Meeting the challenge:

Greenhouse Gas Action Plan

Of the Agriculture Industry in England

Progress report and
Phase II Delivery
April 2012

"We offer this Plan as a serious statement of intent and a commitment to reduce our industry's GHG emissions" (2011)

Meeting the challenge

Over the next 40 years, the global food system will have to feed more people with less environmental impact across a range of scales from the local to the transnational. This will mean providing a higher quality diet whilst dealing with greater competition for land, water and energy and the economic and political pressures of globalisation as the climate changes. Our British farmers and growers will need to adapt to the changing conditions at the same time as reducing greenhouse gas emissions. Greenhouse gases are an inevitable consequence of food production, and the challenge of reducing them whilst increasing food production is huge.

Our coalition of agricultural industry partners launched a Greenhouse Gas Action Plan last year to meet the climate change challenge without compromising domestic production. It's too simple a solution to produce less and import more. This simply "exports" our emissions to other parts of the world. So our Plan has focused on how farmers, across all sectors and farming systems, can become more efficient to help reduce greenhouse gas emissions and make cost savings per unit of production. It is one of a range of voluntary initiatives helping farmers to produce more food and fuel with less environmental impact.

Agriculture can also make a big contribution to mitigating climate change by storing carbon in soils and vegetation and by generating renewable energy. We have been set a target of reducing our emissions by three million tonnes of CO_2 equivalent by 2020. Our estimates suggest that the emissions reduction potential of renewable energy within our industry could outweigh this target by a factor of six. We know that farming is part of the solution.

This is not only about farmers looking to modify what they do. We, the partners sitting on the GHGAP Steering Group, also have a role to play. During this initial phase of our long-term commitment to delivery and action we have concentrated on how we can work more effectively together and with others. We considered it important to lay these foundations so the industry is better equipped to meet the more ambitious challenges posed by climate change in the future, and in doing so complement actions to improve the sector's competitiveness and resilience.

We know that agriculture has a unique emissions profile and we believe that there is a limit beyond which it may not be biologically possible to make further emissions reductions. However in order to build on our early momentum we propose key actions for the next phase of delivery to 2015 in the spirit that we offered the first Delivery Plan – that despite the challenges and uncertainty, there are a suite of actions that can be implemented on-farm to deliver improved efficiency of production and a reduction of emissions per unit production

This first year has demonstrated vividly that our response is anything but "business as usual". We have worked at taking a strategic approach and have started down the long road of enhancing the way that important messages, technical advice and information are delivered to farmers and growers. This will not be a short journey but we have set off at a good pace and are travelling in the right direction.

ADAS AEA AHDB Agriculture & Horticulture Development Board aic bpc british poultry council CLA Country Land & Business Association RURAL ECONOMY IS OUR BUSINESS LEAF LINKING ENVIRONMENT AND FARMING NFU NIAB TAG ORGANIC RESEARCH CENTRE ELM FARM

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Executive summary

The Greenhouse Gas Action Plan (GHGAP) is the principal mechanism for delivering the farming industry's commitment to a reduction in annual emissions from agriculture in England of three million tonnes CO_2-equivalent (Mt CO_2e) as set out in the Low Carbon Transition Plan by the third carbon budget period (2018 – 2022). Our robust partnership established in 2010 aims to improve awareness amongst farmers and growers of GHG emissions and drive the implementation of on-farm practices that reduce GHG emissions per unit of production, thereby reducing the need for regulation or taxation.

Food production involves natural biological processes that inevitably release GHGs and which require a wide range of mitigation actions; there is no "one size fits all" solution. Nevertheless total GHG emissions from UK agriculture have fallen by 19% since 1990. The GHGAP is focussed on improving efficiency of production, across all farming systems, recognising that the environmental challenge is multi-faceted and that difficult "trade-offs" between mitigation and other priorities will need to be addressed. It is critically important that domestic production should not be compromised.

Agriculture continually evolves, greatly influenced by weather, world-wide economic events and new technology. Priorities and business plans including investments change as a result; thus to be effective any action programme has to include an element of foresight and be responsive. In addition, the long term nature of agricultural systems means that change will not happen overnight. Consequently the GHGAP is a living document, responsive to changes in policy and knowledge, requiring regular refinement over time. As more data is generated, the scale of abatement potential and actions that are most feasible and likely to bring about the greatest impact will become more clearly defined.

The story so far (2010-2012)

The strength and value of the GHGAP has been clearly demonstrated over the past two years. In this first phase we have focussed our efforts on giving advisers the tools and knowledge to help farmers in the identified priority areas and adding value to work that is already going on. We believe that consistency of message and providing easy access to the latest guidance and science is critical to ensuring that our industry makes the link between improving production efficiency, land management decisions, and the associated benefits for farm profitability, and for greenhouse gas reduction. We have begun to work with government and its agencies and with the supply chain to create consensus, unity and authoritative influence in the industry.

We established early on that it was important to demonstrate leadership to the farming community and the commitment of the industry to tackling this challenge; hence the GHGAP Steering Group is chaired by the vice presidents of the NFU and CLA. The ownership generated amongst the members of GHGAP has created a robust partnership.

