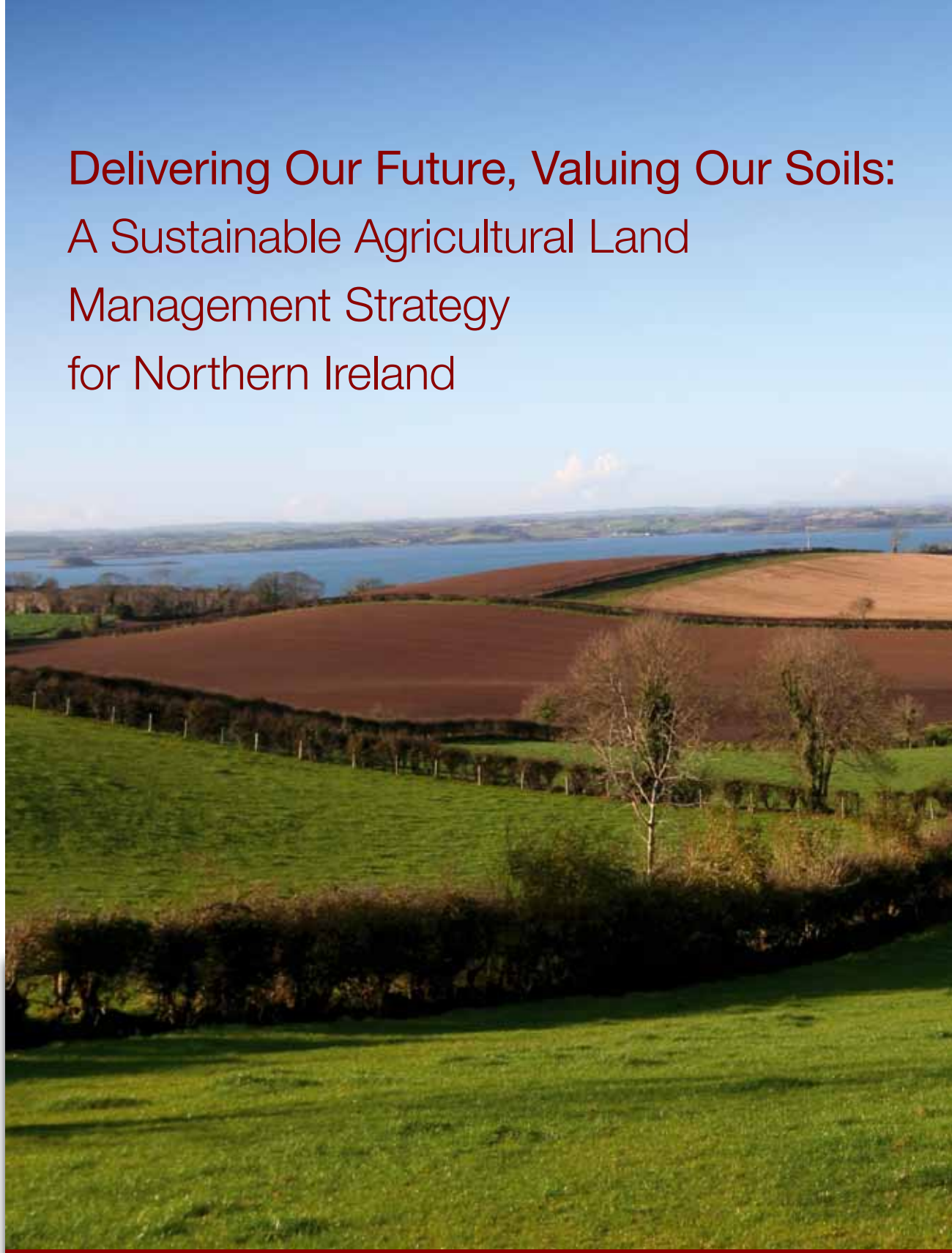
Delivering Our Future, Valuing Our Soils:
A Sustainable Agricultural Land Management Strategy for Northern Ireland



Expert Working Group on
Sustainable Land Management

Chairman's Foreword

As we look to the future to assess what it might hold for the Land based, Agriculture Sector, in Northern Ireland, a combination of Climatic, Market and Political uncertainties, outside the control of farmers, overshadows that assessment. One thing is for certain, the volatility that the Sector has recently had to cope with, will certainly not diminish in the near future.

So always having been guilty of looking for the positive, looking to what farmers can do for themselves; it seemed from the outset, that essential to the Sector's future, has to be the empowering of farmers and landowners, with very farm specific, detailed information, on their productivity, their soil fertility, their water and habitat quality. Only then can they make the right decisions for their own land, which will build an inherent resilience in their business and allow them to minimise the impact of these uncertainties and volatilities.

Can it be achieved? Well by the championing of the concept of "Measuring and then Managing," the N. Ireland Poultry Sector, over more recent years, has already delivered resilient sustainability, diminished uncertainty, through enhanced farm profits, better engagement with young people, a reducing environmental footprint, and an increased output to drive the growth in the N. Ireland Economy, with all being progressed simultaneously. So if the Poultry Sector can do it, so can the Land Based Sector do it as well.

In the N. Ireland's Agri-Food Strategy Board's report, "*Going for Growth*," recommendation 22 foresaw the need for the Land based, Agriculture Sector to ask itself how it could deliver across this breadth of resilient sustainability.

For the last two and half years I have had the privilege of chairing an Expert Working Group, challenged by the Department of Agriculture, Environment and Rural Affairs, to answer recommendation 22. The Group has been made up from a complete cross section of sector stakeholder experts, including deliberately, a significant body of experience from within the Farming Community. We had predicted from the outset, that it was the Farming Community who would have to do most, but not all of the behavioural change needed to deliver a sustainable Land Based Agriculture Sector. It therefore was imperative that they were proactively engaged from the start.

As a Group, we have horizon scanned into the future; we have assessed the risks; we have sought solutions; we have advised on where new knowledge will be needed; we have looked at the levers for positive behavioural change; and we have looked at the indicators which could be used to measure progress of implementation against the Strategy.

We have carried out one of the most intensive engagements the Sector has seen in recent years, twenty nine, one on one, meetings, across the complete cross section of stakeholders, resulting in both the Industry and the NGO Community speaking publically of their desire to see this Strategy implemented.

As Chair, I am delighted to say that we, as an Expert Working Group, have unanimity for the Strategy as laid out in this document. We are very clear, if the Strategy is implemented in full, with the choreography as stated, the N. Ireland Land Based Sector will not only deliver true resilient Sustainability - economic, environment and social; but will also become a World Exemplar, and will be able to maximise its value from a Global Market Place, because of the unique transparency and credibility of the approach being proposed in this Strategy.

I would like to conclude by saying a massive thank you. It is impossible to single out all the many people who engaged, gave evidence, supported and constructively challenged us, through this process, but you know who you all are, and on behalf of my colleagues can I say a massive thank you to you all.

To my employer, Devenish, without your support and generosity of my time, I could not have given the effort needed to credibly chair this Expert Working Group.

To our Secretariat, Mr Patrick Savage, DAERA, for your unselfish and unstinting support for us, and your ability to summarise succinctly what were at times, very detailed and challenging discussions. We could not have achieved this level of positive output without you, thank you.

And finally to my fellow members of the Expert Working Group, who gave up their time unstintingly and without remuneration. Thank you very much for your expert input, for your fantastic challenge function, and more importantly, your understanding that we had to find a Strategy that was fair to all.

Thank you.

Dr John Gilliland OBE

Chairman, Expert Working Group on Sustainable Land Management

Left to Right - Paddy Savage, Patrick Casement, Sue Christie, James Brown, Minister McIlveen, Jonathan Birnie, John Gilliland, Martyn Blair, John Best

Executive Summary

The Agri-Food Strategy Board's *"Going for Growth"* set ambitious targets for Northern Ireland's agri-food sector, including a target for a 60% growth in sales by 2020. It specifically recommended the development of a strategic land management policy and emphasised that agricultural productivity must be considered in parallel with the need for our agri-food industry to maintain and enhance environmental performance.

An independent Expert Working Group was established in 2014 with members from the agri-food, environmental and government sectors. Their aim was to produce a Sustainable Agricultural Land Management Strategy for Northern Ireland which would outline how the ambition of *"Going for Growth"* would be achieved in a way which improved farm incomes and environmental performance simultaneously.

The Group believe this report, as an output of their work, is now ideally timed. Farm incomes have now reached critical levels and Northern Ireland's agri-food sector still needs to improve its performance in key environmental focus areas such as water quality, emissions and biodiversity. The recent merger of the Department of Agriculture and Rural Development and the Department of the Environment warrants a fresh look at policy development and regulation. Therefore we believe that now is the perfect time for an innovative approach, one which can fulfil our dual ambition for good economic performance and improved environmental outcomes.

Our initial findings identified a series of issues in the way agricultural land is managed, which must be addressed:

- Our grass utilisation is significantly below optimal levels
- Less than 10% of our farmland has an up-to-date soil analysis
- 64% of our soils are not at optimum pH
- Almost 30% of agricultural land is let in Conacre, a short term arrangement which denies tenants security in their land tenure and therefore impedes long term planning

Alongside the above, significant improvements in environmental performance are also needed since:

- 63% of NI water bodies are not achieving the "Good or better" status required by the EU Water Framework Directive, despite improvements in nitrogen and phosphorus efficiency on farms
- Only 1 of Northern Ireland's 49 European Priority Habitats is at favourable status
- Agriculture is responsible for 28% of total NI Greenhouse Gas emissions
- The long term decline in populations of farmland species of plants and animals continues

To achieve sustainable land management in Northern Ireland, this strategy calls for a culture of behavioural change created by the provision of personalised information to empower farmers through measuring and managing the performance of their land. We want to see changes in how government regulates and advises farmers on the environment. Too many farmers associate the environment with regulation and penalties leading to a culture of fear. We want farmers to recognise that so much of what is good for the environment is also good for farm businesses and that the environment can be a profit centre and not just a cost centre. We strongly believe that government should take an "advocacy first" approach to improving environmental management on farms. Providing advice and guidance to farmers on how to correct environmental issues should be the initial priority with regulation and enforcement undertaken only where they are needed.

Improving the health of Northern Ireland's agricultural soils is the central focus of this strategy. Healthier soils will deliver better yields of crops and grass which are higher in quality. This will provide the raw material necessary for the increased productivity and profitability envisaged by '*Going for Growth*' and will also deliver environmental improvement simultaneously.

This strategy, if fully implemented, has the potential to positively transform the economic performance of our livestock sectors. Supported by the roadmap we have laid out, it is well within the capability of our grassland farmers to increase their grass utilisation by at least one tonne of dry matter per hectare and to also make improvements in grass and silage quality of 5 to 8%.

As an Expert Working Group we recognised the need for independent validation of the economic and environmental impact of such improvements. We therefore engaged the Agri Food Biosciences Institute (AFBI) to examine what achieving these targets would mean for our main grassland enterprises. The results are summarised in the following tables:

Dairy Sector	Current Average Non-Derogated Dairy Farm Performance	Current Average Farm, utilising 1 extra tonne of **average quality** Dry Matter of Grass, per hectare	Current Average Farm, utilising 1 extra tonne of **good quality** Dry Matter of Grass, per hectare
Whole Farm P. Balance (kg P/ha/year)	11.3	4.2	3.0
Change in N concentration in land drainage water	N/A	+ 2 mg nitrate-N/l	+ 3 mg nitrate-N/l
Net Change in Profit if Milk price is 18p per litre	N/A	+ £120 / ha / year	+ £279 / ha / year
Net Change in Profit if Milk price is 28p per litre	N/A	+ £45 / ha / year	+ £334 / ha / year

Beef Sector	Current Average Non-Derogated Dairy Farm Performance	Current Average Farm, utilising 1 extra tonne of **average quality** Dry Matter of Grass, per hectare	Current Average Farm, utilising 1 extra tonne of **good quality** Dry Matter of Grass, per hectare
Whole Farm P. Balance (kg P/ha/year)	1.93	2.03	0.69
Change in N concentration in land drainage water	N/A	+ 2 mg nitrate-N/l	+ 3 mg nitrate-N/l
Net Change in Profit if Beef Price is 280p / kg	N/A	+ £115 / ha / year	+ £137 / ha / year
Net Change in Profit if Beef Price is 380p / kg	N/A	+ £171 / ha / year	+ £204 / ha / year

The results of this analysis are clear; improving our grass utilisation and quality will mean substantially greater profits for the farmer and significantly lower phosphorus balances on farm. It is vital to our future prosperity that Northern Ireland takes the steps necessary to ensure that we reap these rewards.

The first step towards implementing our strategy is to build a detailed baseline of current productive and environmental performance. Therefore we are recommending that:

- A publicly funded GPS soil sampling and analysis survey of all agricultural land is undertaken with results provided directly to farmers. Support should be provided to translate the soil analysis results into a four year nutrient management plan
- A full aerial LiDAR survey of Northern Ireland is undertaken so that water quality interventions can be targeted with precision and that the carbon sequestered by above-ground biomass can be quantified credibly
- Real-time water quality monitoring should be established in 60 - 80 catchments with farmer discussion groups being established in these areas to deliver water quality improvement while improving farm profitability
- A central database is established to collate all the results from the above along with accessing other relevant information, such as Tellus data and the positioning of priority environmental habitats
- An online cloud-based decision support tool should be developed to give farmers access to the comprehensive personal data relating to their land, informed by the baseline information collated in the central database

Healthy soils require good management to ensure that our farmland delivers its potential for greater profitability and better environmental performance. Improved soil health will be achieved by:

- The appropriate application of lime to optimise the pH of agricultural land in Northern Ireland

- Prioritising fields at lower phosphorus (P) levels for nutrient application
- Precision application of nutrient within fields using GPS technologies
- A significant increase in the proportion of slurries and manures applied using efficient methods such as trailing shoe, band spreading or shallow injection
- More analysis of slurries and manures to complete the calculation of correct nutrient application rates
- Research into whether slurries and manures can be treated to allow safer and more biosecure redistribution between farms
- Research into whether technology such as soil potentiometers and thermometers can facilitate the application of nutrient by soil conditions, rather than calendar date
- Capital support to separate P from slurries and manures on farms which cannot sustainably spread their nutrient to land

An obvious question for the Expert Working Group to address was;

What does sustainable land management look like on a farm in Northern Ireland?

We believe that the key features of sustainable land management are:

- Achieving sustainable profits per hectare
- Good nutrient management leading to greater utilisation of higher quality grass and silage
- Production of more diverse swards with greater proportions of legumes to help extend the grazing season while improving soil structure, carbon and biology
- Properly located woody riparian strips in overland flow pathways to reduce nutrient and sediment loss to waterways to improve biological water quality
- Woody biofiltration blocks, placed downhill of farmyards and at discharges to septic tanks to capture “grey water” and reduce the risk of nutrient leakage
- Appropriate agro forestry planting on grassland farms to extend the grazing season while improving biodiversity and carbon sequestration and providing renewable fuel
- Woodland barriers between farms to improve biosecurity and herd health while increasing biodiversity and carbon sequestration
- Strategic planting of trees around intensive livestock units to reduce ammonia drift resulting in nitrogen deposition on sensitive environmental sites

Although not all of these measures will be appropriate or necessary on every farm in the short term, we strongly believe that if every farm could implement some of the measures above, then the sustainability of our agriculture industry would be greatly improved.

To achieve these positive outcomes, a culture must be created whereby farmers have the confidence to implement these sustainable land management practices.

To assist such a culture, we recommend that:

- Environmental governance is delivered using the principle of "advocacy first." This will probably require separating the task of providing environmental advice and guidance to farmers from the regulatory role of cross-compliance or similar inspections
- Following the recent clarification by the HRMC that land let under a tenancy in Northern Ireland will qualify for Agricultural Property Relief, a fiscal incentive should be introduced to voluntarily encourage farmers and land owners to move away from our eleven month conacre system and towards long term leases of at least five years
- Mentoring should be provided for effective farm succession planning
- Farmers seeking an opportunity to enter the industry should be able to access landowners and farmers willing to provide such opportunities

We believe that implementation of this strategy will be successful if:

- The trust of farmers and land managers is secured up-front
- Policy makers and the food chain, and not just the farming community alone, play their part in implementation
- The strategy is not 'cherry picked' with vital aspects disregarded
- Any phased implementation begins with Business Development Groups, Water Catchment Discussion Groups or interested significant landowners before being rolled out to the rest of the industry
- The correct choreography of implementation is followed with nutrient processing solutions for intensive farms provided before the GPS soil sampling and analysis survey
- A credible science-based sustainability brand for NI food is established
- Regulation is properly targeted and protects the responsible and proactive farmers whilst, if necessary, penalising the inactive
- Implementation is supported by a comprehensive advisory programme encompassing the public, private and voluntary sectors
- Environmentally positive farming becomes a profit centre, not a cost centre

We recognise that our report contains a lot of "big asks" for farmers, regulators and policy makers. Implementing change is not always comfortable but we are convinced that it is necessary. Achieving behavioural change in sustainable land management is subject to two over-riding principles;

1. We must measure first to be able to subsequently manage optimally

2. We must make it easy for farmers to do the right thing

To conclude, we believe that this a strategy which offers something for everybody:

- For farmers, increased resource efficiency and more utilisation of grass for greater profit
- For agricultural entrants, more opportunity to access land
- For the environment, improved soil health and fertility, improved water quality, reduced nutrient losses to water, reduced ammonia loss to air, increased carbon storage and more habitats rich in biodiversity
- For processors, a commitment to sustainability which will positively differentiate and seek better value for Northern Ireland food
- For retailers, a transparent and auditable way to assure their consumers that agriculture is delivering on its environmental responsibilities
- For government, a baseline and a means to achieve its dual commitment to improve farm profitability and meet environmental targets through an efficient and sustainable agri-food sector that drives wider economic growth
- For consumers, assurance that the local food they eat is being produced transparently and to best in class global standards
- For taxpayers, an assurance that their money is being targeted and spent efficiently
- For everybody, the increased wealth and respect created by international and domestic recognition of best in class global standards in land management and food production within Northern Ireland

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Introduction

In May 2013 the Agri-Food Strategy Board (AFSB) published '*Going for Growth*', a strategic action plan in support of the Northern Ireland agri-food industry. '*Going for Growth*' set a significant ambition for our agri-food sector. Its strategic vision for the industry was:

*"Growing a **sustainable**, profitable and integrated Agri-Food supply chain, focused on delivering the needs of the market."*

'Going for Growth' sets challenging and ambitious targets for 2020 which include:

- 60% growth in sales to £7bn
- 15% growth in employment to 115,000
- 75% growth in external sales (sales outside Northern Ireland) to £4.5 billion
- 60% growth in "added value" to £1bn ie the total added value of products and services from local companies

Crucially, the Agri-Food Strategy Board recognised that this growth must be achieved in a sustainable manner and highlighted the natural advantage of our grass-based livestock system as a carbon sink. '*Going for Growth*' referenced many of the major environmental challenges our agri-food industry faces, including water quality, biodiversity and agri emissions. It specifically recommended development of a **strategic land management policy** and emphasised that **agricultural productivity** must be considered in parallel with the need for our agri-food industry **to maintain and enhance environmental performance**.

Responding to *'Going for Growth'*

To meet the AFSB's desire for a strategic approach to land management, the Department of Agriculture and Rural Development (DARD) (now the Department of Agriculture, Environment and Rural Affairs (DAERA)) facilitated the establishment of an Expert Working Group to develop a Sustainable Agricultural Land Management Strategy. This group acts in an **independent and voluntary** capacity. Our membership was drawn from across the wide range of interests associated with agriculture and its impacts. Members' backgrounds cover each of the major farming sectors, as well as environmental advocacy, agricultural policy, food processing and government. A list of members is available at Appendix 2.

The agreed aim of the Expert Working Group in producing a Sustainable Agricultural Land Management Strategy is to;

"Provide farmers, policy makers and regulators with a strategy for land management that helps deliver a future for Northern Ireland agriculture which is economically, environmentally and socially sustainable, while achieving the ambition laid out in the 'Going for Growth' report."

We intend this to be a positive manifesto for change:

Change that is good for the farmer, good for the economy, good for the environment and good for the public

Developing a Sustainable Land Management Strategy: The Process

As an Expert Working Group, we were determined to ensure that our deliberations were based on the following principles:

- Our approach to sustainable land management must be scientifically sound
- Our strategy must be guided by the views and needs of land managers and local expert opinion
- Sustainable land management must recognise the three pillars of Sustainability - **Economic, Environmental and Social**
- We should be as efficient as possible in how we use our resources
- Northern Ireland should aim to be an innovative, smart and tech-savvy agricultural economy
- Actions proposed should have a practical benefit for farmers, the market supply chain, policy makers and regulators, and will also resonate with consumers

As an Expert Working Group we met on 14 occasions between December 2014 and September 2016. These meetings were often held at venues where members saw and learnt from examples of practical and innovative land management such as constructed wetlands, hill farming, grass and clover breeding programmes, bio filtration by willow plants, farms managed by environmental organisations, and indoor and outdoor dairy farming systems. Expert opinion was also received directly from a wide range of bodies, including the Agri Food and Biosciences Institute (AFBI), the College of Agriculture, Food and Rural Enterprise (CAFRE), the Northern Ireland Environment Agency (NIEA), Ulster University, Teagasc, the Department of Agriculture, Food and the Marine, Bord Bia, the Land Mobility Service, the National Trust, the Glenwherry Hill Regeneration Project, Sainsbury's and the Central Association of Agricultural Valuers. We are very grateful to all those who assisted us.

In order to structure the group's deliberations, a comprehensive "Horizon Scanning" exercise was undertaken. We identified nine key areas impacting upon land management:

- Soils
- Water Quality
- Biodiversity
- GHG Mitigation
- Carbon Sequestration

- Resilience to Extreme Weather
- Access to Land
- Air Quality
- Technology

Each of these key areas was analysed in detail with a focus on:

- Current performance
- The policy and legislative framework
- The relevant "knowledge gaps" and "barriers to change"
- The land management practices which can address the "knowledge gaps" and "barriers to change"
- How behavioural change can be achieved on farm

A detailed report on the results of our horizon scanning exercise is available by contacting DAERA.

This document presents our conclusions on the basis of the evidence we have received and the results of our horizon scanning. We firmly believe that implementation of this strategy will substantially improve the sustainability of agricultural land management in Northern Ireland.

A Sustainable Land Management Strategy - Why Now?

We are convinced that now is the perfect time for Northern Ireland's agri-food sector to embark on a new and integrated approach to how we manage our most important and irreplaceable resource - our land. The '*Going for Growth*' strategy has been in place since 2013 and continued progress is needed to ensure achievement of its ambitious targets for 2020. The market signals are also clear. Retailers see sustainable land management as crucial to their business and expect environmental standards to increase substantially over the next decade.

We believe that a new way forward is required to secure a sustainable future for our industry, a future in which we rise to the challenges we face but also grasp our many opportunities and fulfil the ambition of '*Going for Growth*'. Following the United Kingdom's decision to leave the European Union, it is more important than ever that Northern Ireland's agri-food sector articulates its strengths in a coherent way which successfully increases the value of our produce in both existing and developing markets.

Helping farmers achieve a viable farm income is one of our key motivations. We believe that the best means of improving environmental performance on farm is by highlighting pathways for farmers to achieve greater farm profitability while delivering environmental goals. Farm income has reached critically low levels in Northern Ireland, with statistics suggesting that a 16% annual reduction in average farm business income in 2014/15 has

been followed by a further devastating 46% estimated reduction in income in 2015/16.[1] With price volatility primarily responsible for such decreases in income, we see **improving efficiency** as a key means by which farmers can lessen their vulnerability to fluctuating prices. **Utilising primary resources more effectively** is the best way to reduce the costs of production.

At a global level, a historic international agreement[2] has recently refocused minds on the need to reduce GHG emissions so that the world avoids the worst impacts of dangerous climate change. This challenge must be considered in tandem with the need to meet the projected 70% increase in food demand by 2050[3] as a result of global population growth. As the AFSB identified in '*Going for Growth*', Northern Ireland's natural advantages of land quality, abundant water and a high calibre, committed workforce mean that we have the potential to position ourselves as a very efficient and sustainable food region from which increasing proportions of this global demand can be met.

Locally, Northern Ireland has recently published River Basin Management Plans[4] and notified these plans to the European Commission. The Plans set water quality targets for 2021 and are the means of implementing the EU's Water Framework Directive (WFD). Northern Ireland has committed to achieving Good or Better status in 70% of our water bodies by 2021, doubling from the current level of 37%. With agriculture the dominant pressure on water quality in the majority of failing catchments, we need to refocus on how our farms impact upon the rivers and streams which flow through our land.