The GHGAP is taking the first steps to promoting integration - of messaging, advice, demonstration *etc* - across the Steering Group and the wider supply chain. Although focussed on GHG mitigation, the GHGAP believes that in the longer-term its activities could provide the catalyst for change across the entire industry - in the way that it communicates and delivers shared messages. Our pilot Farm Efficiency Hub is a key component in this vision. Its electronic repository of information will provide easy access to the latest guidance

and science in an integrated way for advisers and farmers. It is difficult to imagine the delivery of an initiative as transformational and innovative as the Farm Efficiency Hub in such a short timescale in the absence of the GHGAP. This would support the current thinking amongst the industry of the need for closer cooperation and integration of the range of industry-led partnerships that promote environmentally beneficial management practices alongside increasing food production *e.g*. Campaign for the Farmed Environment, Voluntary Initiative on Pesticides, Tried & Tested and the GHGAP.

Our partnership has been the catalyst for collective action. In taking a strategic approach to the delivery, we have sought to avoid duplication and add value. Sharing work programmes has already produced short and long-term benefits including piggy-backing on planned activities to extend penetration and facilitating collaborative relationships for future co-operation. The sector Roadmaps have gained respect for their approach of focussing on tangible gains for the farmer through improved productivity and for their engagement with the supply chain. The AHDB sector boards are now making clear connections between the Roadmaps and the range of actions the GHGAP aims to deliver.

For our first phase Delivery Plan we carried out a strategic assessment of agricultural emissions to identify the principal sources and mitigation options. As a result we identified a suite of actions to be implemented at farm level in order to achieve production efficiencies and thereby reduce emissions per unit of production. The collective expertise of the Steering Group proved invaluable in identifying the actions, which are fundamental to consistent messaging across the partnership and beyond. Our GHGAP logo, designed to echo these actions, is an important achievement; providing a clear demonstration of the collective, integrated activities that the partnership is and will be delivering.

We have committed to reporting on progress so that farmers and land managers can be confident that their changes in farm practice are leading to lower emissions. We have worked closely with the GHG Platform as it seeks to source data to improve the agricultural inventory. However we believe that much work still need to be done in identifying robust indicators of progress. Our experience over the past year and in writing this report reinforces our belief that monitoring the impact of the GHGAP's activities and hence changes in on-farm practice remain a challenge for both the GHGAP and for Government. We will take this up during the next phase of delivery.

Next steps of delivery (2012-2015)

We have proposed key actions for the next phase of delivery to 2015 when the revised agricultural GHG inventory is published, in the spirit that we offered the first Delivery Plan:
"The complexities and challenges should not delay progress in taking steps to increase the implementation of on-farm actions to reduce GHG emissions. It is acknowledged that there is uncertainty about GHG emissions, and that technical solutions to their reduction in food production systems will take time and investment to deliver in the longer term. Nevertheless, there are a suite of actions that can be implemented on-farm to deliver improved efficiency of production and a reduction of emissions per unit production."

By 2015 we aim to have achieved the following:

Priority area	Proposed action	Target date
Strategic co-ordination (and reporting)		
Steering Group action 1	Consider options for funding a GHGAP co-ordinator in the context of greater integration between industry-led initiatives, the role of Farm Efficiency Hub (FEH) and plans for overall funding and management.	By end 2012
Steering Group action 2	Maintain oversight of mitigation activity to identify gaps in action or progress in collaboration with others *e.g.* Defra's Research Platform Policy Group, as appropriate	Throughout phase II
Steering Group action 3	Evaluate and agree key indicators of activity and progress for the GHGAP with the GHG Platform and Defra Statistics team in order to better report on progress	Throughout phase II
Steering Group action 4	Test Farm Efficiency Hub (FEH) with adviser focus groups and collate feedback	By end 2012
Steering Group action 5	Convene high profile workshop with senior Defra officials to exhibit the FEH and present the case for wider ambition in support of co-ordinated (integrated) advice delivery and industry-led initiatives	By April 2013
Communication		
Steering Group action 6	Continue to identify opportunities for collaboration in communications within the GHGAP, with other farming organisations and service providers and the supply chain, and investigate the opportunities for greater exposure in the trade press	On-going
Steering Group action 7	Subject to Steering Group approval, initially assess the usefulness of social media as a form of communication	From 2013 to 2015
Steering Group action 8	Review the on-farm actions to take into account new knowledge and policy.	In 2013
Management skills and advice		
Steering Group action 9	FACTS Qualified Advisers continue to undertake new training	By end 2014
Steering Group action 10	AIC to draft plans for a register of feed advisers consulting with members, with BSAS, AHDB livestock sectors and others on administration and a standard of training for eligibility to remain on such a register. Agreed plans to be resourced and implemented.	By Sept 2012 By mid 2013
Steering Group action 11	Use Tried & Tested campaign (guidance and tools) to help raise the skills and understanding of farmers in the benefits of integrating animal feeding planning and crop nutrient planning on livestock farms	By end of 2013 then on-going