Biodiversity is also an immediate priority due to the poor performance of Northern Ireland in respect of European Priority Habitats; only one of 49 such designated habitats is at Favourable Status and around a third of habitats have declined between 2002 and 2012.[5] There is increasing concern about the impact of nitrogen deposition on these habitats, and specifically the contribution that ammonia emissions from livestock make to that problem. Northern Ireland is the only part of the UK in which ammonia emissions are not continuing to decline and new agricultural developments are likely to be subject to vigorous assessment of their environmental impact. A recent European agreement has also set the UK a 2030 ceiling that represents a 16% reduction in ammonia emissions.

As our neighbours in the Republic of Ireland continue to engage farmers and promote their commitment to sustainable food production through the "Origin Green" programme, the perfect moment has arrived for Northern Ireland agriculture to promote its plan to combine commercial growth and environmental performance.

1 https://www.daera-ni.gov.uk/sites/default/files/publications/dard/stats-review-2014-final.pdf https://www.daera-ni.gov.uk/sites/default/files/publications/dard/ni-agricultural-incomes-2015.pdf

2 https://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf

3 World must sustainable produce 70 per cent more food by mid century - UN Report http://www.un.org/apps/news/story.asp?NewsID=46647#.V-UUtlKa3cs

4 https://www.daera-ni.gov.uk/topics/water/river-basin-management

5 From Evidence to Opportunity: A Second Assessment of the State of Northern Ireland's Environment (DOE, 2013).

Furthermore, the restructuring of government in Northern Ireland offers the ideal opportunity to fully align the dual objectives of increasing the competitiveness of local farming and improving its environmental performance. With government policy on both agriculture and the environment now delivered by a single Department of Agriculture, Environment and Rural Affairs (DAERA), we hope that implementation of our strategy provides the new Department with a robust, scientifically sound and innovative way of addressing its dual mandate.

Agricultural Land Management - Where are we now?

In assessing how Northern Ireland's agricultural land is managed, we examined the baselines of current performance and concluded that there is significant scope for improved practice in some important areas.

Farmers want good performance from their land. To achieve that goal, a fundamental principle of business must be understood;

We must measure first to be able to subsequently manage optimally.

Land Use: An Historical Context

Agricultural land use has changed significantly over the 70 year period since the start of the Second World War, with mixed farming systems being largely replaced by more specialised farms concentrating on one or two enterprises. Major declines in the area of arable crops such as cereals (down 72% since 1940) and potatoes (down 93% since 1940) have been reflected in increases in the area of grassland (up 18% since 1940). Numbers of cattle and sheep have doubled in the same period, establishing Northern Ireland agriculture as primarily a grassland based livestock economy.

In the last 30 years there has been an ongoing intensification of agriculture with improved grassland expanding into what were semi-natural habitats. These habitats have suffered increasing fragmentation and a resultant loss of biodiversity. Agricultural land has also been lost to building and development, particularly during the years of the housing boom up to 2007, and in more marginal habitats to woodland through the development of scrub as a result of undergrazing. The implementation of '*Going for Growth*' provides a unique opportunity to look at existing and potential management practices in order to find ways in which we can make farming more sustainable while at the same time ensuring that we increase our productivity to help to feed a growing global population.

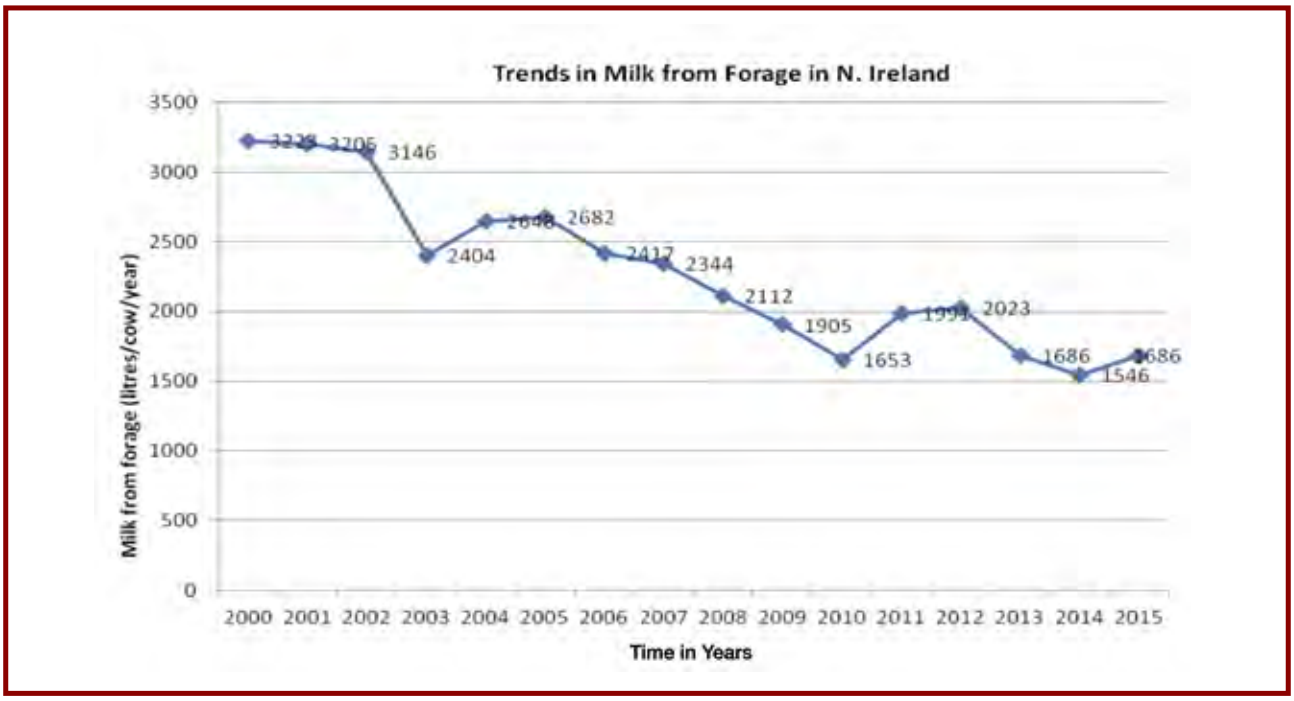
Grassland Yield, Quality and Utilisation

Grass is the cheapest and most environmentally sound means of providing nutrition for livestock. Grassland accounts for 93% of the area farmed in Northern Ireland but evidence suggests that the yields, the quality and the utilisation of grass are all substantially sub-optimal. This gap between current and potential yields is not marginal, nor can it be explained only by land quality or type. CAFRE benchmarking has shown that levels of milk produced from forage have almost halved since 2000.[6]

Estimates of current grass utilisation suggest that on average farmers are utilising approximately 5 tonnes of dry matter per hectare per year on improved grassland. Yet potential average utilisation across the ruminant sectors is 9.5 tonnes of dry matter per hectare per year.[7] This highlights a fundamental inefficiency in the performance of ruminant livestock farming in Northern Ireland, especially given that total grass yields (before utilisation) of 12 tonnes of dry matter per hectare are achievable on recently reseeded land[8] and yields of up to 15 tonnes of dry matter per hectare are possible in ideal conditions.

Our ruminant livestock farmers are not properly exploiting the cheapest form of nutrition available to them even though it has the potential to reduce the need for more expensive alternatives, such as concentrate feeds. Increasing grassland utilisation and quality will reduce reliance on concentrate feeds and thus decrease the importation of phosphorus in excess quantities which contributes to our water quality issues.

Table 1: Trends in Milk from Forage in Northern Ireland[9]



6 Table 1.

7 Agri-Land Use Case Study on Yield of Utilisable Dry Matter from Grass - An Initial Analysis, AFBI.

8 CAFRE.

9 The calculation for dairy cow milk yield supported by forage assumes that concentrates are used by the cow solely for milk production and that forage provides for the cow's maintenance and the balance of milk production. This simple measure of forage utilisation efficiency has declined substantially in recent years.

Analysis of Soils, Slurries and Manures

Deliberations on how land is managed quickly led us to a fundamental conclusion:

Our soils are not being tested routinely, to the detriment of the farmer and the environment.

Proper application of nutrients is integral to good agricultural practice, yet farmers cannot have any confidence that they are applying nutrient at the appropriate levels if there is no valid soil analysis available for a piece of land. Where insufficient nutrient is applied, agricultural productivity is reduced. Where too much nutrient is applied, the farmer's money is being wasted and there is a much greater risk that excess nutrients will reach watercourses. Slurry and manure analysis is another component part of best practice in nutrient management but very few farms are regularly analysing their slurries and manures.

We estimate that less than 10% of agricultural land in Northern Ireland has a valid current soil analysis. This means that only around 2% of soils are being analysed each year. Therefore, 90% of our agricultural land is unlikely to be managed optimally. This is not a sustainable situation and does not optimise agricultural productivity nor manage environmental impact properly. Soil analysis is critical to achieving increased resource efficiency on farms.

Soil pH, Structure and Nutrient Status

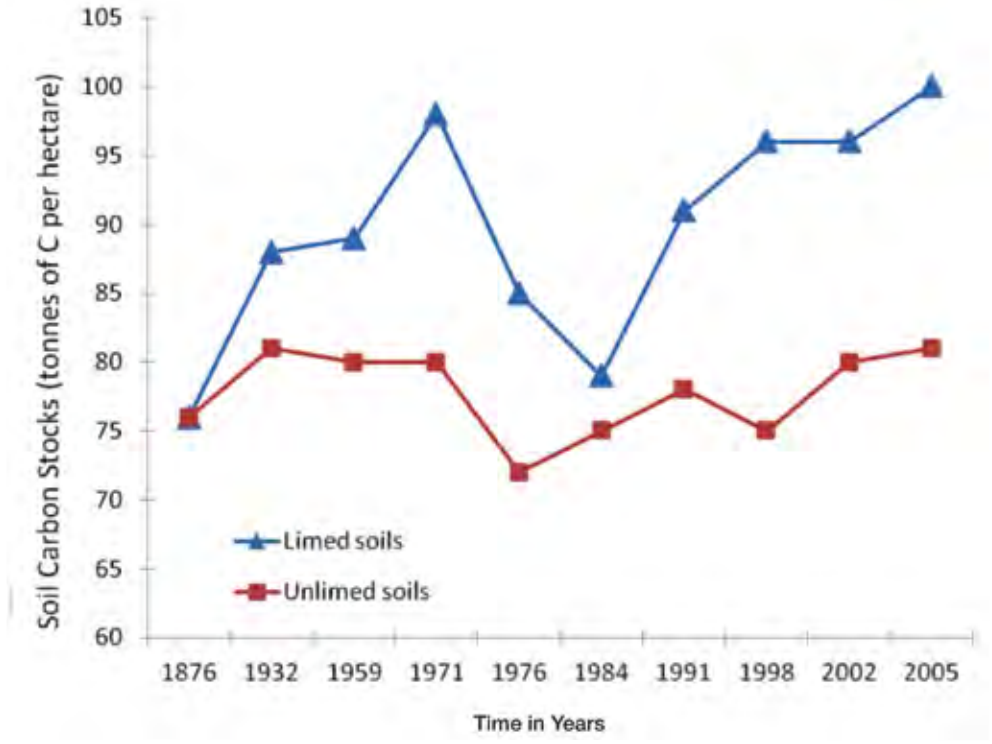
A key indicator of soil health is soil pH. If soil pH is not at optimal levels (6.5 for arable fields, 6.0 for grassland on mineral soils, 5.3 for grassland on peaty soils[10]), then farmers will not be able to significantly improve yields and will not get the most from the organic and inorganic fertilisers they apply. Optimising soil pH should be a fundamental principle of good agricultural land management. Appropriate liming based on soil analysis is the key way to address deficiencies in soil pH. An AFBI survey showed that 64% of Northern Ireland's grassland soils are below optimum pH[11]. This is an important barrier to both agricultural productivity and environmental performance and must be addressed.

Regular liming is an important aid in maintaining legumes, such as clover within diverse swards. Experimental evidence suggests that liming can also have long-term positive effects on carbon sequestration in soils. The effects of lime application on both sward diversity and soil carbon sequestration may vary depending on the fertiliser application, organic matter content and management history. We recognise that lime application needs to be appropriate to the organic matter content of the soil and the habitat.

10 https://www.afbini.gov.uk/news/afbi-research-shows-soil-testing-pays-dividends

11 https://www.afbini.gov.uk/news/afbi-research-shows-soil-testing-pays-dividends

Table 2: Impact of soil pH and lime application on carbon sequestration

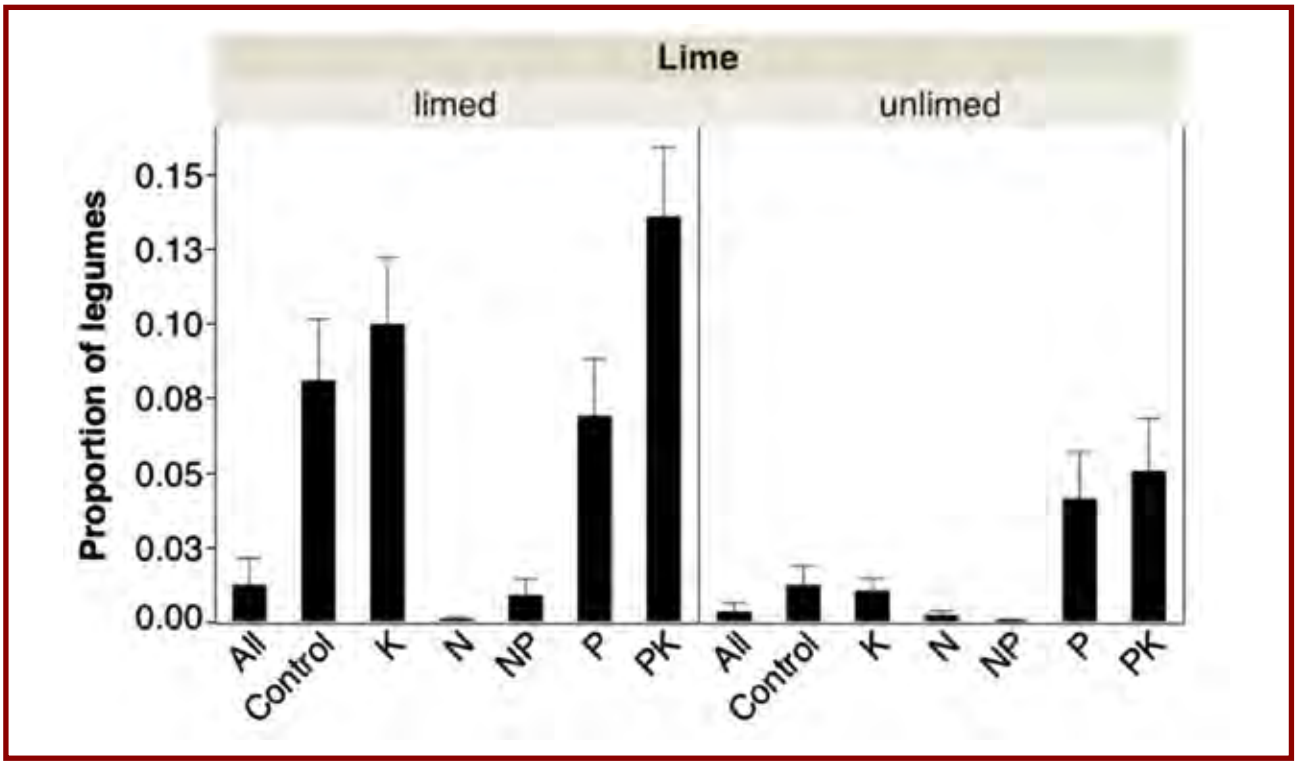


The graph above shows that limed grasslands have greater soil carbon sequestration ability in the long-term compared to unlimed grasslands.[12]

It shows liming effects on soil organic carbon (C) stocks (tonnes of C per hectare) in the Park Grass Experiment at Rothamsted, Harpenden, Hertfordshire, UK. Changes in soil C stocks are shown between 1876 and 2005.

12 Modified graph from Fornara, D.A., Steinbeiss, S., McNamara, N., Gleixner, G., Oakley, S., Poulton, P.R. Macdonald, A.J., and Bardgett, R.D. 2011. Increases in soil organic carbon sequestration can reduce the global warming potential of long-term liming to permanent grassland. *Global Change Biology 17, 1925-1934.*

Table 3: The impact of the application of lime to the proportion of legumes (White Clover and Common Vetch) in a grass sward



Legend:
All = all nutrients applied (N, P, K, Mg)
Control = no nutrients
N = only N
P = only P
NP = NP together
K = only K
PK = PK together.

Note that legume cover tends to increase under liming and under nutrient treatments which do not include Nitrogen (N) such as P, K and PK.

The graph above shows how limed grass swards can achieve a greater proportion of legume cover than unlimed grass swards.[13] It shows changes in the proportion of legume species (e.g. clover) in the sward under different liming and nutrient fertilisation treatments.

13 Fornara, D.A., Steinbeiss, S., McNamara, N., Gleixner, G., Oakley, S., Poulton, P.R. Macdonald, A.J., and Bardgett, R.D. 2011. Increases in soil organic carbon sequestration can reduce the global warming potential of long-term liming to permanent grassland. *Global Change Biology 17, 1925-1934.*

Optimising the nutrient status of our soils should be a key objective for our land managers. However, 71% of soils are not at phosphorus (P) Index 2, the optimum for sustainable grass growth, and 40% of soils are below optimum Potassium (K) levels[14]. Furthermore, 36% of first cuts of silage suffer from Sulphur (S) deficiency, compared with 9% of second cuts and 3% of third cuts. These figures provide clear evidence that there is substantial scope for improving nutrient management within our agricultural system.

Each soil will supply nutrient to the plants and lose nutrients to the environment at different rates. In the long-term, if we are going to optimise nutrient application to maximise productivity and minimise losses to the environment, we need to have farm nutrient advice guidelines tailored to the requirements of different soils and farm types.

The physical structure of soils is also critical to their productivity. Factors such as peaty soils, overstocking with animals, use of heavy equipment, use of veterinary vermicides and neglect can lead to a breakdown of the open structure of the soil, loss of soil biodiversity and decreases in the capacity of the soil to support grass growth. Surface compaction has detrimental effects on trafficability, aeration, drainage (surface run-off is increased), soil structure and soil biodiversity (microbial and faunal). Poached and water-logged soils are particularly susceptible to the growth and spread of unproductive rushes.

14 Presentation - DARD Practicalities of Nutrient Redistribution https://www.daera-ni.gov.uk/publications/industry-workshop-roadmap-improving-farm-efficiency-and-profitability-%E2%80%93-nutrient

Land Rental System

28.5% of Northern Ireland's agricultural land is rented, with the vast majority of this land let in conacre. Conacre is a system of renting agricultural land on a short term seasonal basis of 11 months or less that is particular to Ireland. As a group, we considered the issue of conacre in depth and reached a firm position;

The insecurity created by the short 11 month tenancies within the conacre system and their dominance in land rental damages the competitiveness and environmental performance of Northern Ireland agriculture.

We believe that reliance on short term conacre agreements robs tenants of any security in their land tenure in the medium or long term. The result is that tenants will generally be reluctant to invest in soil fertility or environmental performance because they have no guarantee of a return on their investment. Land owners have limited incentive to invest because they are not managing the land. Thus, a significant proportion of our agricultural land is at risk of being managed suboptimally, with few benefits accruing for either agriculture or the environment. We agree with the AFSB's assessment that conacre is a barrier to longer term business planning and are convinced that long standing habits must change if '*Going for Growth*' targets are to be achieved in a sustainable way.

The perceived tax implications of a move towards longer term leasing have historically been used as an argument in favour of continuing to use conacre. However recent developments have thrown significant doubt on the contention that there are negative tax implications to longer term leasing. In August 2016, HRMC's Inheritance Tax Policy Division confirmed to the Central Association of Agricultural Valuers (CAAV)that land qualifying as agricultural property let under a tenancy in Northern Ireland would qualify for Agricultural Property Relief under the Inheritance Tax Act.[15] That places longer term leases on an equal footing with conacre in terms of inheritance tax treatment.

Furthermore, analysis suggests that for the purposes of Capital Gains Tax, there is no difference in treatment between longer term leases and conacre, where the conacre owner is not undertaking husbandry of the land.

We believe that these clarifications should provide landowners and farmers with the confidence to look positively at the advantages of longer term leasing and particularly the security of income and tenure it can provide. We therefore welcome the initiative by the Central Association of Agricultural Valuers and the Northern Ireland Rural Valuers Association to develop a model tenancy agreement.

15 A representative of HMRC stated that;
I can therefore confirm that Agricultural Property Relief afforded to qualifying agricultural property let on a tenancy granted on or after 1 September 1995 by section 116(2)(c) of IHTA is not dependent on whether the tenancy is under a code of law, but just has to be tenancy of that property. Such tenancies would include those in Northern Ireland.

Farm Business Succession

Planning for an orderly succession is key to ensuring the long-term sustainability of a farm business. Where management control passes to a person with formal agricultural training, increases in productivity are likely to result. A recent study commissioned by the Irish government showed that trained farmers have, on average, 12% higher levels of agricultural output when compared to farmers without formal qualification.[16] However, succession planning has long been a difficult and neglected issue on farms and, even though the average age of farmers in Northern Ireland is 58, only 55% of farm businesses have a plan for succession.[17] In order to get the best out of our limited land resource, we must find a means of supporting both the ambitious young trained farmers seeking an opportunity to establish or expand their business and also those experienced farmers considering stepping back in some way from their full range of commitments. In a recent survey, 53% of farmers suggested that they would be interested in an advisory service on the issue of succession and inheritance planning.[18]

16 http://www.finance.gov.ie/sites/default/files/AgriTaxReviewITIArticle.pdf

17 https://www.daera-ni.gov.uk/sites/default/files/publications/dard/fss-2013.pdf

18 http://www.ufuni.org/news/succession-planning-remains-a-critical-issue-for-farm-families

Off-farm Slurry and Manure Export

Livestock manures and slurries are an important resource for farming and a key source of nutrients. However, over-application of these nutrients can have serious environmental consequences and best practice involves using soil, slurry and manure analysis results to determine the location and rate of nutrient application. Exporting slurry off-farm is a potential means of moving nutrients from areas where it could pose an environmental risk, to other farms where it is less of a risk and can improve agricultural productivity. Utilising nutrients in areas where they can provide greatest benefit contributes to resource efficiency. Statistics suggest that only 12% of farms export any slurry and 63% of land does not receive slurry on an annual basis.

The export or receiving of slurry is not a solution for nutrient management on every farm since there are considerable cost implications of transport, while the biodiversity value of some land means that it is not appropriate to apply nutrients. Many farmers are also discouraged by the requirement for additional record keeping to the extent that they choose buying imported bagged fertiliser as an easier solution than taking the best and most sustainable option for their business.

Biosecurity is also a very important consideration where slurry is transferred from one farm to another. However, we believe that there is still potential for a risk-based approach which addresses any biosecurity concerns and encourages balanced nutrient management by exporting slurry or its derivatives in a way that makes economic and environmental sense, converting a potential environmental problem into a valued resource.

Transfer of Slurries and Manures: Potential Order of Biosecurity Risk
1. Transfer of slurry/manure from a livestock farm to an arable farm (least risk).
2. Transfer of slurry/manure between livestock farms of different species.
3. Transfer of slurry/manure between livestock farms of the same species.
4. Transfer of slurry/manure between livestock farms where one has had a recent disease outbreak (most risk).