Steering Group action 12	Continue to promote the benefits of improving skills and training *e.g.*Continuing Professional Development schemes by AHDB livestock sectors	On-going
Steering Group action 13	Continue to support "carbon footprinting" through • initiatives such as the development of a tool for the cereals and oilseeds sector (HGCA to lead) • considering options to meet the range of farmers' needs of "carbon footprinting"	Throughout Phase II By end 2013
Crop nutrient management		
Steering Group action 14	Continue to promote the Tried & Tested nutrient management plan, website and tools and the benefits of professional advice, and soil analysis, with a continuing focus on the needs of the livestock sector	On-going
Steering Group action 15	Sub-group of GHGAP and Tried & Tested partners to plan how best to promote the benefits of accurate nutrient application and the services available considering different sector needs	By mid 2013, then through to 2015
Steering Group action 16	Promote strong linkages between nutrient and soil management activities *e.g.* between Tried & Tested and HGCA nutrient and soil management events	Throughout Phase II
Soil and land management		
Steering Group action 17	Look for opportunities to promote the benefits of soil management and soil organic matter *e.g.* AHDB-HGCA, CSF project - running 70 farm events	Throughout Phase II
Steering Group action 18	Conduct further evaluation of Defra surveys in conjunction with the Defra Statistics teams to help identify the most reliable means of indicating progress in soil sampling	By end 2014
Steering Group action 19	Evaluate contribution of CFE measures (including farm stewardship) to GHG mitigation	By April 2014
Livestock nutrition		
Steering Group action 20	Create a new guide and tool – a Tried & Tested Ruminant Feeding Plan with balance sheets and showing the link between feeding practices and animal health and also the integration between grass & forage nutrition and feed management	By end 2012
Steering Group action 21	Promote the new plan through the Tried & Tested nutrient management network, and through the supply chain for milk and beef products	Through to 2015
Livestock health and fertility		
Steering Group action 22	Build on the early success of established programmes *e.g.* DairyCo's Mastitis Control Programme, and take	Throughout Phase II

	opportunities to collaborate with animal health professionals	
Steering Group action 23	Work with the Cattle and Sheep Health and Welfare groups to tackle critical health issues relevant to the beef, dairy and sheep sector.	On-going
Energy efficiency and renewables		
Steering Group action 24	Continue to provide information on energy efficiency and technology through existing e.g. GrowSave, and the new initiatives *e.g*. Pig Improvement by Information Technology (PIVIT) project	On-going
Steering Group action 25	Continue to support and make the case for renewables and AD in particular because of its mitigation potential and other environmental benefits including contributing to the Voluntary code of practice/Best practice guidelines for AD crop feedstocks	On-going

Introduction – the Greenhouse Gas Action Plan

Under the Climate Change Act 2008, the UK Government is legally required to achieve an overall 80% reduction in greenhouse gas (GHG) emissions from 1990 levels across the UK economy by 2050. The agriculture sector is keen to play its part in contributing to meeting this target. The Greenhouse Gas Action Plan (GHGAP) is our contribution. It is the principal mechanism for delivering our commitment to a reduction in annual emissions in England of three million tonnes CO_2-equivalent (Mt CO_2e) as set out in the Low Carbon Transition Plan by the third carbon budget period (2018 – 2022).

Our engagement in the process is based on a number of principles:

- That production efficiency gains should be the focus of activity, and that domestic production should not be compromised in the face of food security concerns
- The need for an improved agricultural inventory that (accurately) reflects changes in agricultural practice
- Ideally, all other GHG costs and benefits associated with the agricultural industry should be recognised, e.g. energy costs and efficiency gains for agricultural inputs, as well as on-farm renewable energy generation.
- Recognition that there are complex trade-offs with animal welfare, food safety and other environmental goals for the industry (such as biodiversity and maintenance of upland heritage landscapes).

Fourteen organisations representative of the breadth of the agricultural industry in England launched the GHGAP in April 2011 with objectives to:

- Establish a robust partnership that will stimulate and deliver an industry-led approach thereby reducing the need for regulation.
- Improve awareness amongst farmers and growers of GHG emissions and of the particular farm practices that will improve efficiency and business performance, whilst simultaneously reducing emissions.
- Drive the implementation of on-farm practices that reduce GHG emissions per unit of production in a manner that promotes animal health and welfare and environmental protection by:
    - Improving the use of science continuously to update technical advice and decision making tools;
    - Developing innovative, effective means of delivering business and technical advice to farmers and growers that motivates and enables them to adopt improved practices;
    - Enhancing partnerships and networks to improve the breadth of awareness in each sector and stimulate uptake and adoption of innovative and beneficial practices.
- To work effectively with the GHG Platform[1] funded by Government to share information and data that will enable progress in reducing GHG emissions in the agriculture sector to be better estimated over time.

This document reports on the first phase of delivery (2010-2012) during which we have focussed on the establishment and consolidation of the key activities to underpin future implementation, including a feasibility study of a pilot information hub - the Farm Efficiency Hub - and identification of areas for collaboration and co-operation. We have interacted

[1] www.ghgplatform.org.uk

with, as far as possible, existing industry and Government initiatives and trusted networks that supply advice and information to ensure more effective delivery without duplication.

We are also presenting the next phase of our delivery plan, out to 2015. As in the first phase, our overall approach will be responsive to changes in policy, scientific developments, and farming circumstances. Defra is, this year, reviewing the range of policies and incentives that might contribute to mitigation and research for the revised inventory will be complete in 2015. These developments, along with changes to the Common Agricultural Policy (CAP), are likely to have significant influence on our activities.

The challenge of producing more food with lower emissions

Achieving an overall 80% reduction in GHG emissions will present all sectors of the UK economy with a significant challenge, but those faced by the agriculture sector are unique. Food production involves natural biological processes that inevitably release GHG's. Crops require nitrogen for growth and to produce economic yields. Livestock release methane as a result of enteric fermentation during digestion and manure is an unavoidable by-product. Variability in environmental conditions, such as temperature and rainfall is uncontrollable, and will influence food production and associated emissions from year to year.

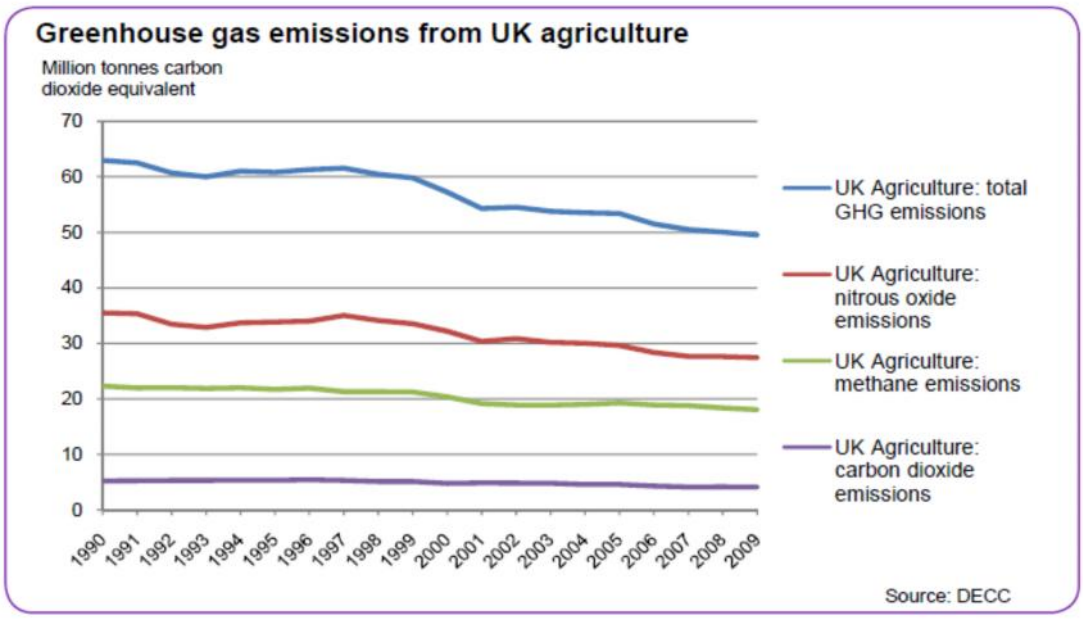
We believe that there is a limit beyond which it may not be biologically or technically possible or cost-effective to make further emissions reductions. However we must remain open to future technological breakthroughs or innovative production systems that might be possible in the long term. The biologically-constrained future minimum level of agricultural GHG emissions needs to be placed in the context of a decarbonised UK economy which recognises the contribution of agriculture to renewable energy and carbon storage, including new bio-based pathways such as biomass energy with carbon capture.

We believe it should be possible to establish an optimum GHG balance for the UK, based upon the most efficient systems producing domestically a substantial proportion of the food needs of the future population (c. 70 million by 2050). Concentrating on increased yields and efficiency across all types of farming would allow the opportunity for land to be available also for forestry, the cultivation of bioenergy crops and the maintenance of permanent grassland, all of which would increase the storage or displacement of carbon from burning of fossil fuels while providing other environmental benefits (biodiversity, soil quality, water quality, etc.).

Emissions from UK agriculture in 2010 were approximately stable at 50.7 million tonnes CO_2e compared with 50.2 in 2009, making up 9% of the UK total (Figure 1 provides data up to 2009). Our industry remains the main source of methane (44% of the total) and of nitrous oxide (80%), although emissions have decreased by 20% and 19% respectively since 1990.

There is no "one size fits all" solution to mitigation in our industry. Actions to increase production efficiency and reduce emissions of GHG's are often compatible with limiting losses of ammonia, nitrate, phosphate, pesticides *etc* but this is not always the case and in particular when considering animal health and welfare or wildlife and landscape conservation. The environmental challenge is multi-faceted and difficult "trade-offs" will need to be addressed.

Figure 1: Greenhouse gas emission from UK agriculture 1990-2009 (not updated for latest 2010 data)



It is possible to indicate how efficiently the agricultural industry uses resources by looking at the headline indicators of input, output and productivity. Total factor productivity has risen consistently since the early 1970s. In that time, the volume of final output rose by 25% while the volume of inputs to agriculture fell by 16% although the upward trend levelled off from around 2005, the reasons for which need to be explored. Some of the change in productivity, though not all, will have a bearing on GHG intensity.

Our self-sufficiency in food production has fallen in recent years resulting in a heavy reliance on imports. This is increasingly being seen as a food security risk in the face of rising populations both at home and worldwide; it also means we have limited or no control over the provenance and ethics used in the production of the food we eat. Using the UK's resources in land, skills, natural resources and climate with greater efficiency will deliver GHG and other environmental benefits, improve food security and our economic position.