Legacy Phosphate and Water Quality of Surface Waters and Groundwaters

We are keen to highlight that significant effort has been made by the agriculture sector to address the issue of water quality over the past decade, especially in response to the implementation of the Nitrates Action Programme. This programme has had a positive impact on nutrient management with tangible improvements achieved since 2004, which include N balance (down 10%); N efficiency (up 12%); a 32% decrease in the P balance; and an increase of 28.5% in P efficiency.[19]

Yet the news on water quality is not all good. 63% of our waterbodies are not achieving the "Good or Better" status required by the Water Framework Directive. This represents performance well below the EU average of 47%.[20] Agricultural run-off does have a significant impact on water quality, however not all parcels of land can be treated the same. In fact, it has been shown that the vast majority of phosphorus losses (80%) come from relatively small proportions of the land (10% to 20%)[21], predominantly during extreme rainfall events in what are called "overland flow pathways." It is therefore clear that without proper targeting of these water overland flow pathways, interventions on water quality can be misplaced or ineffective. The impacts of weather patterns and rainfall events must also be taken into account.[22] We wish to emphasise that there will be no "quick fix" on water quality since Northern Ireland has a significant historical legacy of Phosphorus in both soils and water bodies. This legacy P will continue to have an impact for many decades to come, since at current averages of P removal by crops, it could take up to 50 years to draw down surplus phosphorus.[23] **However, whilst we accept that the lag time between improving practices and achieving better water quality may be frustrating for farmers and policy makers, it must not be used as an excuse to avoid setting our agri-food industry on the pathway to sustainable land management.**

19 https://www.daera-ni.gov.uk/sites/default/files/publications/daera/ni-nap-review-report-2014.PDF

20 https://www.daera-ni.gov.uk/publications/industry-workshop-roadmap-improving-farm-efficiency-and-profitability-%E2%80%93-nutrient

21 http://www.teagasc.ie/publications/2015/3739/Presentations/Djodjic_F.pdf

22 http://www.teagasc.ie/publications/2015/3739/Presentations/Mellander_PE.pdf

23 Withers, P.J.A.; Edwards, A.C.; Foy, R.H. Phosphorus cycling in UK agriculture and implications for phosphorus loss from soil. Soil Use Manag. 2001, 17, 139-149.

Biodiversity within our Farmed Landscape

We found a very mixed picture as regards biodiversity on Northern Ireland's farms and countryside. Northern Ireland is performing poorly in respect of European Priority Habitats with only one of our 49 habitats at favourable status. Furthermore, 36% of NI priority habitats and 31% of European protected species have declined between 2002 and 2012.[24] Nitrogen deposition caused by livestock ammonia emissions has been identified as a significant pressure on sensitive habitats. The majority of NI protected habitats have been reported as being damaged or under threat of damage from nitrogen deposition.

The situation in terms of species is somewhat brighter with over half of Northern Ireland's priority species at favourable status, a proportion which compares favourably with the UK as a whole. However, 31% of European protected species have declined between 2002 and 2012.

In particular, populations of farmland birds have been under pressure in recent decades with significant declines of 60% to 90% in the numbers of farmland birds such as yellowhammer, curlew, cuckoo and skylark on NI farms. Overall, 39% of bird species have declined over the long term, while 62% increased. Over the short term, 58% of bird species declined and 42% increased.[25] Butterfly populations are an excellent indicator of overall biodiversity, and recent UK figures, in which Northern Ireland was included for the first time, suggest there have been significant decreases in numbers for many butterfly species. The role of pollinators, both native and farmed, is vital for many arable crops as well as general ecosystem functioning. In total, 20% of the species known to occur in Northern Ireland are thought to be at risk of extinction.[26]

Biodiversity within soils is very important in determining the ability of soils to support plant growth and process nutrients. The vital role played by earthworms has long been understood, but the role of other organisms is less well recognised, though it is clear that they play a vital role in nutrient cycles, and contribute significantly to the soil carbon content. Research into this important topic has become increasingly important in recent years, but there is still much to learn about maintaining and improving the biodiversity of soils and its impact on soil health and productivity.

24 From Evidence to Opportunity: A Second Assessment of the State of Northern Ireland's Environment (DOE, 2013).
25 State of Nature 2016: http://www.rspb.org.uk/Images/State%20of%20Nature%20UK%20report_%2020%20Sept_tcm9-424984.pdf
26 State of Nature 2016: http://www.rspb.org.uk/Images/State%20of%20Nature%20UK%20report_%2020%20Sept_tcm9-424984.pdf

Greenhouse Gas Emissions from Farming

Agriculture remains the largest source sector of Greenhouse Gases (GHG) in Northern Ireland and is responsible for 28% of total local GHG emissions.[27] This emissions profile is similar to that of the Republic of Ireland where policy is influenced by what is called the "Irish Paradox", whereby the proportion of GHG emissions from Irish agriculture is the largest in Europe but Ireland's food products, such as milk and beef, have one of the lowest carbon footprints (emissions per unit of output or "carbon intensity") internationally.[28] The Teagasc vision of carbon neutral farming as a 'horizon point' for 2050 is an ambition which we admire.[29] Carbon neutrality requires agriculture to lock away as much greenhouse gases as it emits, resulting in 'zero net emissions.' In practical terms this means that agricultural greenhouse gas emissions (methane, nitrous oxide and carbon dioxide) generated by agriculture would have to be offset by carbon sequestration and the displacement of fossil fuels emissions by the sector.

North of the border, regional measures for carbon intensity in agricultural production are being developed. Results of this work are soon to be published and early indications are that the carbon intensity associated with local dairy farms is significantly below the global average[30] and among the top performers. A statistical bulletin will be published with full details when the work is complete. Development of a similar methodology for the beef sector will commence thereafter. We believe that policy must avoid the perverse outcome of placing indirect local caps on GHG emissions on agriculture which result in the displacement of local food production to less GHG efficient production regions and therefore cause an overall increase in global emissions.

Northern Ireland's agricultural sector is committed to tackling climate change through the 'Efficient Farming Cuts Greenhouse Gases' Strategy and its recently published Greenhouse Gas Implementation Partnerships Plan for 2016 to 2020.[31] This approach recommends on farm implementation of more efficient practices which reduce the carbon intensity of food production while improving farm profitability and resource efficiency. Land management is a key part of this strategy, particularly in relation to nutrient management and application methods. The broad nature of the 'Efficient Farming' strategy, and the wide range of measures it promotes, means that all farms, regardless of type or size, will find actions which will be beneficial for their system.

Our work has identified a need for an increased focus on the carbon stored within agricultural soils and farmed landscapes, and the potential to add to this store through carbon sequestration. Although forest cover is relatively low, Northern Ireland is rich in hedgerows and has some farm woodland. This woody biomass performs an important

27 Northern Ireland greenhouse gas inventory 1990-2014 statistical bulletin https://www.daera-ni.gov.uk/sites/default/files/publications/daera/ghg-inventory-statistical-bulletin-2014.pdf

28 http://www.bordbia.ie/industry/events/SpeakerPresentations/2014/MeatMarketProspectsSeminar2014/Efficient%20Farming%20-%20Dr.%20Roger%20Schulte,%20Teagasc.pdf

29 Can Irish Agriculture be Carbon-Neutral by 2050? https://www.teagasc.ie/news--events/news/2013/can-irish-agriculture-be-carbon-neutral-by-2050.php

30 Methodologies for calculating carbon intensity differ in different regions and use different emissions factors.

31 Efficient Farming cuts Greenhouse Gases Implementation Plan 2016 - 2020 https://www.daera-ni.gov.uk/sites/default/files/publications/daera/16.17.038%20Efficient%20Farming%20GHG%20Action%20Plan%202016-2020.PDF

role in locking carbon in its wood and within the soil. Soils generally store many times more carbon than above ground vegetation. Peat soils and peaty soils are a particularly important carbon stores covering 24.6% of Northern Ireland[32] but many of our peatlands have been subjected to drainage, leading to drying out of the peat which causes some oxidation of carbon and a reduced ability to sequester more carbon.

Our grassland systems also store significant but variable amounts of carbon, depending on soil type and management. Evidence from a long-term research grassland experiment at Hillsborough, demonstrates how soils not only act as significant carbon sinks but have not yet reached carbon saturation after 43 years of intensive management. These findings show significant carbon sequestration rates, capable of offsetting up to 30% of GHG emissions from many grass-based ruminant production systems. Scientific consensus is still to be confirmed on the levels of grassland sequestration and how it should be accounted for. We wish to see the research conducted which will help farmers and policy makers to get credit for the contribution of local grassland in offsetting GHG emissions from agriculture. In the meantime, we must properly recognise the role of hedges and trees, where there is no scientific doubt about their role in carbon sequestration.

32 http://jncc.defra.gov.uk/pdf/jncc445_web.pdf

Environmental Governance within Northern Ireland

A consistent theme of our discussions with farmers was the attitude towards the Northern Ireland Environmental Agency (NIEA) within the farming community. Farmers are extremely fearful of the threat of very significant financial penalties which can result from relatively minor environmental non-compliances. There is a perception that farmers are being unfairly targeted by environmental regulators with no discretion or flexibility shown. NIEA's primary role on farms is as an enforcer of environmental regulations, particularly in relation to the cross-compliance regime associated with the Common Agricultural Policy and direct payments to farmers.

As an Expert Working Group, our major concern is that this perception is overshadowing the vital issue of environmental management on farms. Some farmers have a negative attitude towards environmental management because they associate it with financial penalties. We are convinced that the best way to achieve good environmental outcomes is to inform and empower farmers about the benefits of the environment and how the environment can be turned into a profit centre and not just a cost centre so that they are keen to make the significant behavioural change needed to achieve sustainable land management. We want to make sure that where help is needed on farms, farmers are not afraid to ask for that help.

While we accept and encourage regulation and enforcement where it is needed, we do not believe that total reliance upon it is the most effective means of improving environmental management on farm. We prefer an "advocacy first" approach based on the principle that advice and guidance should be provided to farmers initially on a "no fault" basis to give them an opportunity to correct any environmental issues on their farm without fear of penalty or prosecution. However, it is right and proper that those farmers who wilfully ignore such advice should be subject to enforcement since failure to do so would be unfair on the large majority of compliant farmers.

We believe that Northern Ireland should learn from other regions and countries and their models of environmental governance. For example, in Scotland, the Scottish Environmental Protection Agency are not responsible for Cross Compliance inspections and are therefore able to fulfil an advocacy role concentrating on advice and guidance in the first instance.

DAERA needs to create a culture of articulating environmental issues while at the same time explaining potential solutions. This must be prioritised if we are to achieve positive behavioural change on farm.

Resilience to Extreme Weather

Farming has always been, and will always be, impacted by the weather. We are already experiencing greater frequency of extreme abnormal weather events such as flooding, very wet summers and unpredictable temperatures. The impact of these events will become even greater as we move into the future. The UK Climate Projections indicate that Northern Ireland is likely to see hotter drier summers and warmer wetter winters, coupled with increased frequency of extreme weather occurrences such as heatwaves, dry spells, heavy rain and flooding.[33] Climate models also predict the increased occurrence of short drought events (2 to 4 week events) in the summer months which can have very negative effects on yields in shallow rooted grass varieties, especially in low-species diverse swards. Swards with low species diversity have lower resilience compared to swards that include grass and deeper rooted legume species, including clover. It is therefore vital that our farming systems adapt and become more resilient to extreme weather.

In Northern Ireland, the most significant challenge we face from a changing climate is the increased frequency of heavy rainfall events and the impact which the associated flooding has upon farmland, homes and businesses in both rural and urban areas. How we manage our land can make a tangible contribution in the battle against flooding, primarily through influencing the rate at which rainfall finds its way into watercourses.

33 Northern Ireland Climate Change Adaptation Programme http://www.nienvironmentlink.org/cmsfiles/policy-hub/files/documentation/Climate/ni_climate_change_adaptation_programme__niap__-_pdf_for_web_page_-_jan_2014.pdf

Farming in the Uplands

Our upland farms make a vital contribution to the agri-food sector and enabling these farms to thrive is an important step towards achieving the production goals set out for NI agriculture. Almost half of the total agricultural area of Northern Ireland is designated as severely disadvantaged and this land is home to almost half of NI's suckler cows and most of its sheep, and is closely integrated into lowland farming with a significant proportion of our quality beef and lowland ewe flock originating from this sector. The uplands also provide essential public benefit on a large but mostly unquantified and unrecognised scale, through the provision of clean water and air, flood relief, carbon sequestration and public health and wellbeing through recreation. Farmers in these areas make a significant contribution to the agricultural output of Northern Ireland while also playing an invaluable role in the land management of this region's most important environmental landscapes. Continuing and increasing agricultural production in a sustainable way in these areas is therefore vital to the future of the whole agriculture sector and well beyond.

With the majority of the UK's drinking water originating from upland areas it is important to invest in land management tools which protect the purity of the water source as well as help to reduce the risks of flooding. Upland rivers and streams are also key spawning and nursery areas for trout, salmon and other fish which make an important contribution to our biodiversity, fishing industry and tourism.

The nature of land in severely disadvantaged areas means that the economics of maintaining profitable livestock enterprises is difficult without sufficient levels of financial support. In the absence of support payments in these areas, agricultural production would decline, land abandonment would occur, sites of environmental importance would deteriorate and rural communities would retract as farmers seek alternative employment. Carefully designed and targeted mechanisms must be found to provide recognition and reward for the agricultural, environmental and social benefits that derive from upland farming. We consider that the best way to achieve this is through schemes that enable and encourage upland farmers to graze their land in a sustainable way.

Horizon Scanning - the Results

Having completed our horizon scanning exercise, we reached the conclusion that our deliberations were producing one consistent message for Northern Ireland agriculture:

We must value and improve the health of our soils.

All of our observations and recommendations flow from this central premise. Healthier soils will deliver greater and higher quality yields of crops and grassland, thus providing the raw material necessary for the increased productivity envisaged by *'Going for Growth'*. This improvement in grassland yields will provide our livestock farmers with more of the cheapest source of nutrition available, thus reducing their overall costs. It will also accelerate the off-take of soil phosphate in high P soils through greater grass utilisation (mining P) and therefore allowing soil nutrient status to be optimised in tandem with increases in livestock outputs. Healthier soils store greater amounts of carbon, thus lowering the carbon footprint of the food production system. Since overland flows of phosphate into waterways have a significant impact on water quality, better management of our soils can also help alleviate this. Fortunately, our deliberations led to the conclusion that so many of the land management actions which increase carbon stores and improve water quality will also have a positive effect on biodiversity. We therefore believe that delivering for biodiversity is implicit throughout our recommendations.

What is a Healthy Soil?

"Soil health is the capacity of soil to function as a living system, with ecosystem and land use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health."[34]

34 http://www.fao.org/agriculture/crops/thematic-sitemap/theme/spi/soil-biodiversity/the-nature-of-soil/what-is-a-healthy-soil/en/

Recommendations

Achieving Healthier Soils - The Road to Improvement

With the central focus of our strategy agreed, we identified a number of key activities which have the potential to make substantial improvements to soil health and the sustainability of land management. We fervently believe that these actions, if implemented fully, will achieve our aim of delivering '*Going for Growth*' in a sustainable way with more profitable farms and improved environmental performance.

We have structured our findings and recommendations along five themes:

- Building a Baseline
- Managing Soils More Effectively
- Producing Improved Results
- Enabling Achievement
- Implementing the Vision

1. Creating the Baseline

Throughout this theme we reiterate one of our central messages;

We must measure first to be able to subsequently manage optimally

a. GPS Soil Sampling and Analysis

Our deliberations have led us to two key findings:

- Improving soil health is critical to sustainable land management
- Levels of soil analysis in Northern Ireland are extremely low

We are convinced that it is impossible to address soil health without a major increase in soil analysis at both individual farm and regional levels. Soil analysis is the basis for good nutrient management planning. Those who apply nutrient to their land without soil analysis do so blindly and are unlikely to be making the most appropriate interventions.

The benefits of soil analysis for agricultural productivity have been known for many years but not implemented by the large majority of farmers. We therefore believe that a drastic change in approach is needed to spur the levels of behavioural change which will deliver *'Going for Growth'* in a sustainable way. Accordingly we are recommending that **one-off GPS soil sampling and analysis should be conducted on every farm in Northern Ireland with the results made available free of charge to farmers.** To ensure that all farmers benefit from this initiative and that a comprehensive picture of NI soils is developed, appropriate measures should be introduced to ensure that this soil survey is undertaken on all farms.

This Soil Analysis should:

- Be conducted by independent contractors using GPS technology to track the precise location of each sample
- Take samples throughout Northern Ireland's agricultural land. To aid more precise decision making, sample frequency should be one sample per 2 hectare block rather than the current best practice of one sample per 4 hectare block. If a field is smaller than 3 hectares, then one sample will suffice in that field. In areas of high organic soils[35], one sample per 10 hectare block will suffice
- Be analysed by the same laboratory to ensure consistency in the result so that any deviations relate to soil deviations, not laboratory deviations
- Determine levels of pH, phosphorus (P), Potassium (K), Magnesium (Mg) and Calcium (Ca)

35 High Organic Soils are organo-mineral and peat soils which have an 'A' horizon of greater than 10% organic carbon

- Measure Soil Organic Matter to ensure that subsequent lime application is optimised. Knowing Soil Organic Matter will also improve our knowledge on the amount of carbon currently stored within our soils and allow a baseline to be calculated
- Be undertaken on every farm, initially on a voluntary basis, but with appropriate measures introduced to encourage and compel soil analysis if voluntary uptake is insufficient
- Be translated into a four year nutrient management plan. The aim of this plan will be to optimise pH levels through lime application where environmentally appropriate and ensure that nutrients are applied based on crop and soil need
- Be made publicly available on a third party database
- Be accompanied by support for those farmers with a predominance of fields at high P levels
- Facilitate collaboration with emerging innovative technologies for mutual benefit where possible

Outcomes

Implementing our recommendation for GPS soil sampling and analysis of every field in Northern Ireland will provide:

- Information which allows farmers to optimise their pH and nutrient management
- A baseline understanding of our Soil Organic Carbon
- Details of soils which are at high and low phosphorus indices
- A means of identifying which fields may be suitable for receiving redistributed nutrients

Recommendation 1a

Complete GPS soil sampling and analysis in Northern Ireland's fields at 2 hectare intervals.

b. LiDAR scanning of Northern Ireland

Given that scientific research continues to emphasise the need to target water quality interventions and that 80% of our P enters our watercourses through overland flow pathways, we considered in depth the most effective way of doing so. We concluded that a LiDAR scan of the entire geographical area of Northern Ireland was the most appropriate approach.[36] LiDAR is a 3D laser scanning technology which provides highly accurate data for each survey area. At a resolution of 10 scans per square metre, the data from LiDAR can be used to identify "overland water flow pathways", i.e. the areas within farmland at most risk of transferring nutrients, sediment or pesticide residues into watercourses. Landscape water quality interventions can therefore be targeted to these areas, particularly through agri-environment schemes. LiDAR also provides a credible means of quantifying above ground biomass and thus the amount of carbon sequestered by on-farm trees and hedges can be accurately calculated.

The benefits of LiDAR are not exclusive to agriculture. We expect that those working in sectors such as Mining, Mapping, Communication, Infrastructure, Architecture, Archaeology and Meteorology will all be keen to have access to a LiDAR scan of Northern Ireland. We recommend that a full analysis of the economy-wide benefits should be completed to ensure that the LiDAR scanning results are widely shared and utilised for the benefit of the wider Northern Ireland economy.

The importance of LiDAR has already been recognised in England with the Environment Agency releasing their extensive archive of aerial LIDAR data for public use free of charge. This data covers nearly three quarters (72%) of England's land mass and was released under the "Open Data" policy of the Department of Environment, Food and Rural Affairs (Defra).[37]

Outcomes

Implementing our recommendation for a LIDAR scan of the entire area of Northern Ireland will provide:

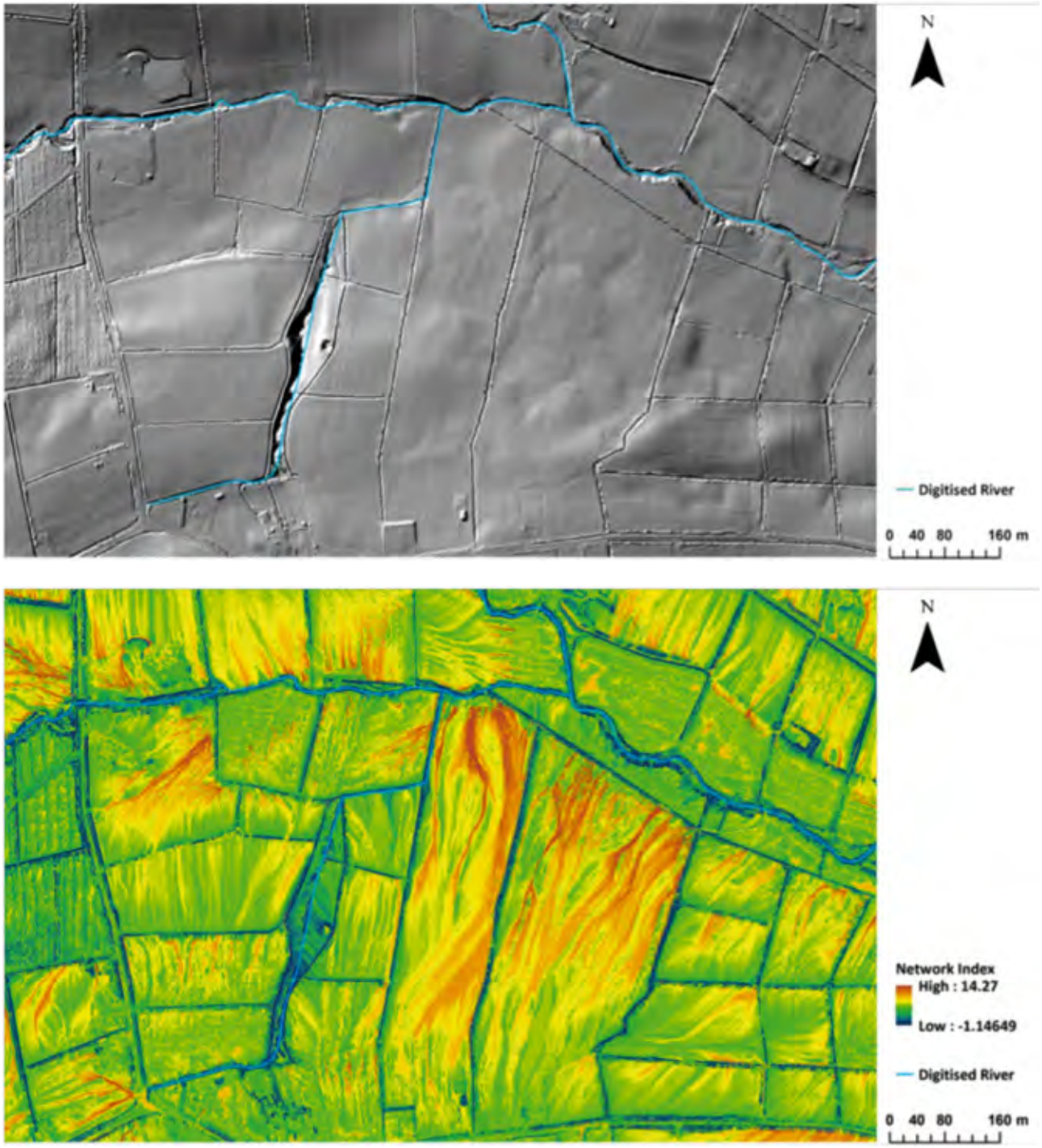
- Details of the areas of farmland at most risk of transferring nutrients into watercourses (overland water flow pathways)
- An accurate means of targeting landscape water quality interventions
- An assessment of the carbon sequestered by above ground trees and hedges
- An important dataset for many other sectors of the economy

Recommendation 1b

Conduct a full LiDAR scan of Northern Ireland to pinpoint areas of overland flow of water and measure above ground carbon sequestration in biomass.

36 http://www.lidar-uk.com/what-is-lidar

37 https://environmentagency.blog.gov.uk/2015/06/16/free-mapping-data-will-elevate-flood-risk-knowledge



Hydrological connectivity in an Irish river catchment showing;

(a) the hydrologically corrected 1m resolution LiDAR DTM represented as a hillshade map with river network overlain, and

(b) for the same area the modelled network index (of Lane et al (2004)) representing hydrological connectivity.

Red areas denote overland water flow pathways with potential for nutrient/sediment loss based on topography and dependent on land use.

c. Real Time High Frequency Water Quality Sampling

Given the imperative to improve water quality, it is vital that performance is measured with the greatest transparency and accuracy possible. We want to see Northern Ireland going beyond the current water monitoring programmes because we believe that the communication of detailed water monitoring results to farmers is a key way of changing behaviour.

From Northern Ireland's 450 river catchments, we wish to see 60 - 80 catchments targeted with the necessary equipment to monitor water quality on an hourly basis, similar to the work undertaken by Teagasc as part of their Agricultural Catchments Programme. Only by establishing this level of real-time monitoring can we know the true picture of water quality in a particular catchment.

We believe that knowledge is power and that access to real-time detailed information on the events impacting upon water quality will empower farmers to deliver more positive behavioural change. If those who are inadvertently damaging water quality can be shown direct evidence of how their actions affect pollution levels, this will be an important influence in changing their approach. Furthermore, by raising our game in respect of measuring water quality, the agri-food industry can convince both the regulators and the marketplace that we are serious about our approach to sustainable land management, even though we know that our phosphate legacy will slow our pace in delivering real improvements in water quality.