greenhouse
gas action plan

The story so far
2010-2012

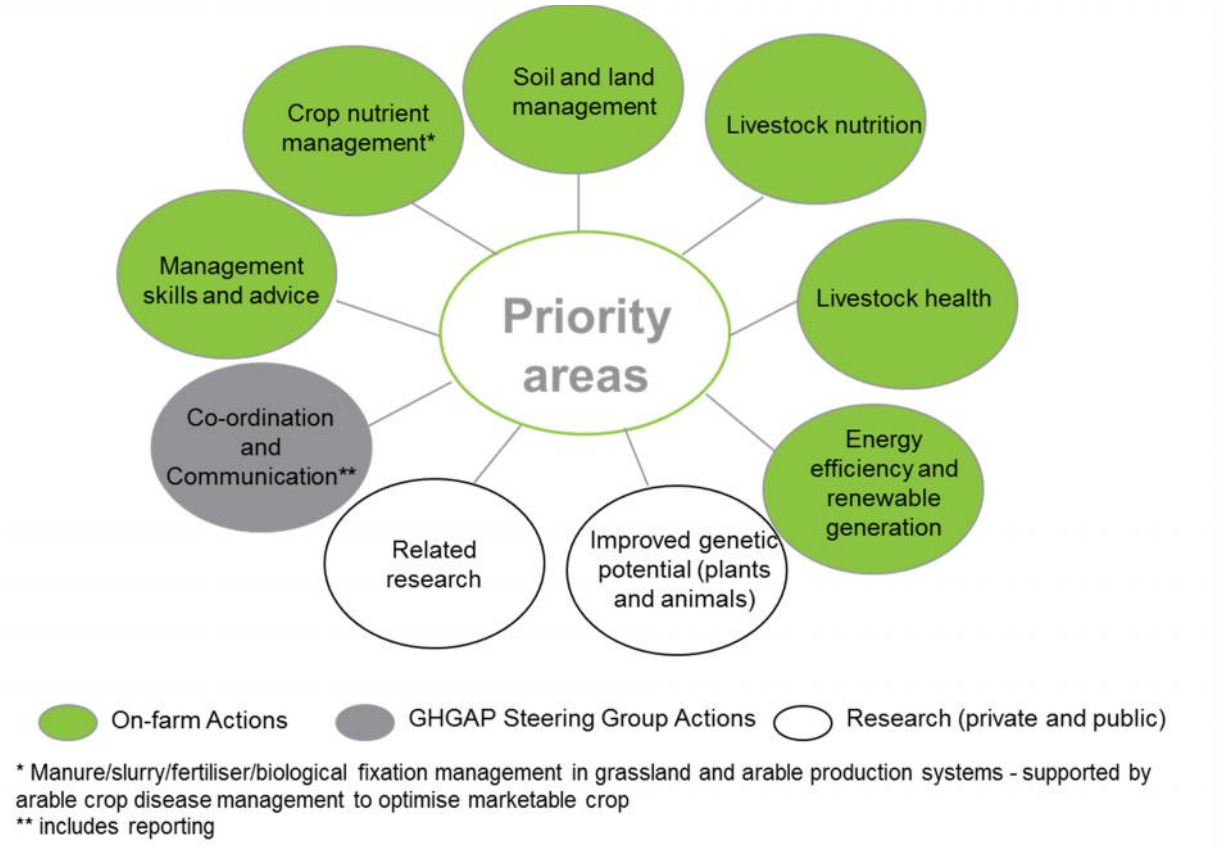
The story so far

GHGAP Steering Group actions

In the first phase Delivery Plan[2] the Steering Group of GHGAP focussed on **strategic co-ordination** and **communication** (see Figure 2) to:

1. **improve co-ordination** in identification of research requirements, and in training and advice, by sharing work programmes and agreeing priorities
2. be **consistent in communications** to farmers and growers
3. address the shared government-industry goal of monitoring and **reporting progress** in changes in farm practice

Figure 2: illustration of the priority areas for the GHGAP (covering GHGAP Steering Group actions and on-farm-actions and research requirements)



On-farm actions

For agricultural systems methane and nitrous oxide are the main GHGs. It has therefore always been clear that our priorities for mitigation are management of nitrogen (*e.g.* in soils,

[2] GHGAP first phase delivery plan

feed and fertilisers) to reduce nitrous oxide and the management of livestock to tackle methane. However these priorities are underpinned by good soil management and will be facilitated by enhancing the knowledge and skills of the industry and investment in related research. Whilst CO_2 emissions from energy and fuel use by agriculture are relatively modest, improved energy efficiency offers business benefits. In addition low carbon energy services present real diversification opportunities, whilst both lowering our own emissions and helping to decarbonise the energy that the UK uses throughout the economy (Figure 2 illustrates these priorities).

In the first phase Delivery Plan GHGAP partners carried out a strategic assessment of agricultural emissions to identify the principal sources and mitigation options. This led to the design of 15 actions to be implemented at farm level in order to reduce emissions per unit of production, by improving efficiencies across all farming systems. Whilst there is some uncertainty about the emissions abatement potential of each action, the evidence suggests that each can improve the competitiveness of farming businesses by increasing production efficiencies and make a positive contribution to reducing GHG emissions. The on-farm actions have been grouped into six priority areas (as illustrated in Figure 2).

The on-farm actions (detailed description in Annex 1) are written for the benefit of a range of stakeholders (not necessarily GHGAP partners) delivering advice and information to farmers. They provide leadership and clarity while giving stakeholders the freedom to use more appropriate and relevant language for their particular adviser and farmer audiences.

The importance of research

Research (public and private) aims to provide advances in knowledge, genetics and technologies to support continuous development in advice and information for farmers. Soil management and optimisation of crop nutrition and animal nutrition management (linked to animal and crop health) feature strongly on the industry's list of funding priorities. Health improvement related research is also important as well as breeding programmes.

Structure of this review of progress

In each section of the progress report we describe:

- the key outcomes for each priority area
- possible indicators of GHGAP partner and on-farm activity

We first detail the value that we believe the GHGAP has added – a particular focus of this first progress report in view of the short timescale since our inception – describing the establishment and consolidation of processes that will provide the foundations for longer-term delivery of changes in farming practice. In subsequent sections, in the absence of robust indicators of progress, we have had to rely on a mixture of short and long-term qualitative and quantitative information to try and paint a picture of the status of the industry as it strives to improve its efficiency and meet its commitment to tackling its emissions.

GHGAP steering group actions

In this initial phase of our long-term commitment to delivery and action we wanted to put in place a strong foundation for working more effectively together and with others. We identified a number of actions covering co-ordination and communication to be delivered by spring 2012:

Table 1: GHGAP Steering Group actions in the first phase of delivery

	Action	Target date	Status
co-ordination			
Action 1	Feasibility study to assess need for an information hub	End April 2011	Complete
Action 2	Pilot information hub will be ready for testing by selected advisers	End April 2012	On track
Action 5	Identify sectors where biggest efficiency gains can be achieved and map out current reach of existing networks	End April 2011	On-going
Action 9	Reporting progress: • Interim progress report • Annual GHGAP progress report	End July 2011 End April 2012	Complete
Action 10	Work closely with GHG Platform to ensure industry information sources are used to help monitor progress in emissions reductions	On-going	On-going
Acton 11	Establishment of fully representative Steering Group	End January 2011	Complete
communications			
Action 3	Continue liaison with other farming organisations, service providers and their networks and trade press	On-going	On-going
Action 4	Establish dialogue with retailer and other key organisations in the supply chain	End February 2011 then on-going	On-going
Action 6	Commission development of key messages	End April 2011	Complete
Action 7	Information and case histories identified and farmer “champions” identified to communicate benefits.	End October 2011	On-going
Action 8	Develop concept of branding of advice	End October 2011	Complete

The following two sections describe our progress against these actions.

GHGAP co-ordination

Better co-ordination of information and delivery is the cornerstone of our long-term commitment to work more effectively together and with others. Through clear leadership, we aim to

i. improve co-ordination in identifying research needs
ii. be consistent in presentation of information and advice to farmers and growers
iii. jointly find ways to address the challenges of showing changes in farming practices

Outcomes

- ✓ The Steering Group – showing leadership and commitment (action 11)
- ✓ Added value of the Steering Group – sharing goals and priorities (action 5)
- ✓ A pilot information hub – the Farm Efficiency Hub – to test the concept of providing advisers with consistent messages and access to the latest advice and science (actions 1 and 2)
- ✓ Active participation in discussions on Defra's Integrated Advice Project - linking to the anticipated role of the Farm Efficiency Hub (supporting action 2)
- ✓ Closer working with the GHG Platform – 'measuring' the progress made by farmers and growers (action 10)

The Steering Group – showing leadership and commitment (action 11[3])

The Steering Group is an unprecedented partnership of 14 organisations representative of the breadth of the agricultural industry in England. Given the diversity of the farming sector, we saw the need to involve a wide range of expertise, and this has increased the challenges in ensuring that action has been co-ordinated and key milestones have been met.

In our first phase Delivery Plan we envisaged that to function effectively and to oversee the complex landscape of activity, that we would require the services of a programme manager or co-ordinator. Despite the fact that to date the GHGAP has had no dedicated resource to fulfil this role a considerable amount has been achieved through the individual contributions of partner organisations. GHGAP partners have readily risen to the challenge with enthusiasm and energy at a time when their resources were already fully committed.

The Steering Group is jointly chaired by officeholders, the vice and deputy presidents, of the NFU and CLA respectively. This senior level of representation demonstrates leadership to the rest of the farming community and the commitment of the industry to tackling this challenge:

[3] GHGAP Action 11: Establishment of fully representative Steering Group

"Avoiding harmful climate change is in the interest of everybody including farmers and other land managers. Over a period of time, on top of these emission reductions we can also make a big contribution in carbon sequestration and producing land-based renewable energy. We are determined to show that the land sector can be part of the solution."

CLA Deputy President Henry Robinson

"The main focus of our Action Plan concerns how farmers and growers can become more efficient, producing more with fewer resources and fewer emissions. This is good news for farm businesses and good news for the environment. By optimising our production efficiency, we can actually reduce emissions per unit of output."

NFU Vice-President Gwyn Jones (2011)

This provides the governance structure for meeting the objectives of the GHGAP. A member of Defra's climate change mitigation team attends Steering Group meetings to reflect the Government's position.

The GHGAP Partners have met quarterly since 2010 and the costs of hosting the meetings have been met by the AIC and NFU. As we envisaged in the our first phase delivery plan, Steering Group Partners have seen the need to meet in "technical mode" to address specific technical or communication issues in more detail. One sub-group was also initiated to lead activity on the pilot information hub.

Individual organisations have shown similar leadership. Echoing its critical role in the GHGAP, the AHDB has set up an "in-house" Climate Change Mitigation and Adaptation Group (ACCMA). This group meets quarterly to ensure cross-sector awareness and integration.

"Activities to encourage the reduction of on farm GHGs fit hand-in glove with efforts to improve on farm efficiency and financial returns. This is the priority under our Better Returns Programme which promotes the win:win scenario to producers when raising awareness to Climate Change mitigation"

pers.comm, EBLEX

"AIC has two key contributions to make to driving down GHG emissions. Our members' network of advisers contributes to the delivery of the industry-led action plan, providing high quality advice to support best practice and efficiency in crop and livestock production. In addition, emissions are also being reduced by investments in fertilisers and feed manufacture."