Targeting will be required to identify the catchments in which this approach will achieve the greatest benefits. We suggest that some of the criteria which should be used to target catchments include:

- Catchments with the worst water quality due to nutrient pollution (categorised as Poor or Moderate under the WFD)
- Catchments at most risk of slipping from Good WFD status
- Catchments which provide drinking water
- Catchments which impact upon other societal goods such as sensitive environmental sites, bathing waters or shellfish waters

Once catchments are targeted, we recommend the establishment of a discussion group programme for farmers within that catchment. This programme should use outside professional expertise, the results of the water quality monitoring and other data available to mentor farmers in improving their land management. If this programme is successful, then the real-time water quality monitoring will show the improvements in water quality within the catchment in the medium to long term.

Outcomes

Implementing our recommendation for more frequent water quality sampling will provide:

- More accurate information on water quality to aid communication of why water quality improvement within a catchment is so important
- A way to target action to improve water quality
- A means of driving positive behavioural change amongst farmers
- Measuring improvement of water quality

Recommendation 1c

Establish an enhanced regime of water quality monitoring on 60-80 of Northern Ireland's 450 river catchments.

d. Creating a Central Database and Decision Support Tool for Farmers

Information is only of benefit to farmers if they can use it practically. To ensure that the vital information to be gathered by water monitoring, LiDAR and soil analysis is properly utilised, we recommend the establishment of an online cloud-based "decision support tool" for farmers. This package should provide farmers with the following information as a minimum:

- The latest information on water quality in their immediate area, including the results of the real-time monitoring, where appropriate
- The results of soil analysis for fields associated with that farmer
- The results of the LiDAR scanning relevant to that farmer
- With permission from farmers, LPIS maps and field data sheets with historic land use information for that farmer's fields
- Reseeding and cropping history
- Data collected by the Geological Survey of Northern Ireland's TELLUS project on soils, stream sediments and stream waters
- AFBI's Soil Classification Survey - 'Soil and Environment Northern Ireland'
- Habitat Mapping
- Weather Data (with appropriate permissions)
- Flood Maps
- Sites designated for conservation or heritage interest
- Location of sensitive environmental sites nearby, particularly those impacted by the deposition of excess atmospheric nitrogen

This Decision Support Tool should be supported by a **transparent and comprehensive database to provide a baseline of current agricultural and environmental performance.** We believe that creating and publishing a baseline is the only credible way to show that we are serious about positively changing behaviour, achieving improvements and measuring these as they happen. We also believe that the baseline will help farmers to understand the rationale for changing behaviour and show the additional potential of their soils and their farm.

However, this information must be made available on a "no fault" basis. As highlighted elsewhere in our report, where soil analysis shows that nutrient levels are not currently at optimal levels, mentoring should be the primary approach. Farmers must be assured that providing information on the status of their soils will not be to their detriment, so long as they take reasonable action to address the important environmental issues on their farm.

This type of decision support tool only achieves its potential if it is user-friendly. To ensure that maximum value is derived from the project, the system must be straight-forward and easily accessible for farmers. The software should allow a farmer to "build" each dataset on top of their land virtually so that they have a comprehensive suite of information to inform their subsequent land management decisions.

Outcomes

Implementing our recommendation for a central database and farmer friendly cloud-based online decision support tool will provide:

- A comprehensive database to inform sustainable land policy
- Easy access for farmers to all the information they need to make sustainable land management decisions
- An informed basis for site specific land management recommendations

Recommendation 1d

Create a Sustainable Land Management Decision Support Tool for farmers, supported by a transparent and comprehensive database on soil, water, biodiversity and land use for the provision of personalised information for each farm in Northern Ireland, thus empowering farmers to deliver more positive behavioural change.

2. Managing Soils More Effectively

a. Soil pH Management

Soil pH is fundamental to good land management. If pH is not at optimal levels (6.5 for arable fields, 6.0 for grassland on mineral soils, 5.3 for grassland on peaty soils[38]) then nutrients are not efficiently utilised and grass quality greatly detoriates. PH will determine the dominant grass species in a sward. Better quality grass species thrive at optimal pH. Failing to utilise nutrients effectively impacts upon crop and grass quality and yields and therefore additional fertilisers and/or concentrate feeds are required to maintain output. Purchase of fertiliser and concentrate feeds are costs to the farmer so where these inputs are not being used efficiently, money is being wasted and profitability is affected. Inefficient use of inputs also poses an environmental risk. Where more nutrient is being applied than is necessary, there is greater opportunity for nutrient to be lost to watercourses and where sub-optimal grass yields are achieved, the use of additional concentrate increases the overall phosphorus balance and causes GHG emissions.

Fortunately there is a straightforward and cost-effective means of rectifying soil pH- liming. Adjusting soil pH by lime application has the benefit of both mineralizing nutrients currently locked in the soil, and making more efficient use of nutrients applied as either chemical fertiliser or as slurry or manure. Lime also increases soil bacterial activity leading to improved soil structure and permeability which can also help to reduce rush cover. With the results of GPS soil sampling and analysis available to farmers, nutrient management plans will give straightforward advice on pH levels and the levels of liming appropriate. Taking these simple steps will allow each farm to fulfil what AFBI describes as;

the potential to unlock hundreds or thousands of pounds through more efficient use of fertilizers, better grass and crop quality and increased productivity.

Care must be taken to make sure that when lime is being applied, it is with the right type of line, calcium or magnesium lime. This must be selected in accordance with the soil analysis.

We recognise however that advice on lime application must be tailored to ensure that there is no negative impact on sensitive environmental habitats or high organic soils.

38 https://www.afbini.gov.uk/news/afbi-research-shows-soil-testing-pays-dividends

Outcomes

Implementing our recommendation to optimise the pH of agricultural land by adding lime where appropriate will result in:

- Better grass quality and quantity
- Better nutrient management on-farm
- Displacement of unnecessary fertiliser and concentrate feed inputs
- Reduced nutrient losses to watercourses
- More profitable farming systems
- Improved soil structure and permeability
- Increased carbon sequestration
- Reduced rush cover on land

Recommendation 2a

Use liming as appropriate to optimise the pH of agricultural land in Northern Ireland.

b. Slurry Assessment

We believe that better and smarter manure management is absolutely integral to sustainable land management. Slurries and manures are valuable assets when used effectively but failure to properly manage this resource can cost the farmer money and cause environmental problems. We want to encourage more precise management of manures and slurries on Northern Ireland's farms. By analysing the nutrient content of manures and slurries, farmers will be able to more accurately apply nutrient based on crop requirements and soil fertility. Slurries and manures can be laboratory tested but a simple means of assessing slurry content on farm is also available. An online application is available from DAERA Online Services which can provide an estimation of slurry dry matter and nutrient content from a 500ml pool of slurry poured onto the ground.[39] We strongly support these "easy for use" technologies which can improve decision making in a simple and straightforward way and would like to see them developed further. Effective communication to farmers on how they can make best use of these technologies should be accelerated.

Outcomes

Implementing our recommendation to make technology available to assess slurry content will lead to:

- Better and more accurate nutrient management on farm, thus boosting farm profitability
- Reduced nutrient losses to watercourses

Recommendation 2b

In the short term, communicate the availability of a ready reckoner for assessing the dry matter and nutrient content of slurry. In the medium term, we recommend the development of an accessible, rapid, low cost analysis system for slurries and farmyard manures.

39 http://eservices.ruralni.gov.uk/temp/SGslurrycalculatorv4.mp4

c. Matching nutrient application to crop need

With access to GPS soil sampling and analysis results, farmers will be able to much better target their application of manures and slurries. Where grassland farmers have a mixture of fields at differing phosphorus indices, we strongly recommend that nutrient containing phosphorus is applied only to those grassland fields with a P Index below 3. We are convinced that the Northern Ireland farming industry must accelerate its move away from the application of nutrient containing phosphorus to land at high P Indices. We accept that this process will take both time and effort but we strongly believe that it is best to make this change voluntarily and with support and guidance, rather than risk it being imposed by regulation at a later date. We do not want to see Northern Ireland farmers in a similar situation to farmers in the Netherlands where there is a requirement for mandatory mechanical processing of a proportion of all slurries and manures in electronically traceable containers and tankers.

Outcomes

Implementing our recommendation to match nutrient application to soil P index and crop need will lead to:

- Better and more accurate nutrient management on farm, thus boosting farm profitability
- Reduced nutrient losses to watercourses

Recommendation 2c

Provide appropriate mentoring to encourage farmers to match nutrient application to soil P index and crop need.

d. Slurry Spreading using Trailing Shoe, Band Spreader or Shallow Injection

There are well established benefits of applying slurry by advanced methods such as trailing shoe, band spreading or shallow injection, as opposed to the traditional splash plate. These advantages include the economic benefits of increased N availability and greater grass yields which lead to reductions in fertiliser costs. There are also significant environmental positives. In particular, applying slurry by advanced methods reduces ammonia emissions which in turn will reduce nitrogen deposition on sensitive sites rich in biodiversity. There is also a greatly reduced risk of slurry being transferred to watercourses and these technologies also decrease GHG emissions. From a social perspective, the odour of slurry is reduced. The advanced methods also allow more time for spreading which can take place up to four weeks after cutting.

These modern slurry spreading techniques have been supported in Northern Ireland through training regimes and publicity, as well as grant aid. While good progress has been made in moving away from splash plate spreading, further initiatives will be required to embed this positive behavioural change throughout the industry. We believe that both science and economics dictate that the use of splash plates for slurry and manure spreading should be phased out, and that by 2020 all new slurry spreading equipment being purchased should be fitted with an advanced technique such as a trailing shoe, band spreader or shallow injector. We do not, however, propose any restriction on the spreading of slurry by splash plate. This recommendation aims to ensure that any new technology being utilised on farms represents best sustainable practice.

Outcomes

Implementing our recommendation to hasten the move towards slurry application by more efficient techniques will lead to:

- Better nutrient management with associated benefits for farm profitability
- Reduced nutrient losses to watercourses
- Reduced ammonia emissions
- Reduced odour

Recommendation 2d

Take measures to significantly increase the proportion of slurry which is applied on land by trailing shoe, band spreader or shallow injection.

e. Variable Rate Spreading of Nutrient

We are mindful that grass nutrient requirements can vary, even within fields. GPS technologies can facilitate precision nutrient application and allow nutrient to be applied automatically and accurately where it is needed within a field. Some arable farmers already spread slurries using variable rate application tankers which can be guided by GPS. Using the results of GPS soil analysis, these technologies can change application rates while spreading within a field, thus ensuring that nutrient application rate is properly matched to soil need. We encourage farmers to move towards these technologies, based on our consistent principle that sustainable land management requires careful application of nutrients to where they are an agricultural asset and not an environmental risk

Outcomes

Implementation of our recommendation to utilise technologies to improve nutrient application will lead to:

- Better and more accurate nutrient management on farm, thus boosting farm profitability
- Reduced nutrient losses to watercourses

Recommendation 2e

Optimise nutrient application by ensuring that farmers can access financial support and training in the use of appropriate technologies, such as variable rate spreaders.

f. Nutrient application by soil moisture and temperature conditions

Good nutrient management is a fundamental theme of this strategy. We want to aim for maximum nutrient efficiency as this will drive profit, improve water quality and reduce GHG emissions. At present, organic manures cannot be applied to land between 15th October and 31st January. Such "calendar farming" rules have been a source of much frustration within the farming community, particularly in milder autumns. Since the adoption of the closed period in 2007, technology for precision agriculture has continued to advance.

Soil potentiometers are now available which can measure soil moisture and temperature on a real-time basis and could potentially identify whether soil conditions are appropriate for the application of nutrient. We believe that the best available science should guide decisions on land management. We therefore recommend that research should be commissioned to investigate the feasibility of using these types of innovative technologies on farm to govern nutrient application.

This research should identify the environmental and economic impacts of applying nutrients based on soil moisture and temperature conditions and plant uptake of nutrients during, and outside of, the present closed period. If it can be established that it is environmentally acceptable to apply nutrient during the closed period where soil moisture and temperature levels are appropriate, we would suggest that those "early adopting" farmers who utilise soil potentiometers should be allowed additional flexibility in their spreading of organic manures. We accept that a change in approach to application of nutrient by soil condition may lead to restrictions on dates where spreading is currently allowed but we remain firm in our view that the future of our industry is best served by adopting a science-based approach which maximises flexibility and "future-proofs" for a changing climate. We want to see this key issue addressed through a clear and effective set of scientifically based measures and a sound legal framework that provides legal certainty to operators and avoids unnecessary nutrient losses to water.

Outcomes

Our recommendation is for research into the viability of using technology to guide nutrient application based on soil conditions rather than calendar date only. If such technologies are shown to be feasible, facilitating their use will:

- Ensure better nutrient management
- Avoid land being damaged by nutrient application in unsuitable conditions during the current "open period"
- Align nutrient application with the best available science
- Reduce run-off of nutrients into water courses
- Provide extended grazing seasons where soil conditions are appropriate

Recommendation 2f

Commission research into the viability of using technology for nutrient application based on soil conditions, rather than calendar dates.

g. Exporting Slurries and Manures Off-Farm

The availability of GPS soil sampling and analysis across Northern Ireland will allow identification of areas with high and low P indices. We believe that there is potential to increase the sustainability of land management by transferring slurry from areas at high P indices to fields and farms where improved land is at P index 2 and below. This proposal highlights our commitment to effective nutrient management - crop need should be the guiding principle for nutrient application on farm. We want to see farmers making best use of the organic nutrient sources available to them locally. This approach makes good business sense, is resource efficient and will have environmental benefits.

We accept entirely that some land will not be suitable for receiving nutrient due to its high biodiversity value and that cost will be a limiting factor in respect of transporting nutrients. However, we want to see a structure established which facilitates the appropriate movement of slurries from farm to farm. Slurry redistribution will not single-handedly solve Northern Ireland's P balance issue but it does have a contribution to make. Unnecessarily onerous administrative processes should not be a perceived barrier to the transfer of slurries between farms, otherwise people will continue to import artificial fertiliser with its less onerous administrative regime.

Outcomes

Reviewing the administrative system for the transfer of slurries and manures between farms may lead to:

- Better nutrient management at regional level
- Some farms receiving a valuable source of nutrients
- Other farms reducing the risk of excess nutrient application and subsequent nutrient loss to watercourses

Recommendation 2g

Maximise the use of local nutrients by simplifying the administrative burden of moving slurries and manures between farms to ensure that it is as straightforward as possible.

h. The Biosecurity Implications of exporting slurries and manures

The biosecurity risk of spreading animal disease such as TB has been identified as a barrier to the transfer of slurry between farms. However we believe that there is a need to assess whether there are effective means of treating slurries so that they can be redistributed between farms in a safe and biosecure manner. We recommend that such research should be conducted as a priority. This research should investigate whether there are economic and environmental benefits of such slurry treatments. It should also consider the need to produce guidelines for slurry redistribution and assess any health and safety issues arising.

One potential solution could be the addition of lime to dewatered slurry.[40] We believe that lessons may be learned from the wastewater industry with regard to its use of lime in the treatment of municipal wastewater sludges. Lime treatment is routinely used in some wastewater treatment facilities to produce a 'pathogen kill' in sludges, creating a more bio-secure product which is suitable for application to agricultural land. Those products are regulated by the 'Safe Sludge Matrix'. In theory, a similar approach might be able to be taken with dewatered agricultural slurries which could have benefits for the pH of the receiving ground.

If a means of treating slurry and manures is identified which allows redistribution in a more bio-secure manner, then a slurry redistribution scheme should be established to put those farms wishing to import nutrient in contact with other farms wishing to export slurries and manures. Key to our approach on this issue must be the rational assessment of the risks involved in the transfer of slurry between various types of farms based on crop and livestock species.

Outcomes

If a means of treating slurry and manures to improve bio-security can be established, then implementing our recommendation for increased bio-secure redistribution of slurry and manure to appropriate farms will lead to:

- Better nutrient management at regional level
- Some farms receiving a valuable source of nutrients
- Other farms reducing the risk of excess nutrient application and subsequent nutrient loss to watercourse
- Farms being able to exchange bio-secure slurries and manures through a slurry redistribution scheme

40 https://www.agriculture.gov.ie/media/migration/animalhealthwelfare/diseasecontrols/tuberculosistbandbrucellosis/diseaseeradicationpolicy/TBLeaflet2014Final250314.pdf

Recommendation 2h

Investigate the potential for bio-secure redistribution of slurries and farm manures by conducting research into treatments and creating a risk matrix for such transfers. If this is successful, establish a slurry redistribution scheme to increase the proportion of slurries being sustainably redistributed.

Transfer of Slurries and Manures: Potential Order of Biosecurity Risk

1. Transfer of slurry/manure from a livestock farm to an arable farm (least risk).
2. Transfer of slurry/manure between livestock farms of different species.
3. Transfer of slurry/manure between livestock farms of the same species.
4. Transfer of slurry/manure between livestock farms where one has had a recent disease outbreak (most risk).

i. On Farm Nutrient Reprocessing Solutions

Phosphate is a finite and valuable resource. It therefore makes sense to manage it effectively. Where phosphorus is in surplus and not being effectively used, this is a fundamental inefficiency in the food chain. We must find cost-effective ways of managing phosphorus to maximise its contribution to food production and minimise its contribution to water pollution.

We recognise that when the results of soil analysis are considered, many of our most productive and intensive farmers across the pig, poultry, dairy and beef finishing sectors are likely to find a legacy of high phosphorus levels at Index 3 and above throughout their farms. We estimate that this may apply to at least 1200 farms and will be skewed towards those farms with high productivity levels. These farms must be protected as they make a vital contribution to the Northern Ireland economy in general, and specifically to achievement of the *'Going for Growth'* targets. They must be given assistance to voluntarily phase out the practice of applying untreated slurry to soils which are already at high P levels. Achieving this is likely to require a significant capital investment in technologies such as decanting centrifuges and bench press separators. This capital investment will require public support. There is also potential for the agri-food industry to benefit from the potential development by research organisations, such as Queen's University Belfast, of innovative technologies to extract and recycle phosphorus.

The feasibility of intensive livestock farms "sharing" these technologies such as decanting centrifuges and bench press separators to deliver most value for money should be examined. By separating the P into a solid fraction, it can be transported off-farm much more easily and cost effectively across much larger distances. Thus the sustainability of the system is significantly improved and resources are used more effectively.

Providing these nutrient processing solutions must be a priority during the implementation of this strategy. Failure to assist these farms **upfront** will undermine delivery of both this strategy and *'Going for Growth'*. These types of productive farms deserve and require our support and we are adamant that the many potential benefits of this strategy will not be achieved if these solutions are not provided.

Outcomes

Our recommendation is that intensive farms where a predominance of fields are at high P indices should receive capital support for nutrient reprocessing. Implementing this recommendation will lead to:

- Reduce the number of fields with already high P indices which continue to receive P
- Reduced nutrient losses to watercourses
- Increased availability of valuable nutrients where they are required
- Improved sustainability for our most productive farming systems

Recommendation 2i

Provide capital support for nutrient reprocessing on "High P" farms.

3. Improving Results

a. Better Grassland Management and Utilisation

Since evidence shows that current utilisation of grass in Northern Ireland is far below potential levels, we believe that there is a pressing need for Northern Ireland to re-examine how it uses its most valuable resource - our land, our soil and the grass which grows upon most of it.

Increasing the quality and quantity of grass grown and utilised from improved grasslands is a good example of how agriculture and environment can thrive in tandem. Making these improvements will be:

- Positive for Agriculture because it provides a financial gain to the farmer from making better use of the cheapest feed available for ruminant livestock production. CAFRE Benchmarking statistics show that there is a strong relationship in the dairy sector between high proportions of milk from forage and increased profitability.[41]
- Positive for the Environment because increased grass utilisation "mines" surplus Phosphorus from the Soil and can displace additional P inputs from inorganic fertiliser and concentrate feeds, thus reducing P balance and GHG emissions

As we have highlighted, the adage that you need to "measure to manage" rings very true in farming. If significant improvements are to be achieved, then farmers will need to increase their focus on the grassland resource. Regular liming and reseeding of improved grasslands are key factors in improving productivity. Swards over five years old are estimated to have 25% less potential yield than recently established swards.[42] Initial results from research by AFBI suggest that occasional reseeding has little effect on soil carbon stocks, and that subsequent management practices are more important in conserving soil carbon.[43]

Sward assessment and grass utilisation measurement and recording must become the norm on grassland livestock farms. Simple technologies such as rising plate meters can help farmers more accurately assess grass cover while grass budgeting software can be used to assist farmers in planning their grazing and silage strategies. We also need to see increased use of the precision technologies available for grass silage harvesting equipment. These will give farmers the benefit of real-time and accurate assessment of individual grass dry matter yields and GPS yield mapping within fields. This yield mapping will be a key aid to grassland and nutrient management. Such technologies are already well proven in the arable sector.

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41 Efficient Farming to Improve Nutrient Utilisation Presentation https://www.daera-ni.gov.uk/publications/industry-workshop-roadmap-improving-farm-efficiency-and-profitability-%E2%80%93-nutrient

42 CAFRE.

43 Efficient Farming Cuts Greenhouse Gases - Implementation Plan 2016 - 2020, Focus on Research: Grassland Carbon. Sequestration in Northern Ireland https://www.daera-ni.gov.uk/sites/default/files/publications/daera/16.17.038%20Efficient%20Farming%20GHG%20Action%20Plan%202016-2020.PDF

Grasshopper

The Grasshopper sensor unit measures grass volume by paddock. It uses high frequency technology to measure grass accurately to 1mm and then combines these readings with the latest weather forecast data and ground conditions to measure grass drymatter. Grasshopper is used in conjunction with conventional plate meters and outputs data to on grass volume to the farm computer and/or compatible online databases. It takes a series of samples across the paddock being surveyed. Each sample is tagged with a date, time (to the second), and its geo-location. The geo-tagging of each reading means that yield maps can be generated to show the farmer where the lower yielding areas are and facilitate precision nutrient management. The sample is the compressed height of the grass at the sample point. When reviewing sample data it is possible to review any single sample, a small area or the paddock as a whole.[44, 45]

Silage quality is a key component of profitable dairy, beef and sheep production in Northern Ireland. By improving the quality of silage, we can improve the nutritional value of the diet, reducing the level of meal feeding for the performance targets set for the livestock and thus optimising the benefits derived from the land. The average quality of silage on Northern Ireland has barely improved over the past 10/15 years and this is a fundamental inefficiency in our grassland livestock system.[46]

Cutting grass for silage at an earlier, “leafier” stage is fundamental to improving silage quality. Since contractors are fundamental to silage production in Northern Ireland, it is vital that the prevailing systems and contracts for silage contracting are optimised to target better silage quality and greater utilisation. By increasing the number of cuts of silage taken each year, better quality forage is likely to result although care should be taken to avoid soil compaction. Good silo management is also an important factor in improving silage quality. Farmers can reduce silage wastage by filling and sealing a silo as quickly as possible.

With scientific analysis showing that 36% of fields were Sulphur deficient for their first cut of silage, improvements in early yields of silage can be assisted through the application of Sulphur. Farmers should follow the AFBI advice that Sulphur should be applied to all silage swards in the spring to eliminate the risk of deficiency throughout the year.[47]

Good grassland management is inextricably linked to farm profitability. Where weather and ground conditions allow, farmers should aim to maximise the amount of time livestock spend grazing grass. Benchmarking figures show that those farmers who make best use of their grass will see benefits for their farm income. Importantly, this is a prize that is

44 http://www.truenorthtechnologies.ie/faq.html#answer2

45 Taking the grind out of grass management http://www.independent.ie/business/farming/taking-the-grind-out-of-grass-management-31321499.html

46 https://www.afbini.gov.uk/news/make-wise-use-chemical-fertiliser-grass-production-spring-latest-findings-afbi

47 http://www.farmingfutures.org.uk/blog/spring-grass-may-be-lacking-sulphur

within the grasp of every farmer. Our message is that there is a large suite of measures available to improve grass productivity. These include:

- Liming to optimise pH
- Better nutrient management
- Early grazing
- Reseeding
- Sward measurement
- Use of mixed grass swards
- Improved shelter for grazing livestock through higher hedges and shelter belts
- Use of precision technologies
- Agro Forestry

Many, if not all, of these options will be applicable on each grassland farm in Northern Ireland. The sustainable achievement of *'Going for Growth'* targets depends upon our farmers rising to this challenge in large numbers.

Outcomes

Implementing our recommendations for improving grassland yields and silage quality will lead to:

- Greater quantities of the cheapest available feed for ruminant livestock
- Greater uptake of phosphorus from the soil through additional grass growth
- Reduced reliance on concentrate feeds for livestock production, with associated cost savings and reductions in P balance
- Improved farm profitability
- Fewer rushes on agricultural land

Recommendation 3a

Use a variety of grassland management techniques to increase grass utilisation on Northern Ireland farms by at least one tonne per hectare per year and improve grass and silage quality by achieving a 5 - 8% increase in ME (metabolisable energy) content. These goals can be achieved by:

(i) Reaching optimal soil fertility.

(ii) Ensuring that regular reseeding is undertaken across NI's grassland resource (20% of rotational grasslands and 5% of permanent grasslands annually). However reseeding is not recommended for designated species rich grasslands or grassland on high organic soils.

(iii) Applying Sulphur to all silage swards in the Spring.

(iv) Entering into dialogue with local silage contractors on the optimal method of charging to ensure better quality and utilisation of grass.

(v) Prioritising increased grass utilisation in soils of P Indices 3 and above to accelerate mining of phosphorus in high P soils.

(vi) Increasing the uptake of grass measurement, both manually and using best techniques in forage harvesters linked to GPS yield mapping.

(vii) Choosing the right grass/clover mixes.

b. Incorporation of Legumes in Swards

We believe that sward diversity can play an important role in improving the economic and environmental output of our agricultural land. While it is well established that legumes such as clover can fix nitrogen and thus displace the need for chemical fertiliser, recent science shows that clover also has significant benefits for water percolation. Researchers at IBERS Aberystwyth have found that clover swards can have water infiltration rates up to 14 times greater than perennial ryegrass.[48] This shows how useful clover can be in improving resilience to extreme rainfall events and creating drier swards. Where swards are drier, grazing will be possible on more days each year, thus increasing annual grass utilisation. Legumes such as clover also increase the amount of carbon stored within soils, thus reducing the carbon footprint of the agricultural system.

CAFRE advice on establishing clover within a sward sets a target of an average clover content over the season of around 30% in the Dry Matter (DM). This should be achieved by meeting the following targets for percentage ground cover:

- 20% to 30% cover early in the growing season
- Approximately 40% cover midway through the growing season
- Peak of 50% to 60% cover in the latter half of the growing season

Herbal leys include grasses, herbs and clovers and the deep roots of many of those species mean that resources can be unlocked from deeper in the soil than simple grass mixes can achieve. Herbal leys also have the benefit of improving soil fertility and structure and thus improving the resilience of the farm system by allowing more days for grass utilisation each year. There are also biodiversity benefits, both within the soil and for vital insect pollinators.

We recommend that farmers consider incorporating greater plant diversity within their swards. At low levels of nutrient fertilisation, highly diverse swards will be more productive than swards which lack diversity. These highly diverse swards will also provide significant additional benefits such a reduction in nutrient leaching, improved soil structure, better percolation and greater resilience to the more frequent drought events predicted by climate change models.[49] Regular liming is an important aid in maintaining legumes within diverse swards.

48 The Prosoil Project, Presentation by Christina Marley, Institute of Biological, Environmental and Rural Sciences, University of Aberyswyth.

49 Fornara & Tilman 2008, Journal of Ecology; Fornara & Tilman 2009, Ecology; Fornara et al. 2009, Journal of Ecology.

Outcomes

Implementing our recommendation for more diverse swards and greater incorporation of legumes such as clover will lead to:

- An extended grazing season and greater annual grass utilisation
- Better soil structure and an associated reduction in flood risk
- Improved soil health
- Increased soil and insect biodiversity
- Reduced need for chemical fertilisers
- Greater carbon sequestration within soils

Recommendation 3b

Farmers should grow more diverse swards and consider greater incorporation of legumes, such as clover. Where clover is established in swards, farmers should be targeting clover content of 30% in the Dry Matter.

Table 4: Impact of Legumes on Water Infiltration through soils[50]

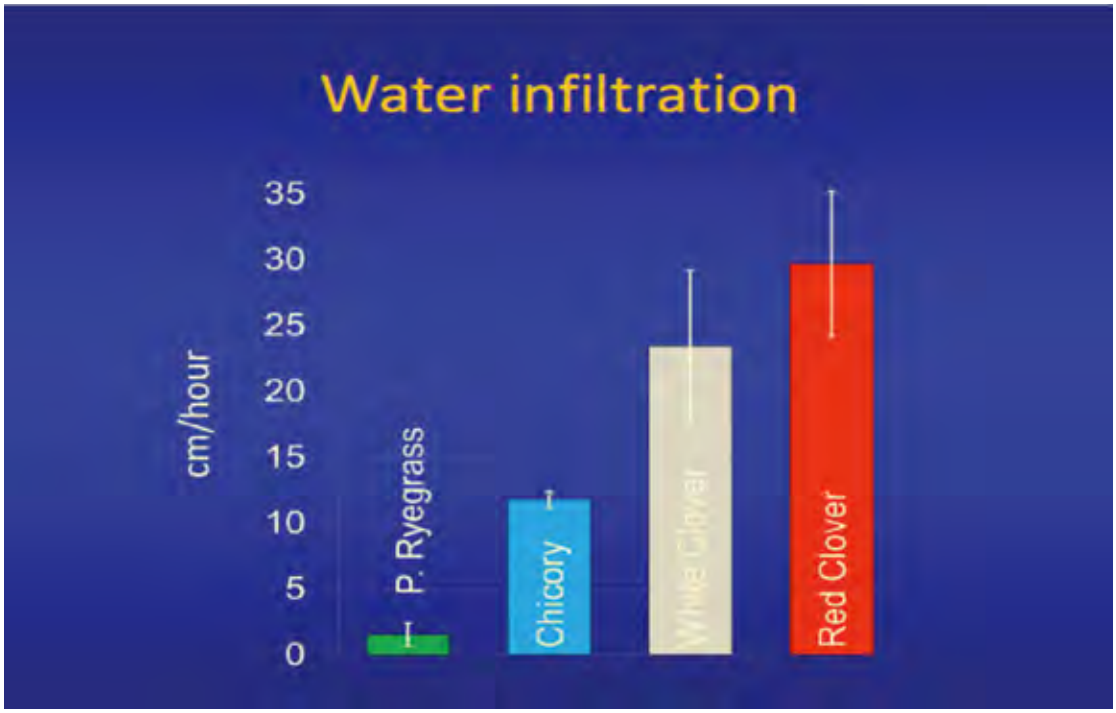
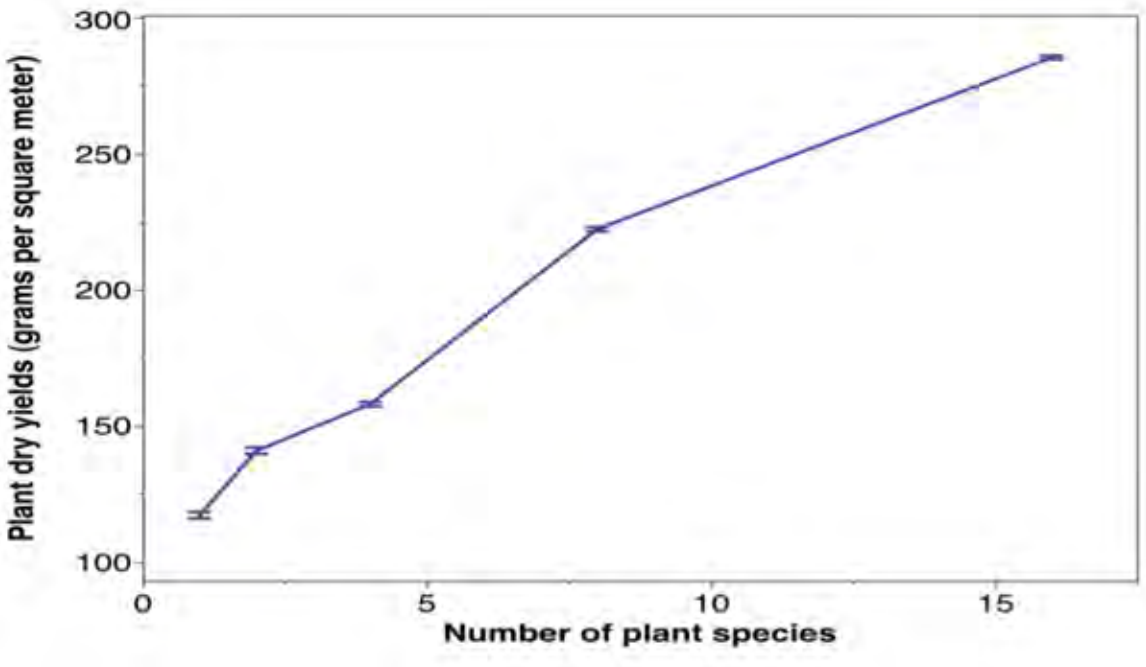


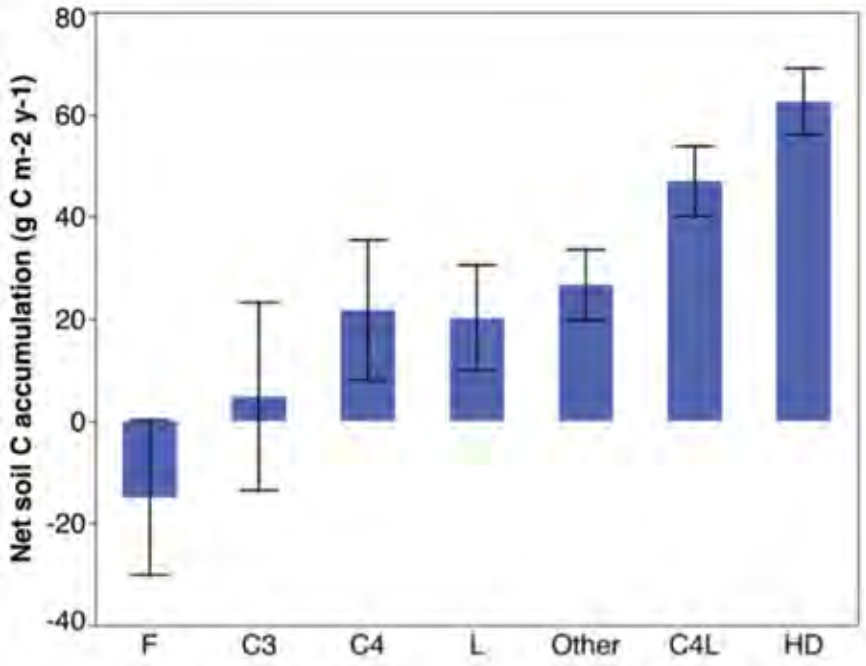
Table 5: Relationships between number of plant species and plant yields in a semi-natural prairie grassland ecosystem of North America[51]



50 The Prosoil Project, Presentation by Christina Marley, Institute of Biological, Environmental and Rural Sciences, University of Aberyswyth.

51 This is a modified version of the original graph published in the paper: Fornara D.A. and D. Tilman, 2008. Plant functional composition influences rates of soil carbon and nitrogen accumulation. *Journal of Ecology 96, 314-322.*

Table 6: Relationships between the functional composition of a prairie grassland and soil carbon sequestration between 0-60 cm soil depth[52]



Legend

C3 = C3 grass monoculture

C4 = C4 grass monoculture

L = legume monoculture

F = Forb monoculture

C4L = swards including at least one C4 grass and one legume species

Other = swards which do not include combinations of C4 grasses and legumes together

HD = High Diverse swards planted with 16 plant species

52 This is a modified version of the original graph published in the paper: Fornara D.A. and D. Tilman, 2008. Plant functional composition influences rates of soil carbon and nitrogen accumulation. *Journal of Ecology 96, 314-322.*

c. Landscape Interventions

Aerial scanning of the entire NI land mass by LiDAR (as recommended at 1b) will provide farmers with information on where water quality interventions should be targeted. With the site of the intervention identified, the next land management question to arise is;

What type of intervention is best to achieve maximum environmental and economic benefit?

We recommend that establishment of woody riparian strips in overland water flow pathways should be a key means of preventing nutrient and sediment flow into watercourses. These woody riparian strips must be populated by plants such as willow which can withstand wet conditions and can be coppiced regularly. These strips will slow the flow of surface water, collect the sediment and absorb the Phosphorus before it enters the watercourse. It is critical that these woody strips are then harvested to provide a source of renewable fuel and a potential income stream. More importantly, this removes the phosphate which builds up within the riparian strip, therefore allowing it to be "mined" and taken out of the agricultural system. These woody riparian strips will also have benefits for carbon sequestration and biodiversity, and will contribute to flood alleviation by reducing surface run-off and slowing the flow of water into streams and rivers. We believe this is an excellent example of how sustainable land management can contribute to the "circular economy"[53] since the woody strips are used initially to address the potential environmental impact of agriculture but also support farm activities as a fuel source post-harvest and deliver environmental and social benefits beyond the farm.

We see the establishment of woody biofiltration blocks, placed downhill of farmyards and at discharges from septic tanks, as an effective means of reducing the risk of nutrient leakage to watercourses. It is the multiple benefits associated with these types of practices which make them attractive as a driver of sustainable land management.

These technologies are applicable to all catchments but some prioritisation may be required based on the need for water quality improvement.

Outcomes

Implementing our recommendation for woody riparian strips in overland flow pathways and biofiltration blocks will provide:

- A means of preventing nutrient and sediment loss to watercourses
- A source of renewable heat from biomass
- A home for biodiversity
- A greater sink for carbon sequestration
- A tool in flood alleviation

53 WRAP and the circular economy http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy

Recommendation 3c

Target water quality interventions on at least 4,000 ha of land by establishing;

- **woody riparian strips in overland flow pathways and**
- **woody biofiltration blocks downhill of farmyards and at discharges to septic tanks**

d. Innovative tools to deliver multiple benefits within a sustainably managed landscape

We believe that achieving sustainable land management will require bold and innovative approaches from our farmers. In addition to the well-known biodiversity, pollination, pest control and shelter benefits of trees and hedgerows, they also have beneficial impacts on soil biodiversity, structure and carbon storage for several meters into agricultural fields. The appropriate use of trees within the food producing landscape is a method of land management which has been neglected in Northern Ireland for too long. We believe that there is significant scope for environmental and economic benefits to be derived from using trees in ways which complement agricultural productivity, rather than compete with it. There are numerous means of achieving this goal.

Agro-Forestry

Northern Ireland is home to well established research on the many benefits of establishing agro-forestry, a land management system whereby grassland can be interspersed with widely spaced trees, yet uptake of agro-forestry has remained low. We believe that the time is right for a sustained push to encourage this type of innovative land management.

Agro-forestry, unlike traditional forestry, can share the same land space as agricultural production. Its major asset is the production of a drier sward, and so increasing the number of days and weeks on which grazing is possible each year. Agro-forestry plantations therefore allow livestock to be turned out earlier and brought into housing later in the season. They will also provide a "safety net" of drier land during extreme summer rainfall events.

Sheep can graze within agro-forestry plantations after planting while cattle can also use the land once the trees are better established (after around 7 years). Crucially, the trials in Loughgall, County Armagh have found that agro-forestry systems have no impact on pasture growth for the first 13 years and that subsequent declines can be reversed by thinning the trees.

Apart from the income to be derived from the biomass harvested, another major benefit for agricultural productivity is the increased resilience of the farmland. Studies have shown that the establishment of on farm woodland can reduce the flooding risk by significantly increasing the rate at which water can enter the soil, thus decreasing the flow of water into rivers and streams.[54] The trees increase carbon sequestration and provide a home for biodiversity.

To accelerate our pathway to a carbon neutral livestock system, we recommend that farmers should consider the benefits of establishing an agro-forestry system on a proportion of their land to suit individual farm locations and catchments. This will add resilience to their grazing system in wet weather and allow early and late seasonal grazing.

54 https://www.woodlandtrust.org.uk/blogs/woodland-trust/2014/02/trees-and-flooding

Woodland for Biosecurity

The way land is managed can also make an important contribution to improving animal health. By establishing woodland strips on the borders of farms, farmers can achieve an effective biosecurity measure which will reduce the risk of diseases such as TB and BVD by preventing direct animal to animal contact, as well delivering the benefits of biodiversity, renewable fuel, carbon sequestration and soil improvement. We therefore recommend that farmers consider the viability of woody biosecurity corridors along their farm boundaries. These corridors will also provide the benefit of reconnecting disparate biodiversity habitats. There is also evidence that adding shelter belts of trees to livestock farms can boost animal welfare and productivity, with reduced lamb mortality in the 48 hours after birth and more rapid lamb growth in their first 21 days. Improved soil porosity will also reduce the incidence of both foot rot and liver fluke in sheep.[55]

Using trees to reduce Ammonia Spread

Nitrogen deposition caused by ammonia emissions from livestock has a significant impact on sensitive environmental habitats. It is therefore important that the governance and management of intensive livestock units is conducted in a way which lives up to our responsibility to protect Natura 2000 sites. Many of the solutions for ammonia emissions (such as scrubbers and flooring systems) are not directly linked to land management, while the recent switch by many local poultry farmers from LPG heating to drier biomass heating has led to a significant reduction in ammonia emissions from these facilities.

Woodland is an effective aid in mitigating the impact of nitrogen deposition. Tree shelterbelts around farms can capture ammonia emissions while the turbulence created by their canopies can reduce nitrogen deposition to the immediate surroundings.[56] Therefore, there is a clear rationale for tree plantations to be placed strategically around intensive livestock units to capture and disperse ammonia away from sensitive sites. Planting fast growing woody species will improve the capability of shelter belts to disperse ammonia. Although this is not a 'silver bullet' on the issue of nitrogen deposition, it can make a tangible contribution to reducing the problem in the long term. There is also evidence that such woodland has production benefits as well, with free-range chickens producing 2% more eggs when allowed to forage in woodland.[57] We advise all intensive livestock units to consider establishing tree plantations for ammonia abatement, including fast growing woody species to provide early benefit.

55 Model 'Electric' Sheep Helping Researchers Keep Flocks in Fine Fettle https://www.bangor.ac.uk/news/latest/model-electric-sheep-helping-researchers-keep-flocks-in-fine-fettle-28203

56 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291522/scho0711btyr-e-e.pdf

57 Trees Mean Better Business http://www.woodlandtrust.org.uk/mediafile/100412411/cs-wt-220115-eggs-and-trees.pdf?cb=89533b362e7b4d7fb4329d9adb58966f

Outcomes

Implementing our recommendations for incorporating trees appropriately within productive farming systems will lead to:

- An extension of the grazing season
- Better soil structure and an associated reduction in flood risk
- Improved soil health,
- Increased grass utilisation per hectare per year with associated profitability benefits
- Drier grazing pastures for livestock
- Greater carbon sequestration within soils and trees
- Availability of a renewable fuel source
- Improved animal health
- A reduction of ammonia dispersal from intensive livestock units with corresponding reductions in nitrogen deposition on sensitive habitats

Recommendation 3d

Farmers should incorporate trees appropriately within productive farming systems, to include at least;

- **5,000 hectares of Agro-forestry across Northern Ireland**
- **1,000 hectares of biosecure woody corridors, targeted in areas of high risk for livestock disease**
- **1,000 hectares of woody species sited around intensive livestock units**

e. Sustainable Grazing in the Uplands

We strongly believe that hill farmers play a vital role in protecting and enhancing biodiversity as well as providing essential ecosystem services in the uplands. Policy must recognise that productive agriculture in the uplands will be positive for the environment, when properly managed. However the economics of maintaining profitable livestock enterprises in upland areas often require direct financial support.

Prescriptive stocking rates are blunt instruments which do not take into account the unique characteristics of each upland area. Innovative approaches to land management, such as the Pontbren Project, show that the best way to achieve both environmental and production benefits is to allow land managers the flexibility to design targeted site-specific, collaborative environmental initiatives. The key principle must be that grazing should be managed at levels which are right for each particular site, taking into account the need to protect and enhance environmental features, and also to provide a sustainable income for the farmers. Such initiatives should work positively with local environmental interests, such as Landscape Partnerships,[58] to develop site specific plans for mutual benefit. Upland farmers should be rewarded for their input into devising the plans and for subsequent delivery of their individual plan, with opportunities for higher payments for delivery of additional benefits, such as rewetting of peatland or providing flood relief areas.

Rush control is a particular issue on marginal land and sustainable solutions are required to ensure that this important land base makes its contribution to the achievement of *'Going for Growth'* targets. CAFRE studies are showing that the use of weed wiping equipment to treat rushes with Glyphosate is the most effective means of rush control where its use is appropriate.[59] These studies also highlight that improving soil pH can help reduce rush cover.

Strategically planted trees can also enable extended grazing seasons by providing higher soil temperatures through their sheltering effect, a lower water table due to the increased porosity of the soils beneath them, and direct protection for livestock from wind and rain, while also reconnecting disparate biodiversity habitats.

Outcomes

Implementing our recommendation for site-specific management plans in the uplands will:

- Provide hill farmers with a sustainable income
- Ensure that biodiversity thrives in the uplands
- Provide public benefits including flood control, water purification, carbon sequestration and recreation
- Allow a flexible and interactive approach at local level

58 http://www.heartoftheglens.org

59 The use of Glyphosate is not appropriate on certain sites of high nature value.

Recommendation 3e

Ensure that sustainable and flexible management plans are in place for upland areas which recognise the importance of achieving stocking levels which benefit both the farmer and the environment simultaneously and receive appropriate financial support.

4. Enabling Achievement

a. Environmental Governance

We are strongly of the view that the success of this strategy is dependent on the establishment of a revised model of environmental governance. The relationship between farmers and the statutory bodies responsible for monitoring and enforcing environmental performance must be improved so that a much more positive view of the environment and its importance is engendered amongst farmers and the agri-food sector. If sustainable land management is to be successfully achieved, then environmental performance should be recognised as an indicator of success for a farm business, not as a restriction on farming activities.

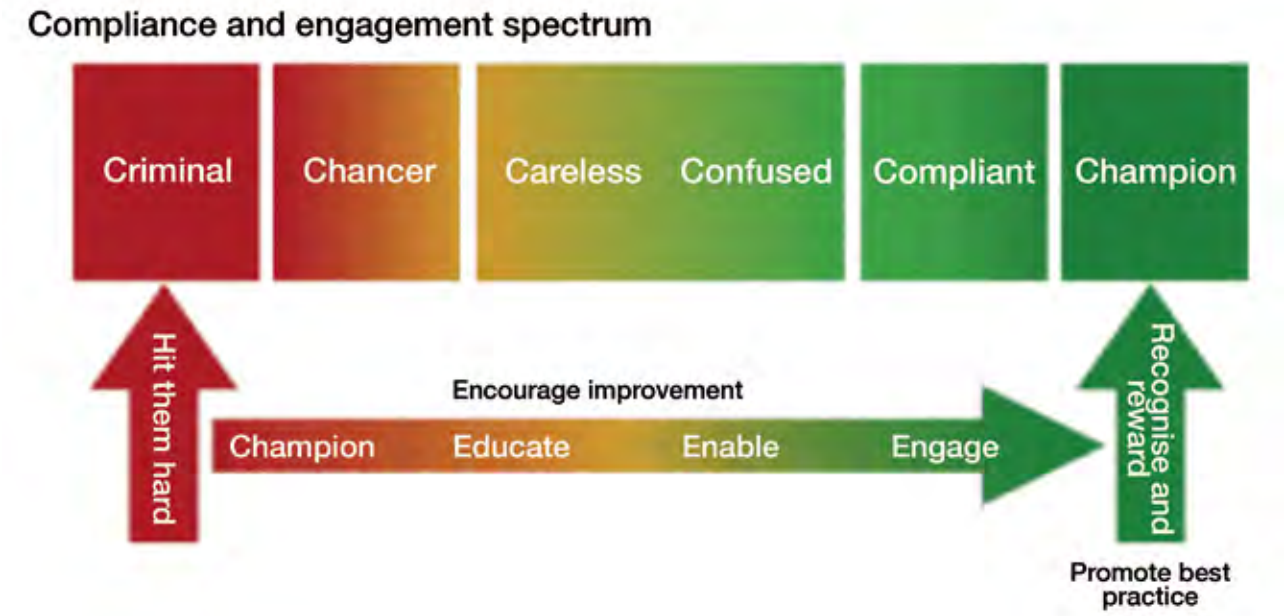
As responsibility for both agriculture and the environment is now merged within one department, it is vital that environmental governance is approached from an "advocacy first" basis. When environmental problems arise on a farm, the priority must be to provide advice, guidance and support to the farmer on how such issues can be resolved. Agricultural advisory programmes can provide assistance to both environmental regulators and farmers in achieving an appropriate agricultural solution.