David Caffall, AIC Chief Executive

Added value of the Steering Group – sharing goals (actions 5[4])

In the first phase delivery plan we set out that "we would, as far as possible, make use of existing industry and Government initiatives and trusted networks that supply advice and

[4] GHGAP Action 5: Identify sectors where biggest efficiency gains can be achieved and map out current reach of existing networks

information". The GHGAP partnership has offered an opportunity to use the expertise of the participating organisations to provide a strategic overview of the delivery landscape. Stimulated by their involvement in the GHGAP, the AHDB sector boards are now making clear connections between the sector Roadmaps (dairy[5], beef and sheep[6], pigs[7] and combinable crops in preparation) and the range of actions the GHGAP aims to deliver:

Dairy Roadmap – our route to environmental success (2011) *"The Dairy Roadmap provides a vehicle for delivery of the Greenhouse Gas Action Plan's targets in the dairy sector. The Dairy Roadmap is a 'living document' and will be updated at regular intervals, ensuring that it and the GHGAP are aligned and remain challenging and forward-looking"*	Down to Earth – the beef and sheep roadmap (2011) *"Our roadmap work is a part of the overall project and contributes towards the (GHGAP). We have included notifications throughout this document where a specific activity links directly to a section within the GHGAP"*
Advancing together – a roadmap for the English pig industry (2011) *"The GHGAP is integral and complementary to this Roadmap. It sets out key priority areas to be addressed and stresses the methods of efficient production that will in turn deliver the GHG reductions required. This Roadmap focuses on the pig sector but takes account of the wider aspects of the GHGAP for all agricultural sectors to ensure potential synergies are exploited e.g. the interdependence of the pig and dairy sectors where the dairy sector supplies co-products such as whey used as pig feed or, provision of manures and slurries for biogas and crop production"*	Growing for the Future – an environmental roadmap for the UK cereals and oilseeds industry (in preparation) *"This cereals and oilseeds Roadmap will dovetail with (other initiatives) ….to help the agricultural industry meet the challenges of reducing greenhouse gas emissions and improving its environmental sustainability"*

The GHG emissions reduction aspirations of the roadmaps are in line with the 11% target set by Government for the entire industry, except where evidence has been available to deliver more *e.g.* BPEX has set an ambitious yet achievable target for English pig farming of a 17% reduction in its GHG emissions from 2008-2020 as it seeks to achieve the objectives of the 2 Tonne Sow Programme[8].

"The GHG Action Plan provides the framework for AHDB to enhance its working relationships with other organisations in delivery of its 'Roadmaps' and associated initiatives."

Professor Ian Crute, Chief Scientist at AHDB

[5] Dairy roadmap
[6] Down to earth
[7] Pig Environmental Roadmap
[8] 2 Tonne Sow

In this first year of delivery, the GHGAP work-plan has delivered a common strategic understanding of how initiatives already planned for 2011-2012 fit with and contribute to achieving the objectives of the GHGAP (see Annex 3). The work-plan covers all of the GHGAP's priorities for on-farm action and this approach has already delivered benefits:

> *The work-plan has had both short and long terms effects. In the short-term this has prompted the exploitation of additional opportunities for collaboration in Knowledge Transfer (KT) work across sectors. The longer term benefit has been in terms of the facilitation of collaborative relationships between colleagues in different sectors and organisations working on complementary activities such that when opportunities arise to work collaboratively contacts are in place to make this happen more easily and in a more timely manner.*
>
> *EBLEX*

The work-plan is only a snapshot of activity in time and this current version may not cover all priorities and actions. The future will provide the opportunity to be more proactive in our approach, sharing information on scientific and commercial developments and to establish collaborative work programmes to meet the GHGAP's goals. It will also enable the identification of gaps in delivery so that future plans can be put in place to address these. Work to fill some gaps is planned. For example, we identified the benefits of working closely with the professional nutrient management campaign, Tried & Tested[9], which is already well received by farmers and targets the livestock sector. This has resulted in extending the Tried & Tested activities to animal feeding management – with benefits for GHG mitigation. It was agreed that the focus should be on the diary, beef and sheep sectors and that a guide to feed management planning, would be produced in 2012 and promoted by the Tried & Tested routes (see Livestock Nutrition section for more information).

At the time of writing our first phase Delivery Plan, we had considered it feasible to "map out the current reach of existing networks". Our initial discussions highlighted the size of the task due to the complexity of the advisory landscape. Defra project FF0202[10] noted "the sizes of advice services vary enormously, from single farm consultants operating as sole traders through to national-scale large organisations such as the Agricultural Industries Confederation." In addition the broad-ranging nature of the GHGAP target of improving the efficiency of resource use – nutrients, livestock, energy – alongside the number of projects, initiatives *etc* operating at different temporal and spatial scales compounded the difficulty. We concluded that this would be a costly project in its own right and that our limited resource would be better spent on actions that would deliver tangible and more useful outputs.

In terms of technical, face-to-face advice, we estimate that 60% of advice is provided by the supply trade industry, 35% by self-employed/company consultants and those working for agronomy groups *etc*. and 5% from AHDB staff with an on-farm presence, and other professionals.

[9] Tried & Tested is run by AIC, CLA, (FWAG), LEAF and NFU, with funding from NE as part of Defra's Catchment Sensitive Farming programme. It aims to improve nutrient management practices on farm. Further information available at http://www.nutrientmanagement.org/

[10] Agricultural Advisory Services Analysis - FF0202

Delivering synergy – agreeing and sharing priorities (action 5[11])

The nature of agricultural GHG emissions is very different from other sectors of the economy such as electricity generation, transport, manufacturing, *etc*. The principal greenhouse gas for most industries is carbon dioxide (CO_2) from fossil fuel combustion, whilst for agricultural systems methane and nitrous oxide are the main GHGs. Determining these emissions is much more complex than measuring CO_2, and they are bound up in highly complex and imperfectly understood natural soil and animal microbial processes. These processes are not directly controllable by human intervention, and furthermore they are subject to seasonal and annual variability as a function of the weather, crop yield, *etc*.