The principle of "advocacy first, enforcement second" can be implemented in a number of different ways, including by government or an independent body established by government, or alternatively by extending the Rivers Trust model throughout the region, as has been successfully demonstrated by the Ballinderry Rivers Trust. This structure has many advantages.

- Since they have no statutory authority, Rivers Trusts can provide advice and guidance without farmers fearing prosecution. They are there to "help you out, not catch you out"
- Rivers Trusts can use their staff and volunteers to monitor water quality
- Rivers Trusts are capable of leveraging additional funding in addition to that received from government, thus improving value for money for the taxpayer

Whatever model emerges as the preferred option for providing advice and guidance to farmers, it is crucial that the structure identified for mentoring farmers must not also be responsible for enforcement of the cross-compliance regulations, just as SEPA are not the authority inspecting for cross-compliance in Scotland.

While we strongly support the "advocacy first" approach, we fully accept that there is a need for regulation and indeed the aim of the "advocacy first" model is to ensure that the better environmental performance sought by legislation is achieved. Prosecution and penalties are a necessary deterrent for those who wilfully disregard their environmental responsibilities. However, these responses should be seen as a last resort, to be used when advice and guidance have been deliberately ignored or in the most flagrant and damaging of breaches. It is right and proper that the very small minority of farmers who continue to pollute the environment are tackled with the full force of the law.



Outcomes

Implementing our recommendation to move to an "advocacy first" model of environmental governance will produce;

- Better relationships between farmers and government
- Better environmental outcomes as farmers follow the advice provided
- A more positive attitude amongst farmers towards environmental responsibilities
- More finance available on farm for environmental improvements through avoided penalties

Recommendation 4a

Review current environmental governance structures and implement a new "advocacy first" approach to environmental governance where the chosen "advocate" is not responsible for regulating the cross-compliance or any similar regime.

b. Moving from Conacre to Long Term Leasing

We believe that good farm business planning is fundamental to sustainable land management. That is why we are so frustrated that long term planning is difficult on almost 30% of our agricultural land because it is tied up in an archaic conacre system which does not incentivise good land management practices, and effectively excludes the land from agri-environment schemes which require security of tenure over several years. Supported by the recent HRMC clarification on inheritance tax, we agree with the conclusion reached by the Central Association of Agricultural Valuers that;

The traditional arguments in favour of conacre have lost their attraction.
(Except in the Potato and Vegetable sectors[60]).

We strongly believe that government policy should work towards significantly reducing the proportion of land in Northern Ireland which is let in conacre. We believe that one of the most effective means of achieving this would be by providing tax incentives for those leasing land for a fixed term of five years or greater. For example, in the Republic of Ireland there is an annual tax exemption of €18,000 of income from a lease of five or six years with up to €40,000 exempted for longer leases. Although tax varying powers are not devolved to Northern Ireland, our view is that the nature of the conacre system, which is particular to the island of Ireland, justifies an intervention from the UK Treasury to encourage long term leasing. We believe that a strong case could be put to Westminster for the introduction of a Northern Ireland-specific tax incentive for long term leases of land. We want to see broad political commitment across the Executive for this proposal or an alternative type of incentive. With the Republic of Ireland addressing the conacre issue through significant tax incentives and longer term leasing already established practice in England, Scotland and Wales, we in Northern Ireland are in danger of being increasingly disadvantaged by an outdated land rental system that does not deliver optimal results for either productive agriculture or the environment.

Outcomes

Our recommendation for fiscal incentives which increase the proportion of land let in leases of five years or more will result in:

- More security for land tenants
- Greater certainty of income for land owners
- More investment in land management practices
- Longer term planning resulting in management practices with improved environmental and social outcomes
- Healthier soils which can support greater farm profitability and better environmental outcomes

60 Tenancies, Conacre and Licences Arrangements for Occupying Agricultural Land in Northern Ireland, Publication by the Central Association of Agricultural Valuers (Bracketed comments are our addition).

Recommendation 4b

Introduce a fiscal incentive which encourages farmers and land owners to move away from conacre and towards long term leasing.

c. Land Mobility Scheme

A recent study, commissioned by the Irish government, showed that trained farmers have on average 12% higher levels of agricultural output when compared to untrained farmers.[61] Many of the next generation of young trained farmers are keen to be provided with an opportunity to farm. With only a tiny percentage (approximately 0.1%) of agricultural land offered for sale each year,[62] collaborative farming arrangements are an excellent way of facilitating these farmers. There are also many land owners who wish to step back from farm management and enjoy the benefits of increased leisure time and a better social and family life that can be derived from collaborative farming, as well as the economic advantages of economies of scale.

Some of the models of collaborative farming include;

- Long Term Leasing,
- Farm Partnerships (where two farmers bring assets and expertise together to farm as one),
- Share Farming (where two farmers farm the same piece of ground as separate entities)
- Share Milking (where a land owner supplies land and facilities and a share milker supplies labour and management drive)

Often the difficulty is matching those seeking an opportunity with those willing able to provide one. An "honest broker" is needed to facilitate collaborative farming arrangements, to match together potential partners and to provide impartial advice to each party with the aim of reaching a fair agreement which provides benefits for all. Fortunately, there is an excellent example of how this model can successfully operate on this island. The ROI's Land Mobility Service was established in late 2013 and has delivered 138 collaborative farming arrangements to the end of 2015.[63] We strongly encourage the Ulster Farmers' Union and the Young Farmers' Clubs of Ulster to continue with their efforts to establish a similar Land Mobility Scheme for Northern Ireland.

Outcomes

Establishing a Land Mobility Scheme will;

- Facilitate new and mutually beneficial collaborative farming arrangements
- Allow the next generation of trained farmers an opportunity to farm
- Give farmers the option of reducing their management responsibilities while retaining a role within the farm business

61 http://www.finance.gov.ie/sites/default/files/AgriTaxReviewITIArticle.pdf

62 http://www.nienvironmentlink.org/cmsfiles/Towards-a-Land-Strategy-for-NI_2015-Main-Report.pdf

63 http://landmobility.ie

Recommendation 4c

Support the UFU and Young Farmers' Clubs of Ulster as they establish a Land Mobility Scheme for Northern Ireland.

d. Farm Succession

Despite an average farmer age of 58, 55% of farms do not have an identified successor. There are many deep rooted cultural and economic reasons for this situation but since managed and orderly succession is fundamental to continuing good land management, we feel this must be addressed.

We also wish to see farmers encouraged to address how they can plan for an effective succession. We realise that many of the issues involved in farm succession are sensitive and complex and will require specific professional advice. Any guidance should recognise that the day to day responsibilities of farm management of the farm are a separate and discrete issue to land ownership.

We see a role for a mentor which farmers can access on the subject of succession. The function of this mentor would be to assist in brokering conversations within farm families, to provide a general outline of what succession will entail and to highlight the issues on which professional advice will be required and where it can be sought. The aim of this service is to make it easier for farmers to tackle this key issue.

Outcomes

Establishing a “first point of contact” to clearly signpost expert advice on succession planning will:

- Provide opportunities for the next generation of trained farmers
- Increase the sustainability of the farm business
- Facilitate a dignified retirement for those farmers who wish to end their day to day involvement with the farm

Recommendation 4d

Provide a mentor on succession planning to farmers to broker conversations, outline the key elements of succession and signpost professional advice.

5. Implementing The Vision

Foremost in our minds throughout this process has been the principle that any strategy is only as good as its implementation. We therefore strongly ask government and industry to prioritise the implementation of this strategy and to view it as a key component of the '*Going for Growth*' agenda.

Successful implementation of the Sustainable Land Management Strategy will require a mixture of three approaches simultaneously:

- Policy Push
- Market Pull
- Regulatory Kick

We are adamant that the steps outlined in this chapter represent the best way to successfully implement this strategy.

a. Secure the trust of Farmers

To successfully implement this strategy, the trust of farmers and land managers must be secured. A partnership approach among government, industry and the environmental sector is the best means of achieving sustainable land management. We must implement the strategy in a way which demonstrates to farmers that improving their environmental performance is good for their farm business and that help and support is available. If the environment continues to be considered as a by-word for regulation and penalties on many farms, then the positive behavioural change we need will not be achieved. We must turn environmentally positive farming from a cost centre to a profit centre. The "advocacy first" approach to environmental governance will be key to positively engaging farmers and land managers.

In order to achieve buy-in from farmers, we believe that it is vital to follow the correct choreography of implementation. There is an order for implementation which will ensure that maximum benefit is derived from the recommendations. We want to see an early change in the culture of environmental advocacy and regulation on farms to give a public signal that government recognises its responsibilities in aiding farmers to change their behaviours. We also see the need to provide nutrient processing solutions for intensive farms at high P levels as an important early step which should be addressed as a matter of priority before soil sampling and analysis. These are the farms on which achieving sustainable land management will require the greatest effort and these are also the farms which will do most to achieve the additional production envisaged by '*Going for Growth*'. In order to secure the trust needed across the industry for full implementation of the strategy, we need to show these intensive producers that support is available which will make their businesses sustainable and can protect their livelihoods.

Steps must be taken to ensure that if certain catchments continue to struggle with water quality, then any regulation required for that catchment should be properly targeted and **must protect the proactive farmers whilst, if necessary, penalising the inactive**. We also hope to see farmers within catchments encouraging their peers to take up sustainable land management practices. The Ballinderry Rivers Trust and their work in the Ballinderry catchment is an excellent example of how water quality can be addressed on a catchment basis.

This strategy asks farmers to make considerable changes to the way their land is managed. We believe that **policy makers also need to play their part** by ensuring that those "early adopters" who lead the way in implementing change are not subsequently disadvantaged by changes in policy or exclusions from incentives.

Outcomes

If farmers and land managers can be assured that implementation of this strategy will benefit their farm business and improve their sustainability:

- They will be much more likely to implement the sustainable land management measures we have recommended

Providing nutrient processing solutions as a priority will:

- Reassure farmers with high P levels throughout their farm that these recommendations will benefit their farm business, and the agri-food industry as whole

Protecting proactive farmers within a water catchment will:

- Encourage more farmers to make positive behavioural change

Recommendation 5a

Government and the agri-food supply chain should work in partnership with farmers to implement this strategy. A change in the culture of environmental advocacy and regulation and support for nutrient processing schemes should be prioritised.

b. Stages of Implementation

As an Expert Working Group, we are strongly united on one critical point;

Our recommendations must not be cherry picked.

We are adamant that on-farm implementation of this package must not be on a partial basis since the series of measures will only have validity for farm businesses if they are implemented in full. We cannot accept core themes of the strategy being disregarded.

However we are realistic enough to recognise that it may be necessary to phase implementation of the strategy. If this is the case, then we recommend that the first phase should involve the farmers who are members of Business Development Groups under the Rural Development Programme and also the farmers participating in the new Water Catchment Discussion Groups, as well as interested significant landowners who wish their land to participate. Phasing implementation in this way will allow the piloting and evaluation of the best communication and behavioural change tools, before rolling them out to the rest of the industry. We also want to see the market encourage its producers to participate in this programme.

Outcomes

Phasing implementation, by beginning with Business Development Groups and Discussion Groups based on Water Catchments, will ensure that:

- An existing Rural Development Programme structure can be used to aid implementation in the early stages
- The sustainable land management approach is also trialled on a catchment basis in a discrete geographical area
- Lessons can be learnt in the early stages of implementation to inform roll-out across Northern Ireland

Recommendation 5b

Farmers and government must not implement this package on a partial basis. Phasing of implementation should begin with Business Development Groups and Discussion Groups within Water Catchments, as well as interested significant landowners who wish their land to participate.

c. Building the Brand

We are confident that implementation of this soils-based approach to sustainable land management can form the building blocks for a world leading and credible science-based sustainability brand for the NI agri-food industry. We recommend that the Agri Food Strategy Board and Food NI use this platform to develop a sustainability brand which differentiates NI produce with the aim of seeking better value from international and domestic markets.

Retailers have advised us that the market requires solutions to farming issues to be science based. We want the market to recognise the efforts of local farmers in implementing sustainable land management practices. Our approach provides a transparent, credible and auditable baseline which can be used to demonstrate improvement to retailers and consumers. The market demands integrity. Where claims are made on behalf of our farmers, we must be able to test these, and back them up. We want to see Northern Ireland establish itself as a world leader in smart sustainable agriculture which is open to innovative technologies and collaborations.

Crucially, our sustainable land management approach addresses the environment in a holistic way which incorporates emissions, water quality and biodiversity. An effective and dynamic brand will improve the marketing of NI food in the international market and can provide more outlets for the increased volume of food Northern Ireland intends to produce. Our engagement with retailers has emphasised that demonstrating higher standards will have market benefits. Such standards must deliver significant consumer benefit and be easily communicated. There must also be a critical mass of product adhering to these standards.

Outcomes

Establishing a credible sustainability brand for NI food will:

- Improve the marketability and value of NI food produce
- Allow local farmers to be recognised for their efforts to achieve sustainability through transparent measurement of behavioural change and credible communication to the marketplace and consumers

Recommendation 5c

The Agri Food Strategy Board and Food NI should develop a sustainability brand for Northern Ireland based on a credible and science-based approach to land management.

d. Farm Advice

The actions within this strategy must be supported by an advisory programme of training and guidance. Without this help, farmers cannot be expected to make the major changes in farming practice that are required. Although implementation of this strategy should become a key priority for the government farm advisory service, we recognise that the public sector cannot deliver the level of support required on its own. However, we believe that by working in partnership with private and voluntary sector advisors, a comprehensive advisory programme can be developed. The fundamental premise should be that all those who contact farmers in an advisory capacity should be familiar with the principles of sustainable land management and be willing to guide farmers towards the greater profitability associated with this behavioural change. All those providing advice to farmers need to be comprehensively trained to an accredited standard so that farmers are receiving consistent messages on how best to implement sustainable land management

Outcomes

Providing a comprehensive programme of sustainable land management advice will:

- Provide and deliver an accredited and upskilling course and qualification for farm advisers from both the public and private sectors
- Ensure that all farmers who seek advice gain improved knowledge on how to manage their land sustainably

Recommendation 5d

Develop a comprehensive advisory programme on Sustainable Land Management by training public, private and voluntary sector advisors through an accredited course and qualification. These advisors will then roll out the programme to farmers.

e. Funding

There are significant resource requirements associated with fulfilling the recommendations of our strategy. In a time of budgetary constraints, we appreciate the potential difficulty the Northern Ireland Executive may encounter in providing funding for full implementation of this strategy. However, with '*Going for Growth*' aiming to increase turnover of the agri-food industry by over £2.5 billion, we believe that the approach we have outlined will allow that growth to be achieved in a credible, transparent and sustainable way. Therefore this strategy is very worthy of investment. We would strongly suggest that the long term cost of not implementing this approach will be much greater than the finance needed to fulfil these recommendations. Furthermore, we believe that this strategy proposes a level of integration and innovation on land management which is not replicated elsewhere in the world. We are confident that Northern Ireland can be pitched as a "pilot exemplar" of how environmental obligations can be achieved in an area of sustainable agricultural production.

This strategy will require funding but the benefits are so clear that we will be able to make a strong case for financial support from both the public and private sectors. Implementation of this strategy will allow the new Department of Agriculture, Environment and Rural Affairs to establish a culture where agricultural productivity and good environmental performance are regarded as mutually achievable.

Outcomes

Procuring sufficient funding streams to implement these recommendations will:

- Provide the Northern Ireland agri-food sector with a sustainable future
- Reposition Northern Ireland to achieve international recognition as a place of environmental innovation and global best practice in land management
- Outline a template by which sustainable land management can be achieved in other countries and regions

Recommendation 5e

Identify sufficient funding streams to enable implementation of our recommendations and therefore achieve international recognition for Northern Ireland as a place of environmental innovation and global best practice in land management.

Delivering the Change

Sustainable Land Management - what will it do for us?

This report outlines a series of recommendations, all of which we are convinced are both rational and valid. More importantly, we believe that when all of these actions are taken together they will add value to each other and provide a pathway to sustainable land management. But what impact will this have on Northern Ireland agriculture and will it be enough to achieve *'Going for Growth'* targets in a sustainable manner?

We believe that sustained government, industry and market support for the implementation of this report will lead to an increase in average grass utilisation from the current levels of five tonnes to at least six tonnes of Dry Matter per Hectare on improved grasslands and an increase to 5 to 8% in grass and silage quality.

As an Expert Working Group, we commissioned research on how achieving those targets for utilisation and quality will impact on farm profitability and P balance[64]. The results are summarised below. Crucially, the increases in nitrogen application required to achieve these targets will increase nitrate losses to water by only a small proportion with nitrate levels in water remaining well within agreed limits.

64 The effect on dairy farm sustainability of feeding dairy cows an extra tonne per hectare per year of utilisable grass/forage DM; Dr J. Bailey (AFBI), and The effect on beef farm sustainability of utilising an extra tonne per hectare per year of utilisable grass/forage DM; Dr. F. Lively (AFBI).

Table 7: Summary of AFBI Analysis on the impact of increasing grass utilisation and quality on Dairy and Beef farms in Northern Ireland

Dairy Sector	Current Average Non-Derogated Dairy Farm Performance	Current Average Farm, utilising 1 extra tonne of **average quality** Dry Matter of Grass, per hectare	Current Average Farm, utilising 1 extra tonne of **good quality** Dry Matter of Grass, per hectare
Whole Farm P. Balance (kg P/ha/year)	11.3	4.2	3.0
Change in N concentration in land drainage water	N/A	+ 2 mg nitrate-N/l	+ 3 mg nitrate-N/l
Net Change in Profit if Milk price is 18p per litre	N/A	+ £120 / ha / year	+ £279 / ha / year
Net Change in Profit if Milk price is 28p per litre	N/A	+ £45 / ha / year	+ £334 / ha / year

Beef Sector	Current Average NI Beef Farm Performance	Current Average Farm, utilising 1 extra tonne of **average quality** Dry Matter of Grass, per hectare	Current Average Farm, utilising 1 extra tonne of **good quality** Dry Matter of Grass, per hectare
Whole Farm P. Balance (kg P/ha/year)	1.93	2.03	0.69
Change in N concentration in land drainage water	N/A	+ 2 mg nitrate-N/l	+ 3 mg nitrate-N/l
Net Change in Profit if Beef Price is 280p / kg	N/A	+ £115 / ha / year	+ £137 / ha / year
Net Change in Profit if Beef Price is 380p / kg	N/A	+ £171 / ha / year	+ £204 / ha / year

Given that there is the potential for farmers to be utilising at least 9 tonnes of Dry Matter per Hectare of grass, we believe that utilising an average of six tonnes is a very achievable goal. Hitting this target can transform our industry by giving farmers access to much more grass, the cheapest feed available for ruminant livestock production. With this extra resource, farmers can rise to the challenge of the Agri-Food Strategy Board's growth targets.

Crucially this economic growth will be achieved in tandem with better environmental performance as the additional grass grown will "mine" phosphorus from the soil and displace additional phosphorus inputs from concentrate feeds, leading to reduced phosphorus balances. The increased agricultural productivity will be delivered by effective

nutrient management, rather than haphazard increases in uses of chemical fertiliser or concentrate feeds. Water quality interventions will be targeted through LiDAR, biodiversity will flourish, ammonia spread will reduce and agriculture's GHG footprint will be reduced as a result of better nutrient management and increased carbon sequestration. Socially, increased land mobility will improve the viability of our farming families and wider rural communities.

Behavioural Change

We recognise that our report contains a lot of "big asks" for farmers and their families. Moving to a situation where the large majority of our farmers are adhering to nutrient management plans based on GPS soil sampling and analysis will require a huge change in culture across the industry. Encouraging widespread use of cloud-based online decision support tools to inform land management will also be a major adjustment for many farmers, while tearing away the comfort blanket of Northern Ireland's conacre system will need an equally significant change in mindset.

Implementing change is not always comfortable but we are convinced that it is necessary. We believe that achieving behavioural change in sustainable land management is subject to two over-riding principles;

1. We must measure first to be able to subsequently manage optimally

2. We must make it easy for farmers to do the right thing

For example:

- Where a farmer is provided with LIDAR data, he must receive clear advice on where and what is the appropriate landscape water quality intervention
- Where a farmer receives GPS soil analysis, his crop nutrient requirements should be clear and the associated nutrient management plans should be easy to follow
- Where experienced farmers wish to consider collaborative farming solutions, they should be able to easily access trained and enthusiastic farmers seeking such opportunities
- Where a landowner wants to let land on a long term lease, template agreements which are clear and concise should be available
- Where a farmer uses a cloud-based online decision support tool, it should be simple and user-friendly and provide the farmer with the information he needs for his or her land as quickly as possible

We therefore recommend that the advisory and training programmes supporting implementation of this Sustainable Land Management Strategy should adhere to the principles below:[65]

- We must recognise that farmers (like all people) will learn in different ways. Therefore, knowledge exchange must suit as many different learning styles as possible, such as:

65 http://nuffieldinternational.org/rep_pdf/1448137977JonathanBirnieeditedreport4.pdf

- Interactive learning
- Regional workshops
- Discussion groups
- Visual learning
- Spoken/verbal learning

- We must empower people to have confidence in their own ability to deliver change
- Good extension should work with farmers, not for them. It should involve a two way flow of information and work with different target groups. Good advisors will realise that they can learn from the farmer about land management, as well as passing on the advisor's expertise
- Good farmer discussion groups can quickly spread better land management practice, but time, commitment and a good discussion leader are required. It will be particularly important to identify progressive farming leaders within water catchments to provide an impetus for the establishment of discussion groups on sustainable land management in these focus areas
- People are generally better at remembering the experiential or visual as opposed to what they are told in a verbal presentation. Live demonstrations or video presentations are therefore more effective methods of knowledge transfer. By using YouTube and online meetings, key messages on sustainable land management can be spread much more widely
- Farmers value farming experience highly, so extension should involve many more high performing, practical and progressive farmers. Farmers will be most inclined to learn from what other farmers are doing and will be most likely to copy good practice if they have seen it working on farm
- Research into sustainable land management should address practical problems and must have an implementation plan from the outset for passing on the new knowledge. Extension services should be closely linked to the commissioning of research and farmers should be involved in practical research projects
- Farmers need to be encouraged to try new technologies and to regularly assess the benefits (or otherwise) of that technology for their farming system. There is no "one size fits all" technological solution and each farmer needs to consider the correct approach for their system. Where changes are implemented, performance must be monitored
- The key test for new technologies is that they should make managing a farm business simpler or better. User-friendliness must be the key priority for the sustainable land management decision support tool

- Farmers and their advisors will need to understand market signals on sustainable land management and the details of any sustainability branding. Farmers must be assisted in this by processors through more supply chain integration. It has been made clear to us by retailers than the highest performing farmers are those who are very aware of what the consumer wants. There is also a real need for farm advisors to become involved further up the agri-food supply. Social media is a very helpful means of putting farmers directly in contact with consumers

The key to achieving behavioural change is getting the right information to the right people by the right people using the right methods.

Indicators of Success

We believe that indicators are essential to track the successful implementation of our recommendations. Potential indicators include:

- Achievement of *Going for Growth* targets;
  - Grow sales by 60% to £7bn
  - Grow employment by 15% to 115,000
  - Grow sales outside NI by 75% to £4.5bn
  - Grow "added value" by 60% to £1bn
- Farm Income
- Proportion of agricultural land with a valid soil sample
- Proportion of agricultural land using a nutrient management plan
- Dry matter utilisation of grass per hectare per year
- Quality of grass and silage by ME content
- Lime sold
- Clover sown / Proportion of legumes established
- Reseeding undertaken
- Proportion of slurry spread using low emission techniques
- Proportion of land let under longer term leases
- Proportion of farm businesses with succession plans in place
- Average age of farmers
- Land in Agro-forestry
- Numbers of catchment level programmes delivered
- Performance under the Water Framework Directive
- Performance under the Habitats and Birds Directives
- Biodiversity - Performance of farmland species and habitats
- GHG emissions from NI agriculture
- Carbon intensity of NI agriculture
- Ammonia emissions from NI agriculture
- Northern Ireland Agriculture Nitrates Balance
- Northern Ireland Agriculture Phosphorus Balance

In order to determine the progress against the '*Going for Growth*' targets both baseline information and periodic monitoring of a selection of these indicators are required. Periodic reporting both to the public and to the Department is essential to demonstrate the effectiveness of the recommendations in achieving more sustainable land management in Northern Ireland. There are good precedents in the environmental sector with the government's State of the Environment reports, produced every five years, and the eNGO's State of Nature reports, produced on a three year cycle, using a wide range of indicators to give an overall picture of progress against targets.

Consideration should be given to repeating LiDAR scanning and GPS soil sampling and analysis every 5 years as these ultimate measurement tools will transparently validate the progress the sector is making.

Conclusion

We firmly believe that this strategy offers something for everybody:

- For farmers, increased resource efficiency and more utilisation of better quality grass for greater profit
- For agricultural entrants, more opportunity to access land
- For the environment, improved soil health and fertility, improved water quality, reduced nutrient losses to water, reduced ammonia loss to air and increased woodland habitats and carbon storage
- For processors, a credible commitment to sustainability which will positively differentiate Northern Ireland food
- For retailers, a transparent and auditable way to assure their consumers that agriculture is delivering on its environmental responsibilities
- For government, a baseline and a means to achieve its dual commitment to improve farm profitability and meet environmental targets through an efficient and sustainable agri-food sector, which drives wider economic growth simultaneously
- For consumers, assurance that the local food they eat is being produced to the highest global standards
- For taxpayers, an assurance that their money is being targeted and spent efficiently and used to deliver on public goods
- For everybody, the increased wealth and respect created by international and domestic recognition of international best practice in land management and food production within Northern Ireland

Appendices

1. List of Recommendations

2. Expert Working Group Terms of Reference and Membership

3 Acknowledgments

4. Practical Examples for Farmers

List of Expert Working Group's Recommendations for Sustainable Land Management

1. Building a Baseline

a. Complete GPS soil sampling and analysis in Northern Ireland's fields at 2 hectare intervals.

Indicative Response: Approximately 400,000 soil samples, predominately in 2 hectare blocks across Northern Ireland

b. Conduct a full LiDAR scan of Northern Ireland to pinpoint areas of overland flow of water and measure above ground carbon sequestration in biomass.

c. Establish an enhanced regime of water quality monitoring on 60-80 of Northern Ireland's 450 river catchments.

d. Create a Sustainable Land Management Decision Support Tool for farmers, supported by a transparent and comprehensive database on soil, water, biodiversity and land use for the provision of personalised information for each farm in Northern Ireland, thus empowering farmers to deliver more positive behavioural change.

2. Managing Soils More Effectively

a. Use liming as appropriate to optimise the pH of agricultural land in Northern Ireland.

Indicative Response: 6 tonnes per hectare of lime spread on 512,000 hectares of grassland

b. In the short term, communicate the availability of a ready reckoner for assessing the dry matter and nutrient content of slurry. In the medium term, we recommend the development of an accessible, rapid, low cost analysis system for slurries and farmyard manures.

c. Provide appropriate mentoring to encourage farmers to match nutrient application to soil P index and crop need.

Indicative Response: 500 Variable Rate Lime and Fertiliser Spreaders operating throughout Northern Ireland

d. Take measures to significantly increase the proportion of slurry which is applied on land by trailing shoe, band spreader or shallow injection.

Indicative Response: By 2020, 80% of slurry and manures are spread by trailing shoe, band spreader or shallow injection

e. Optimise nutrient application by ensuring that farmers can access financial support and training in the use of appropriate technologies, such as variable rate spreaders.

f. Commission research into the viability of using technology for nutrient application based on soil conditions, rather than calendar dates.

g. Maximise the use of local nutrients by simplifying the administrative burden of moving slurries and manures between farms to ensure that it is as straightforward as possible.

h. Investigate the potential for bio-secure redistribution of slurries and farm manures by conducting research into treatments and creating a risk matrix for such transfers. If this is successful, establish a slurry redistribution scheme to increase the proportion of slurries being sustainably redistributed.

i. Provide capital support for nutrient reprocessing on "High P" farms.

Indicative Response: 500 transportable centrifuges or equivalent operating throughout Northern Ireland

3. Producing Improved Results

a. Use a variety of grassland management techniques to increase grass utilisation on Northern Ireland farms by at least one tonne per hectare per year and improve grass and silage quality by achieving a 5 - 8% increase in ME (metabolisable energy) content. These goals can be achieved by;

   i. Reaching optimal soil fertility.

   ii. Ensuring that regular reseeding is undertaken across NI's grassland resource (20% of rotational grasslands and 5% of permanent grasslands annually.) However reseeding is not recommended for designated species rich grasslands or grassland on high organic soils.

   iii. Applying Sulphur to all silage swards in the Spring.

   iv. Entering into dialogue with local silage contractors on the optimal method of charging to ensure better quality and utilisation of grass.

   v. Prioritising increased grass utilisation in soils of P Indices 3 and above to accelerate "mining" of Phosphorus from high P soils.

   vi. Increasing the uptake of grass measurement, both manually and using best techniques in forage harvesters linked to GPS yield mapping.

   vii. Choosing the right grass / clover mixes.

Indicative Response: Reseed 30,000 hectares of temporary grassland and 27,500 hectares of permanent grassland every year

b. Farmers should grow more diverse swards and consider greater incorporation of legumes, such as clover. Where clover is established in swards, farmers should be targeting clover content of 30% in the Dry Matter.

c. Target water quality interventions on at least 4,000 ha of land by establishing:

- woody riparian strips in overland flow pathways and
- woody biofiltration blocks downhill of farmyards and at discharges to septic tanks.

d. Farmers should incorporate trees appropriately within productive farming systems, to include at least:

- 5,000 hectares of Agro-forestry across Northern Ireland
- 1,000 hectares of biosecure woody corridors, targeted in areas of high risk for livestock disease
- 1,000 hectares of trees sited around intensive livestock units

e. Ensure that sustainable and flexible management plans are in place for upland areas which recognise the importance of achieving stocking levels which benefit both the farmer and the environment simultaneously and receive appropriate financial support.

4. Enabling Achievement

a. Review current environmental governance structures and implement an “advocacy first” approach to environmental governance whereby the chosen “advocate” is not responsible for regulating the cross-compliance or any similar regime.

b. Introduce a fiscal incentive which encourages farmers and land owners to move away from conacre and towards long term leasing.

c. Support the UFU and Young Farmers’ Clubs of Ulster as they establish a Land Mobility Scheme for Northern Ireland.

d. Provide a mentor on succession planning to farmers to broker conversations, outline the key elements of succession and signpost professional advice.

5. Implementing the Vision

a. Government and the agri-food supply chain should work in partnership with farmers to implement this strategy. A change in the culture of environmental advocacy and regulation and support for nutrient processing schemes should be prioritised.

b. Farmers must not be asked to implement this package on a partial basis. Phasing of implementation should begin with Business Development Groups and Discussion Groups within Water Catchments, as well as interested significant landowners who wish their land to participate.

c. The Agri Food Strategy Board and Food NI should develop a sustainability brand for Northern Ireland based on a credible and science-based approach to land management.

d. Develop a comprehensive advisory programme on Sustainable Land Management by training the public, private and voluntary sector advisors through an accredited course and qualification. These advisors will then roll out the programme to farmers.

e. Identify sufficient funding streams to enable implementation of our recommendations and therefore achieve international recognition for Northern Ireland as a place of environmental innovation and global best practice in land management.

NI Expert Working Group on Sustainable Land Management: Terms of Reference and membership

Aim

To agree a sustainable agricultural land management strategy which highlights and demonstrates to land owners and land managers how to continue to develop more profitable farms and achieve the targets set in the '*Going for Growth*' report while producing balanced and enhanced environmental outcomes.

Scope

The agreed strategy will focus on land in the rural setting which is currently managed in support of predominantly agricultural and/or environmental purposes. It will detail a series of principles and practical actions to assist land owners, land managers and government in pursuit of sustainable land use.

Timing

The expert group is expected to complete its work by 31st March 2016.[66]

Objectives

- To identify the current and future key economic and environmental pressures on agricultural land in Northern Ireland
- Examine the existing state of knowledge on sustainable agricultural land use at local, national and international levels
- Identify the barriers to the uptake of knowledge and new systems and highlight where further scientific knowledge is required
- Outline the principles of sustainable land management
- Recommend a series of actions to be implemented by government, agricultural land managers and the market supply chain to improve the sustainability of agricultural land use
- Identify where land can potentially be managed in a more innovative and multi-functional way to produce enhanced agricultural and environmental outcomes simultaneously
- Recommend actions to stimulate effective behavioural change and knowledge transfer

Outputs

- Input to scientific research proposals on agricultural land use
- Define the key strategic principles of sustainable agricultural land use

66 A draft report was completed on 31st March 2016 and forwarded to Noel Lavery, then DARD Permanent Secretary.

- Agreement of an action plan to include knowledge transfer and behavioural change
- Other outputs to be determined following establishment of forum.

Expert Working Group Membership

- Dr. John Gilliland, OBE (Chairman)
- John Best
- Jonathan Birnie
- Martyn Blair
- James Brown
- Patrick Casement
- Dr. Sue Christie
- Norman Fulton
- Aileen Lawson
- Billy O'Kane
- Russell Scott
- Dr John Speers

Government Support Organisations

- DARD Policy (Environment and Scientific Advisory)
- Forest Service
- DARD Service Delivery (Countryside Management)
- Rivers Agency
- CAFRE
- AFBI
- NIEA
- DETI Renewables Policy
- DoE Policy
- NI Water

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- Anne Carson, (Land and Property Service)
- Sinclair Mayne, David Johnston, Jim McAdam, Dario Fornara, John Bailey, Donnacha Doody, Chris Johnston (AFBI)
- Jim O'Toole (Bord Bia)
- Noel Collins, John Muldowney, Paul McKiernan, Ronan Gleeson (DAFM)
- Austin Finn, (ROI Land Mobility Scheme)
- Professor Charles Sabel ,(Columbia Climate Law School)
- Andrew Doyle, TD, (Oireachtas Committee on Agriculture, Food and the Marine)
- Professor Gerry Boyle, Dr Rogier Schulte, Dr Gary Lanigan, Dr Mairead Shore, Dr Per-Erik Mellander, Ger Shortle, Pat Murphy, Tom O'Connell, Stuart Green (Teagasc)
- Professor Phil Jordan (Ulster University)
- Sean Molloy, Audrey O'Shea (Glanbia)
- Professor Rory O'Donnell, Larry O'Connell, (ROI National Economic and Social Council)
- Thomas Steele, (Dairy Farmer)
- Rob Macklin, (National Trust)
- George Mathers, Ian McCluggage, Neville Graham, Eric Long, Graeme Campbell, Colin Alexander (CAFRE)
- Conor Kelly, (Irish Grouse Conservation Trust)
- Jeremy Moody, Charles Meynell, Kate Russell (Central Association of Agricultural Valuers)
- The Ulster Farmers' Union
- AgriSearch
- The Young Farmers' Clubs of Ulster
- The Northern Ireland Environment Link
- Alan Keys, (Ballinderry Rivers Trust)

We are truly grateful for all of your help and support.

Delivering Our Future, Valuing Our Soils: Practical Examples for Farmers

Case Study 1: Agroforestry

What is it?

Agroforestry is the integration of trees within crop or livestock farming systems. Trees can be planted at wide spaces within grassland fields and combined with animal production. In trials at AFBI Loughgall, ash trees were planted at 5m x 5m spacing to allow grazing between the trees.

What are the Benefits?

The benefits of establishing agro forestry systems include:

- Livestock can graze alongside the trees, thus retaining farm income
- Drier swards increase the number of days and weeks on which livestock grazing is possible each year
- Reduced risk of flooding
- Income from harvesting wood from trees
- Animals can use the trees for shade and shelter, increasing animal welfare
- Reduced exposure to the elements can have thrive benefits for livestock
- Enhanced Biodiversity (such as birds, beetles, spiders and snails)
- Greater Carbon Sequestration
- Benefits for water quality as leached nutrients are captured by the deeper roots of the trees
- Less soil erosion

What are the Challenges?

The major challenge is to maintain livestock production at levels comparable to traditional grass swards. Local research at AFBI Loughgall has shown that wide-spaced protected hardwood trees such as ash, oak or sycamore can be established in permanent pasture, initially they should only be grazed with sheep (for about seven years). After this period, cattle can also be grazed.

In the Loughgall trials, pasture growth was not affected until 13 years after the agro forestry was established and full sheep production (when compared with open, grass fields in the same trial) was maintained. Although there was a slow decline in pasture growth after 13 years, growth improved again when the trees were thinned. Good management is therefore important to get the most from all aspects of an agroforestry system.

What do farmers think?

"I planted this area of land in 1997 with help from a DARD Agroforestry grant, which at the time covered the cost of the trees' establishment. I now run 750 ewes on a total of 76 hectares of good grassland, but this was one spot you couldn't put to the plough; it was non-productive.

The leaf canopy is now meeting above the grass swards, and the shading doesn't appear to have any adverse effect on growth. At the same time, the sheep can benefit from the shelter.

I must say that my own experience of Agroforestry has not only given me great satisfaction, turning otherwise less productive land into profitable grazing, but it's also given me a real appreciation of the beauty of trees and their importance to our environment. I would encourage farmers to look at their least profitable land areas with a view to creating small plantations of trees."

Crosby Cleland, County Down sheep farmer, former "UK Sheep Farmer of the Year".

Link to Sustainable Agricultural Land Management Strategy

Recommendation 3d: Farmers should incorporate trees appropriately within productive farming systems, to include at least 5,000 hectares of Agro-forestry across Northern Ireland.

Case Study 2: Improving Forage Quality

What is it?

High forage quality, both in terms of digestibility of grazed and conserved grass are essential if livestock production from forage is to increase. Better quality grass will be more attractive to livestock than lower quality forage. The quality of grass silage produced in N. Ireland, as analysed by AFBI, has shown little change over recent years. Mean silage metabolisable energy (ME) content has remained relatively constant at approximately 10.7 MJ/kg DM, while crude protein (CP) levels have fallen slightly, due in part to declining nitrogen fertiliser use.

What are the Benefits?

The benefits of improving forage quality are:

- Increased silage intake by livestock
- Reduced requirement for concentrate feeds
- Greater profitability
- Reduced P balances

What are the Challenges?

- Getting soil pH correct
- Improving slurry nitrogen utilisation through trailing shoe application methods
- Reseeding with recommended grass varieties
- Small increases in inorganic fertiliser nitrogen use

These management practices require time and investment but there is a financial benefit for the farmers who make this effort.

Link to Sustainable Agricultural Land Management Strategy

3a: Use a variety of grassland management techniques to increase grass utilisation on Northern Ireland farms by at least one tonne per hectare per year and improve grass and silage quality by achieving a 5 - 8% increase in ME (metabolisable energy) content.

Case Study 3: Cost Effective Nutrient Redistribution

What is it?

Cattle slurry and manures are an important and valuable source of nutrients for grass growth, However, they can also be an environmental risk if spread in certain areas where nutrient is not required. It makes sense therefore to spread nutrient in areas where it will be of most benefit and this may mean transport of slurries and manures to other farms.

What are the Benefits?

The potential benefits of exporting manures and slurries are:

- A valuable source of nutrient for the receiving farm
- Sustainable management of a potential environmental risk by the exporting farm

What are the Challenges?

The major challenges are:

- Maintaining financial viability of slurry and manure transport
- Ensuring that the transfer of slurry and manure is undertaken in a way that does not unacceptably increase the risk of spreading animal disease

The table below outlines the distance within which it is economic to transport cattle slurry. This is based on the nutrient value of cattle slurry applied in the spring and how far it is worthwhile to transport it, based on a contractor cost of £30/hour. Analysis of this table shows that transport of slurry is most likely to be cost effective where the receiving fields are at P & K Index 1.

Cattle slurry DM %	Value of load (2000 gal)		Breakeven distance; slurry store to field (miles)	
	P & K Index 1	P & K Index 3	P & K Index 1	P & K Index 3
2	£18.0	£5.3	5.0	0.8
6	**£26.0**	**£6.7**	**7.7**	**1.2**
10	£32.6	£6.7	9.9	1.2

Link to Sustainable Agricultural Land Management Strategy

2h: Investigate the potential for bio-secure redistribution of slurries and farm manures by conducting research into treatments and creating a risk matrix for such transfers. If this is successful, establish a slurry redistribution scheme to increase the proportion of slurries being sustainably redistributed.

Case Study 4: Slurry Separation

What is it?

Slurry can be separated by mechanical means to concentrate P into a separated solid fraction for export off farm. There are 2 main types of mechanical separators; basic 'farm type' separators and decanting centrifuges. The most popular farm type separators include belt presses, brushed screen and screw presses. All these work on the principle of concentrating the slurry dry matter into a stackable solid fraction (usually about 20% of the mass) and a liquid fraction, with a lower dry matter than that in the whole slurry. Most farm type separators will partition 10-20% of the mass to the solid fraction and 15-30% of the P, depending on slurry dry matter content, screen size and separator type. With decanting centrifuges, a similar mass of solids is produced, but a much larger proportion of P is transferred into the solid fraction.

What are the Benefits?

- The solid fraction of slurry containing an abundance of P can be exported off-farm more easily. This means that where a farm has an abundance of fields at high P levels, it can export the P in a more transportable form
- Farms receiving the P fraction will have access to a supply of nutrients in a more transportable form
- The separated liquid requires little or no mixing before spreading and is more easily applied via umbilical systems and/or trailing shoe applicators
- Nitrogen use efficiency of the separated liquid is usually higher than whole slurry, due to its lower viscosity / lower dry matter content, allowing the liquid to percolate into the soil more easily

What are the Challenges?

- With separated slurry, there are three products to manage; whole un-separated slurry, separated liquid and separated solids
- Land with a low P status which can make use of the solid fraction needs to be available within a cost effective travel distance from the source farm
- Given the high capital cost of centrifuges and the lack of 3 phase electricity on many farms, it may be necessary to use a specialist contactor with a mobile centrifuge plant and generator to separate slurry on a number of different farms, thus lowering the cost per tonne of P separated to the solid fraction

What do farmers think?

One local pig farm has invested in a centrifuge slurry separator, which allows the farm to attain a high degree of P separation. When this is done, 75 - 90% of the phosphate remains with the solid portion and this allows the farm to more easily transport surplus P to arable farms further away, while the nitrogen rich liquid can be exported to local grass farms.

Link to Sustainable Agricultural Land Management Strategy

2i: Provide capital support for nutrient reprocessing on “High P” farms.

Case Study 5: ROI Land Mobility Service

What is it?

The ROI Land Mobility Service provides independent expertise to facilitate farmers who wish to enter into collaborative arrangements. The Service operates over three pilot areas and has amassed 360 clients and delivered 138 arrangements to date.

The fundamentals of the service are:

- To provide information
- To outline and explore options
- To act as an honest broker
- To provide a confidential service facilitating land mobility
- To work with farmers' existing professional advisers

The types of collaborative farming arrangements supported by the Service include;

- Contract production or contract rearing (Two parties farming in their own right but working together for better land use)
- Long Term Leasing (Delivering access to land at a known cost for a definite period)
- Partnerships (Two like minded people with a similar vision who wish to develop a farm business together, such as a family partnership or a dairy farmer linking up with a drystock neighbour.)
- Share Farming (Where two or more people come together to farm the same piece of ground. All parties are active farmers and share in the risk and rewards. Share farming can work well for land owners who wish to step back but not retire and it also provides an excellent opportunity for new entrants and young trained farmers to get involved in a farm business at much lower risk and investment.)

A workable arrangement should deliver to all parties;

- Income security and enhancement
- Title security
- The land to be farmed
- Continued family involvement
- Farm development and adding value to the farm
- Quality of life and social benefits
- Tax efficiency

What are the Benefits?

The benefits of collaborative farming identified by the Land Mobility Service include:

- Improved economies of scale leading to increased profits
- Increased leisure time
- Better social and family life
- Improved work environment and reduced work load
- Reduced stress through shared decisions and companionship
- Improved farm safety
- Reduced investment risk and better decision making
- More efficient use of fixed costs
- Operational farms have higher economic, social and environmental value
- Improved use of skills and specialisations
- Expansion, succession planning and farm progression facilitated

What are the Challenges?

The challenges associated with developing a successful collaboration include:

- Matching together two people who will be capable of working with each other and have a similar vision for the land, farm or business
- Defining broad goals and developing a realistic business plan
- Seeking good independent professional advice
- Formulating an agreement which properly defines the arrangement and to which both parties can agree

What do farmers think?

Contract Rearing in action in County Cork[67]

Andrew Desmond entered into a contract rearing arrangement, facilitated by The ROI Land Mobility Service, with Michael and Jerry Murphy in the spring of 2015. Andrew farms 80 acres and was a dairy farmer before converting to suckling. Andrew wanted to stay farming but wanted a more manageable operation and was frustrated by the uncertain returns in beef. With the help of The Land Mobility Service Andrew explored the various options open to him, (including leasing, sharing, contract rearing), to see what best suited him.

67 http://landmobility.ie/wp-content/uploads/2016/01/2015-Land-Mobility-Service-Annual-Report.pdf

Andrew met up with dairy farmers Michael and Jerry Murphy to see how a contract rearing arrangement might work. Father and son Michael and Jerry were looking to expand their dairy operation. Key to them was maximising cow numbers on the milking platform. They had been building up heifer numbers but wanted to release land for milking cows. They looked at leasing and contract rearing. Upon meeting Andrew they felt he was someone they could work with and a contract rearing agreement was facilitated.

In March 2015 Michael sent over 72 yearling heifers, these were followed by an additional 70 weaned heifer calves at the end of May. Both parties feel that the arrangement is working very well, key reasons attributed to this include:

1. From the beginning there was proper discussion followed by a proper agreement, all potential issues were discussed and agreed.
2. There is good communication between all parties.
3. Things are done right. According to Andrew “Good communication has been vital.” Michael adds “The heifers have never looked as good”.

This successful contract rearing arrangement has helped Michael and Jerry expand their cow numbers, for them “it is not just the ground released by the heifers but also the reduced workload”. This has allowed them focus their efforts on cow and grass performance. From a base of 115 cows in 2013 Michael and Jerry are presently milking 185 cows and will move to 210 cows.

Link to Sustainable Land Agricultural Management Strategy

4c: Support the UFU and Young Farmers’ Clubs of Ulster as they establish a Land Mobility Scheme for Northern Ireland.

Case Study 6: Use of Clover on Farms

What is it?

Clover is the most important pasture legume which can be established alongside grass in grazing swards. Clover plants will fix nitrogen, thus reducing the need for chemical fertiliser, as well increasing water infiltration in swards. Swards mixed with clover can be successfully used for grazing and for silage production.

Nine Commercial Development Farms (CDFs) across Wales volunteered to become part of a network of farms trialling new technologies identified through research coming from the Institute of Biological, Environmental and Rural Sciences (IBERS) at the University of Aberystwyth. The farms were used as a practical testing ground for the IBERS research project quantifying the benefits of clover.

What are the Benefits?

There are numerous benefits associated with incorporating clover within grass swards, including:

- Displacement of chemical fertiliser since swards receiving 50 kg N/ha and containing 10 - 20% clover can produce the same amount of lamb or beef as a grass only sward receiving 180 - 200 kg N/ha
- Clover based swards lose quality more slowly than grass swards, dropping about two units of digestible value each week. This contributes to greater herbage intake and:
    - 10% improvement in beef liveweight gain
    - 20% improvement in lamb liveweight gain
    - 5% improvement in milk yields
- Milk protein levels and the proportion of muscle in the carcase can be enhanced while the risk of animal health problems associated with mineral deficiency is reduced for cattle fed on clover swards
- Clover swards can have water infiltration rates up to 14 times greater than perennial ryegrass, creating drier swards and improving resilience to extreme rainfall events
- Research has indicated that stock grazed on clover rich swards produce higher levels of certain essential fatty acids than stock grazing on grass swards
- Higher contents of some acids regarded as beneficial to human health have been found in milk and meat from animal fed grass / white clover silage, compared to grass silage
- Improvements in soil quality based on the number of earthworms

What are the Challenges?

- There is a risk of clover rich swards causing bloat however this has not generally been a problem on Northern Ireland farms and the risk can be managed by not allowing hungry animals to gorge on clover swards, feeding roughage before moving animals to fresh pasture and grazing sheep ahead of cattle. Moving stock onto dry rather than wet herbage is also desirable
- Establishing clover requires careful management with correct timing (late Summer), good soil fertility and good seed/soil contact all required
- Maintaining clover also requires effective management to ensure sustained high levels of herbage production however good financial returns are available. Farmers need to be careful with nitrogen inputs to achieve the target of an average 30% clover content
- To effectively manage clover, farmers are advised to consider the below guidelines;
    - Graze hard with sheep or light cattle during November / December
    - Apply nitrogen as fertiliser or slurry / farmyard manure in early Spring to encourage grass
    - Avoid under-grazing during spring and early summer
    - Rest for 3 to 4 weeks in July or close off for silage
    - Avoid poaching
    - Avoid smothering with slurry
    - Avoid spreading silage effluent
    - Control broad leaved weeds

What do farmers think?

Farmers in Wales trialling multispecies leys following research coming from the Institute of Biological, Environmental and Rural Sciences (IBERS) at the University of Aberystwyth found benefits to using multispecies leys. These benefits included ewe grazing days per year and forage value.

Economics

Earthworm activity creates soil and we can put a financial value on this from the numbers of earthworms in the soil. At **Bryngido** the value ranged from £4.40-£5.60 /ha/yr (£1.78-£2.27 /ac/yr).

From the yield and relative feed value the multispecies ley was worth over £30 /ha (£12 /ac) more than the ryegrass only ley and gave 900 extra ewe grazing days per year.

	Yield tDM/ha	Yield tDM/ac	Relative feed value £/tDM*	Forage Value (£/ha)	Forage Value (£/ac)
Multispecies ley	12.4	5	226	2,802	1,134
Ryegrass ley	11.5	4.7	241	2,771	1,121

At **Bryngido** there was an economic benefit to sowing multispecies ley compared with a ryegrass ley

10 ha of the multispecies ley could provide 45 additional grazing days for 200 ewes compared to a ryegrass ley

*Relative feed value compared to barley and soya at £125 /t and £350 /t respectively[68]

Link to Sustainable Land Agricultural Management Strategy

3b: Farmers should produce more diverse swards where appropriate and consider greater incorporation of legumes, such as clover. Where clover is established in swards, farmers should be targeting clover content of 30% in the Dry Matter.

20 - 30% Clover Cover

68 http://www.prosoilproject.uk/en/media/non-au/prosoil/Bryngido-final-FORMATTED-v1proofed.pdf

40% Clover Cover

50 - 60% Clover Cover

Case Study 7: Teagasc Agricultural Catchments Programme (Timoleague Catchment)

What is it?

The Agricultural Catchments Programme[69] is a Republic of Ireland initiative led by Teagasc which works with 300 farmers across six catchments to evaluate the environmental and economic effects of measures implemented under the Nitrates Directive. The programme works with farmers to gain knowledge, promote good agricultural practice and spread that knowledge to a wider audience.

The Timoleague catchment consists of 42 farms in County Cork which are predominantly dairy, with grassland accounting for 79% of the land type.

A specific example of actions taken within the Timoleague catchment was provided by a dairy farmer at the Catchment Science 2015 conference.[70] As part of the Agricultural Catchments Programme, the dairy farmer engaged with farm advisors and scientists and undertook soil sampling to determine the nutrient status of individual fields. (See P-Index and pH maps below.)

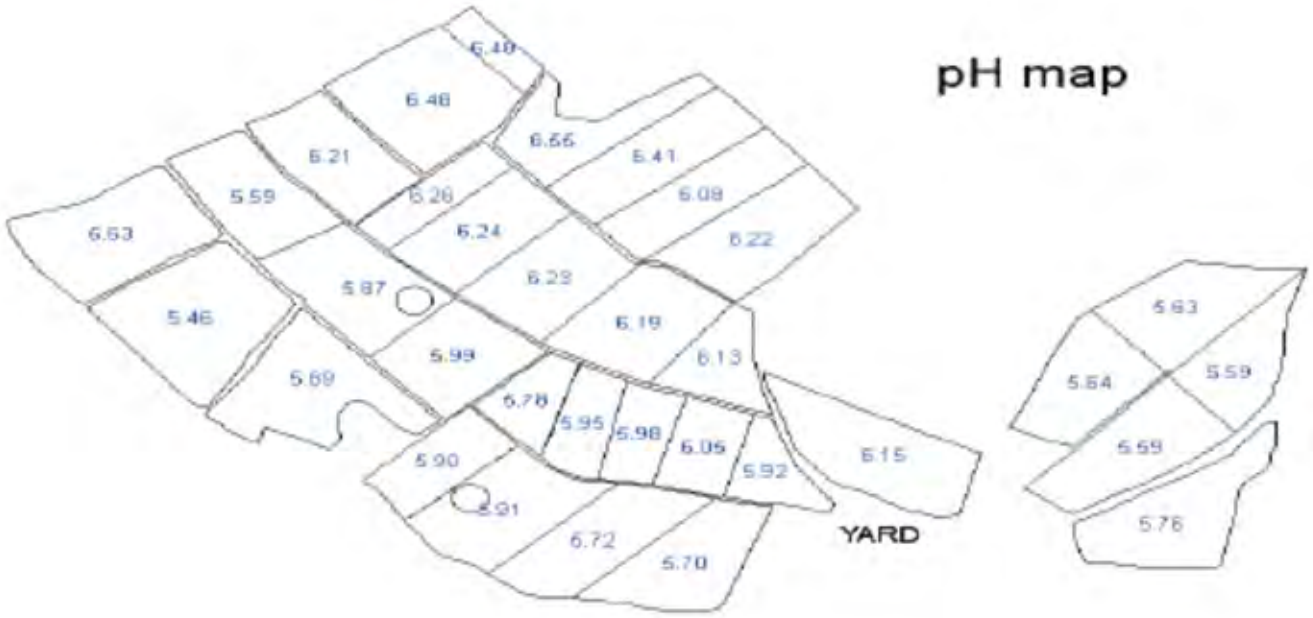
Having undertaken this soil analysis, the farmer applied slurry and lime based on individual field requirements. This more targeted approach led to improvements in soil fertility and grass growth, with grass growth increasing from 8 tonnes of dry matter per hectare in 2009, to 10 tonnes of dry matter per hectare in 2015. He has set a target to increase grass dry matter to 14 tonnes per hectare in the future. In addition to improved grass productivity, the farmer has incurred lower expenditure on fertilisers.

69 https://www.teagasc.ie/environment/water-quality/agricultural-catchments

70 https://www.teagasc.ie/media/website/publications/2015/Leahy_Walsh.pdf

Soil Analysis Maps

John Walsh: Precision Dairying Project



What are the Benefits?

At catchment level, there were both environmental and economic benefits for those participating in the catchments programme:

- Reductions in P balance and greater P efficiency
- A decrease in the proportion of soils classified as being at excessive P index levels (from 32% to 24% over a three year period)
- Total milk production remained constant
- Average gross margin returns of the Timoleague dairy farms were approximately equivalent to the top 10% dairy farms within the Irish Farm Business Survey (€3130 / ha (Timoleague) compared with €3261 / ha (top 10% nationally))

What are the Challenges?

- Rolling out these good practices nationally
- There can be a significant time lag between the reduction in phosphorus source pressures and improvements in river water quality

Link to Sustainable Land Management Strategy

5b: Phasing of implementation of the Sustainable Land Management Strategy should begin with Business Development Groups and Discussion Groups within Water Catchments.

Case Study 8: Improving Catchment Environmental quality by better Nutrient management in the livestock Farming landscape (The CEFN Conwy Project)

What is it?

The CEFN Conwy Project in North West Wales was established to support the local agricultural sector in meeting Water Framework Directive requirements and to support the efficient management of on-farm nutrients, soil and vegetation, so reducing diffuse pollution. 50 farms participated in the project covering a total of over 8,900 ha with 82% of the holdings farming mixed beef suckler cows and sheep.

The CEFN Conwy Project had a 6-point Plan of Action:

- Host local awareness-raising events for farmers
- Survey farmer expert knowledge and current land management practices
- Identify farmers willing to trial management practices new to them
- Undertake field trials to add to knowledge of managing on-farm soil, nutrient loading and vegetation
- Provide free field soil analysis across the catchment at participating farms
- Disseminate technical guidance featuring catchment-specific findings of the project

What are the Benefits?

One of the major benefits of the project was the increased knowledge of the status of each farmer's soils.[71] For example:

- 77% of fields were below the optimum soil pH of 6.0 for grass production, indicating that the grassland productivity of the catchment could be increased by liming
- 77% of fields were either P index 2 or 3, where index 2 is the target for phosphate and index 3 requires slurry application only. Therefore, few fields were either seriously over or under fertilised with phosphate
- 35% of fields were within the target indices for potash (K index -2 or +2)
- 60% were below the optimum target for potash (K index -2 or +2). This suggests that there is an issue regarding the balance of nutrients within the catchment and the available K is limiting grassland production

71 http://cefnconwy.bangor.ac.uk/documents/cefnconwy-web-en.pdf

What are the Challenges?

The major challenge in projects which provide information on soils is to ensure that the results are used to improve land management practices, and that the knowledge is transferred appropriately throughout the sector. For example, the Conwy project found that of the 49 farmers surveyed, none used or had even tried out the two government-sponsored computer programmes for nutrient planning that are freely available. Over half of the farmers used no external source of advice.[72] It is therefore vital that any regime of free soil sampling is accompanied by well planned and well communicated advice.

What do farmers think?

"The NFU Cymru has been involved with CEFN Conwy since its inception and has remained proactive throughout the project, ensuring its member farmers were informed about the opportunities the project presented to them. The NFU Cymru particularly applauds the hands-on approach the project has adopted whilst working with farmers in Conwy and welcomes this pamphlet as a summary of the project and its findings."

Paul Williams - NFU Cymru Senior Group Secretary, Llanrwst.

Link to Sustainable Agricultural Land Management Strategy

1a: Complete GPS soil analysis in Northern Ireland's fields at 2 hectare intervals.

72 http://cefnconwy.bangor.ac.uk/documents/FinalRevisedCEFNaccepted.pdf

Case Study 9: Ballinderry Rivers Trust

What is it?

The Ballinderry Rivers Trust is a charity which aims to conserve, protect and improve the rivers and loughs of the Ballinderry River system, Lough Neagh, the Lough's western-shore streams, and their wildlife, for the benefit of the public and the wider environment.[73]

The Ballinderry Rivers Trust have undertaken a number of projects designed to improve the health of the river.[74] These projects are all based around the Trust's core project values:

- Catchment-based approach - taking a whole river catchment or sub-catchment approach to project work, allowing them to provide multiple benefits through targeted project work
- Evidence-based approach - undertaking project work because there is evidence it is necessary
- Community involvement - involving as many members of the public as possible
- Education and knowledge sharing - telling people what they are doing and why they are doing it and sharing the information gathered during a project with others to further help the conservation and protection of the river

What are the Benefits?

One of the projects undertaken by the Ballinderry Rivers Trust is the Freshwater Pearl Mussel Rescue Project.[75] Its benefits include:

- £160,000 investment in silt remediation and river restoration over 20 kilometres to improve the river to a standard in which freshwater pearl mussels can naturally reproduce and survive to adulthood
- 20,000 metres of new or repaired stock-proof fencing resulting in 3,500 less cattle accessing the river
- 1,000 square metres of land brought back into agricultural production
- 60 open livestock watering bays have been closed up and alternative watering supplied, using pasture pumps
- 3,500 metres of bank revetments (soft and hard engineering) to prevent erosion
- 4,000 metres of willow and alder planted along vulnerable river banks
- 240 juvenile mussels released into the river with release of another 330 planned. These numbers will shift the date of total extinction of the population far beyond the prediction (2098) and continued releases will avoid extinction entirely

73 http://www.ballinderryriver.org

74 http://www.ballinderryriver.org/index.php/protect/our-projects

75 http://www.ballinderryriver.org/index.php/protect/our-projects/freshwater-pearl-mussel-project

What are the Challenges?

The Ballinderry Rivers Trust's primary aim is to improve the quality of the river. To do so, they need to work in partnership with farmers to identify potential pollution sources and suggest means of rectifying farm practices to reduce the risk of pollution. To achieve cooperation, a Rivers Trust must work in cooperation with local farmers and landowners. Since the Rivers Trust is not the regulator, it is much easier to build a good relationship with farmers. Farmers are more likely to engage because the Rivers Trust can provide advice on how the address environmental problems but does not have any legal authority; ***they want to help you out, not catch you out.***

Link to Sustainable Agricultural Land Management Strategy

4a: Review current environmental governance structures and implement a new "advocacy first" approach to environmental governance where the chosen "advocate" is not responsible for regulating the cross-compliance or any similar regime.

Case Study 10: Upstream Thinking Initiative - Looking after the land to look after our rivers

What is it?

Upstream thinking is a partnership of South West Water, the Cornwall Wildlife Trust, the Devon Wildlife Trust, the Westcountry Rivers Trust and the Exmoor National Park Authority.[76] It is supported by the National Farmers' Union, the Environment Agency, Natural England and the Farming and Wildlife Advisory Group. It is a sustainable approach, working with the expertise of partners, the knowledge of farmers and nature itself to improve raw water quality at source.

Farm advisers visit farms and carry out an assessment resulting in a whole-farm plan. This includes a water management plan and future capital investment proposals targeted at water quality improvements, which can be up to 50% funded by Upstream Thinking.

These can include improvements to slurry storage, fencing to keep livestock out of rivers, providing alternative water sources for livestock, and better pesticide management including investment in new equipment such as weed wipers which deliver targeted doses of herbicide.

Work to block drainage ditches on Exmoor has also taken place, with a target of restoring a further 500 hectares of peatland. Delivered by the Exmoor Mires Partnership, this part of the Upstream Thinking programme successfully investigated and restored over 2,000 hectares of land on Exmoor in 2010-15.

The work is targeted to benefit 15 water treatment works supplying 72% of the total daily water to South West Water customers.

Some of the funds invested by South West Water have been allocated by means of an auction system where South West Water put forward £360,000 to be paid directly to farmers for improvements such as fencing, covering feeding sheds and improving slurry stores.[77] Successful bids were identified by ordering bids that providing the best value for money. Value for money was determined by dividing a bid's environmental improvement score by the grant requested.

What are the Benefits?

- 180 capital grants to farmers totalling £2.2 million, enabling farmers to access funding from other sources
- Reducing pollution at source makes cost savings of around 65:1 compared to removing pollution at the water treatment works

76 http://www.exmoormires.org.uk/index.cfm?articleid=8692

77 http://www.cserge.ac.uk/sites/default/files/briefing_note_river_fowey_auction_2.pdf

- Restoration of peat bogs on Exmoor has resulted in a third less water leaving the moorland during heavy rainfall compared with three years previously
- The auction system encouraged farmers to design their own projects and delivered 20 - 40% more value for money than the fixed-price alternative

What are the Challenges?

- Initiatives which are heavily reliant upon advisor contact are labour intensive and can be expensive

What do farmers think?

"Farmers across the South West are recognising that the land they farm provides multiple services for society, including clean water, and they are investing time and money in measures like these that will help protect water sources for the future."

Paul Cottington, Environment Adviser for the National Farmers Union in the South West.

Link to Sustainable Agricultural Land Management Strategy

Investment targeted at reducing the impact of agriculture on water quality will help deliver the aims of the Sustainable Land Management Strategy.

Case Study 11: The Pontbren Project: Sustainable Land Management in the Uplands

What is it?

The Pontbren Group consists of ten neighbouring families who farm a thousand hectare contiguous block in a Welsh catchment. They first came together in 1997 as a group of three, who then invited the remaining seven to join in 2001. The farmers here have worked together to take forward innovative proposals to refocus their farming methods as a means to provide a more sustainable system of agriculture.[78]

Their objectives include:

- Sustainable farm management (now and for the future)
- Improved livestock shelter
- Farm business diversification
- More effective integration of agriculture and woodland management
- Creation of wildlife habitats
- Production of timber for on farm use and for added value processing
- Enhancement of the upland landscape

They have attempted to achieve these objectives through:

- Environmental enhancement - planting shelter belts, new hedgerows and creating a network of ponds
- Production of timber and added value wood products, including firewood, woodchip bedding material and locally grown tree seedlings of native provenance
- Stock reduction
- Niche marketing of farm produce via a Pontbren producer group, at farmers markets and through a supermarket contract
- Business monitoring through the Farm Business Survey

78 http://gov.wales/docs/wefo/report/140328pontprenreporten.pdf

What are the Benefits?

- Farmers have planted 120,000 trees, all native species from local seed stock to maximise healthy growth and increase biodiversity. These trees provide shelter for the stock, as well providing biodiversity and hydrological benefits and supporting biosecurity on farm
- There was an incredible increases in soil porosity in the shelter belts compared to the adjacent grassland with soil in the shelter belts 60 times more porous
- Wood cover has increased from 1.5% of Pontbren land to 5% of the land with no loss of agricultural productivity
- 26.5 Km of hedgerows have been planted
- 12 ponds have been established, covering 5.4 acres of ground
- Areas of wetland have been fenced off to ensure protection
- A shift from crossbred ewes to hardier, local sheep breeds that would not always need to be housed at lambing time or during the long winters, thereby reducing costs
- All farmers conducted financial benchmarking which provided the farmers with objective data on financial performance to allow them to make more informed business decisions
- Farmers were able to use woodchip from thinning their own trees as livestock bedding instead of purchasing straw
- The benefits delivered by these Pointbren schemes (£212k) were cheaper than if they had been delivered under the agri-environment scheme (£443.2k)
- The farmers feel that the successful integration of woodland management into upland livestock farming has also 'future-proofed' their farms by:
    - improving the capital value of the land
    - making their land more resilient to the effects of severe weather events
    - substantially reducing the risk of accidental breaches of biosecurity and water pollution standards.
- The project has worked from the starting point of the farmers' priorities, and been driven forward by their aspirations. Their ownership of the project has ensured much greater involvement and co-operation than would otherwise be the case if they were led by external agents
- The group dynamic has been critical in the formation of social capital which has reinforced the farmers' enthusiasm for the project, motivated them to work to high standards, and provided a support mechanism in more difficult times
- The project is an excellent example of the importance of monitoring, measuring and managing environmental and economic performance

What are the Challenges?

- The Pontbren farmers needed to seek alternative sources of funding, such as lottery funding because they felt that conventional agri-environment and woodland grant schemes do not have sufficient flexibility to support targeted, site-specific, collaborative environmental initiatives led by groups of farmers and landowners
- The farmers remain cautious about catchment level planning and particularly concerned about the steer of external agencies who would encourage trade-offs between environmental and production outcomes. For catchment level management to work, suitable incentives secured over the long-term will be needed.
- Marketing the produce through a catchment co-operative proved difficult
- Farmer-led groups who follow the Pontbren model will need access to the services of skilled facilitators and technical advisers who understand:
    - The objectives of the farm business, and
    - The environmental needs and opportunities

What do farmers think?

"It made me focus on the fact that there was other ways of doing things on the farm rather than just sticking to the animals only… it gave you an opportunity which you wouldn't have had otherwise."

"…none of the existing schemes were appropriate. They were too inflexible and it was not possible for us to enter as a group. We were left with no other option than to develop our own scheme and seek funding from other sources."

"I think we wanted to do our own thing and we wanted to do it as we wanted to do it and not have to tick all the boxes and try and fit into all the rules or whatever, that was the main thing."

"It (financial benchmarking) has helped me. I can see my sheep are making money and the cows aren't. So we have reduced our suckler cows…"

Pontbren Farmers[79]

Link to Sustainable Agricultural Land Management Strategy

3e: Ensure that sustainable and flexible management plans are in place for upland areas which recognise the importance of achieving stocking levels which benefit both the farmer and the environment.

79 http://gov.wales/docs/wefo/report/140328pontprenreporten.pdf

The changes at Pontbren have restored some of the landscape diversity lost during the 20th century while also creating a landscape fit for farming today.

The belts of trees planted on the pasture land had rapidly improved the soil structure and sent roots deeper into the soil. Researchers were surprised to find that trees begin to have this effect as early as two years after planting.

Trees planted along streams will contribute to the required 'good biological status' by stabilising banks, and offering shade and shelter for wildlife.

Case Study 12: Bassenwhaite Catchment, Cumbria Pilot Project

What is it?

The Bassenthwaite catchment provides a landscape scale example of spatially prioritising management practices. The Bassenthwaite Ecosystem Services Pilot Project was set up in 2009 to demonstrate how multiple public benefits can be delivered at a catchment scale. This upland catchment is located in the Lake District, Cumbria, covering 360 km^2 and is dominated by hill sheep farming, with some beef and dairy. The catchment includes the market town of Keswick, which along with the downstream towns were badly damaged by flooding in 2009 and 2015. Farming in the catchment provides a range of benefits for people in addition to food, including timber, water regulation, carbon storage, recreation, tourism and biodiversity. The pilot project aimed to enhance these multiple benefits through an integrated landscape scale approach to managing the catchment. In addition to farmers, partners included the NFU, Natural England, Lake District National Park Authority, Environment Agency, Forestry Commission, United Utilities and Cumbria Tourism.

As a first step, farmers were surveyed to obtain their views on the provision of wider public benefits and how delivering these can be incorporated within their farming businesses. Next a baseline assessment was undertaken. Following the completion of this assessment, partnership workshop meetings were held, wherein partners, including farmers, were encouraged to work together on managing the catchment and understand each other's objectives. Discussion at these workshops was facilitated by the use of the baseline assessment maps. This enabled partners to identify potential areas where changes in land management could enhance the public benefits from land.

As a result of these discussions, partners reached a consensus on management actions and developed a delivery plan that targeted specific areas. Seven land management actions were identified:

- Increase woodland cover
- Achieve sustainable grazing
- Sustainable river management
- Restore Scheduled Monuments at risk
- Improve access
- Manage nutrients on improved grassland
- Improve biodiversity of valley habitats

What are the Benefits?

- The location of new woodland cover sites were designed to fit with farming. Based on the mapping process, bracken beds and steep slopes with eroding soils were targeted as these were among the least important agricultural areas. Connections between existing woodlands were also targeted to enhance habitat connectivity
- Achieving sustainable grazing through reduced ewe stocking levels in priority areas such as blanket bogs, as well as increased grazing of hardy cattle, can lead to a recovery of blanket bog, reductions in soil erosion and compaction, improvements to water quality and preventing a dominance of unpalatable species like mat grass, heath rush and bracken
- The partnership coordinated payments from both agri-environment and woodland grant schemes and the worked with farmers to secure funding through the Higher Level Stewardship prioritisation process
- The partnership also identified sources of funding from the private sector. As part of its Sustainable Catchment Management Programme (SCaMP2) the water company United Utilities paid £4 million for capital works beyond the scope of the agri-environment schemes to primarily address deteriorating water quality. The motivation for this investment by United Utilities is to reduce future operational and capital treatment costs
- Contributions from the tourism industry were made via the Visitor Payment Scheme run by Nurture Lakeland. This scheme allows visitors who benefit from the natural environment to support it by making voluntary contributions through businesses participating in the scheme, such as accommodation providers, retailers and tourist attractions. The contributions are made by an opt-out booking system, donation envelopes and sponsored products[80]

What are the Challenges?

- Careful design of woodland planting is needed
- Benefits can be lost if woodland is not managed properly. Fences and young trees need maintenance
- Balance needs to be found between farming sheep and the provision of multiple benefits. If farmers are reliant on payments, they need to get the balance right for long term continuity of hill farming
- Higher level agri-environment schemes need to be adaptable to farm scale
- There is a minimum number of animals need to make sheep farming viable and farmers want to continue the tradition of sheep farming. Putting a few sheep out is not considered farming; farmers need to be interested in livestock

80 Smith et al. 2013 “Payment for ecosystem Services: a best practice guide.” Defra, London.

Link to Sustainable Agricultural Land Management Strategy

3e: Ensure that sustainable and flexible management plans are in place for upland areas which recognise the importance of achieving stocking levels which benefit both the farmer and the environment.

Case Study 13: CAFRE Rush Control Project

What is it?

The CAFRE Rush Control Project aims to evaluate and demonstrate a range of measures for rush control best suited to Northern Ireland. It will help farmers to maintain and increase land eligibility for area based schemes and is based across four demonstration sites; the Greenmount Hill Farm at Glenwherry, the Crom Estate, Co. Fermanagh, the Belfast Hills and Oxford Island, Craigavon.

What are the Benefits?

- Findings to date are showing that cutting and weed wiping with Glyphosate is the best method of rush control
- Increasing pH in rush covered areas is also important as rushes do not respond well to an increased pH

Treatment / Site Name	Cut Only	Cut + Weed Wipe (Roundup Energy / Glyphosate)	Weed Wipe Only (Roundup Energy / Glyphosate)	Spray (MCPA)	Control
Greenmount Hill Farm	+ 10%	- 51%	- 46%	- 32%	+ 2%
Crom Estate	-5%	-78%	- 30%	- 20%	+ 5%
Belfast Hills	+ 7%	- 31%	- 18%	- 11%	+ 25%

What are the Challenges?

- Glyphosate was recently renewed for use in the EU for an eighteen month period only

Link to Sustainable Land Agricultural Management Strategy

3a: Use a variety of grassland management techniques to increase grass utilisation on Northern Ireland farms by at least one tonne per hectare per year and improve quality by increasing the ME (metabolisable energy) content of grass and silage by 5 - 8%.

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