A supply of nitrogen from organic or inorganic sources is an absolute requirement for the growth of crops and pasture, and it is an unavoidable consequence of soil processes that a small amount of the nitrogen in an agricultural system will be emitted as nitrous oxide. Likewise, methane is produced inevitably by bacteria in the rumen of cattle and sheep as they break down the cellulose in their diet, producing milk and meat for human consumption from the large areas of grassland that are often unsuitable for arable crops.

It is has always been clear that our priorities for mitigation are management of nitrogen (in feed and fertilisers) to reduce nitrous oxide and the management of livestock to tackle methane. The on-farm actions have been grouped into priority areas (as described earlier) which address these, in particular crop nutrient management, livestock nutrition and livestock health (and fertility). We know that the grassland sector is not well served by advice other than on animal health and nutrition, although Defra project FF0202 suggested that livestock diet and health were potential gaps. Despite that project's view that measures relating to nutrient management appear to be well catered for, Tried & Tested's nutrient management plan is meeting a real need amongst livestock farmers.

However, not all farming sectors have the same potential or opportunity for improvement, so it is important to understand the realistic potential for efficiency savings in each of Defra's robust farm types[12]. For example, a low uptake of advanced in-field 'precision farming' technologies in an area characterised by grassland should not be viewed as failure to implement improvement; neither should it be assumed that such technologies are fundamental to achieving efficiencies. Uptake of simple management tools and use of the recommended equipment or components *(e.g.* soil, manure analysis and trailing shoes) may offer relatively low-technology, affordable solutions to achieve the desired outcome. By comparison, a farmer with a high standard of management capability and the latest in-field technologies available may have little scope to make additional improvements, and will almost totally rely on improvements in genetics to make further progress (taking correspondingly longer for such improvements to be detectable). For example, only 7% of arable area has a 'high' or 'very high' potential for variable application of nitrogen, whereas a greater area has potential for variable rates of phosphate and potash – nutrients that are important determinants of nitrogen use efficiency.

The GHGAP considered it important to prioritise activity on the basis of where the greatest potential progress in GHG emissions reductions could be achieved in given sectors, thus enabling effective targeting of existing resources. Looking across all sectors, our initial analysis during the first phase of delivery has suggested the following on-farm actions as targets for promotion (Table 2)

[11] GHGAP Action 5: Identify sectors where biggest efficiency gains can be achieved and map out current reach of existing networks
[12] Defra robust farm types

Table 2: key on-farm actions and associated priority area to be promoted

Arable	Dairy	Beef and sheep	Pigs + poultry	Horticulture
Crop nutrition (and health) 	Livestock health (and fertility) 	Livestock health (and fertility) 	Livestock nutrition 	Maximise marketable output 
Soil management 	Livestock nutrition 	Optimise performance 	Livestock health 	Crop nutrition (and health) 
Optimising performance 	Grassland and forage management 	Grassland and forage management 	Manure management 	Energy efficiency 

The above will be subject to change as new knowledge and information becomes available.

This analysis is based on balancing a number of factors:

- various estimates of abatement potential[13]
- information on current levels of and scope for uptake of particular practices *e.g.* from the Farm Practice Survey and the Roadmaps
- expert opinion of GHGAP partners on opportunities for efficiency improvements and therefore business benefits across all sectors, although the contribution to mitigation may be relatively small
- Acknowledging that the GHGAP's priorities are interchangeable with other farm actions based on local needs and farm priorities

GHGAP activity is already underway to facilitate these particular on-farm actions. Table 3 provides some examples of GHGAP partner initiatives delivering advice and information on the key on-farm actions. More examples are provided in the on-farm actions sections of this report.

Table 3: Examples of GHGAP partner activity on key on-farm actions and associated priority areas targeted for promotion in the first phase of delivery

Sector	On-farm action	Priority area	GHGAP Partner activity
Arable	Soil management[14]	soil and land management	LEAF working with Asda launched 'Simply Sustainable Soils' a practical, guide for farmers on improving the performance, health and long term sustainability of their land
Beef and sheep	Livestock nutrition[15]	livestock nutrition	EBLEX's Better Returns Programme campaign on efficient methods and products for cattle and sheep nutrition (see livestock nutrition section for more information)
Pigs and Poultry	Livestock health[16]	livestock health	BPEX's national Pig Health Improvement programme (see livestock health section for more information)
Cross-sector	Energy efficiency and renewable generation	energy efficiency and renewable generation	NFU's Farm Energy Service

[13] For example, by the Committee on Climate Change, ADAS and Defra research project AC0222.
[14] From Annex 1: Soil management - Soil management - follow good practice: avoid and rectify soil structural problems (e.g. by reducing wheelings and poaching, by sub-soiling, mole draining, adding organic matter). Use soil cultivations appropriate for the soil type and cropping situation without restricting crop growth and nutrient uptake. Monitor and amend soil nutrient status and pH following regular soil sampling and analysis
[15] From Annex 1: Livestock nutrition - plan diets and feeding regimes to achieve desired productivity, efficiently making use of resources available including home grown crops and food industry origin co-products, carefully matching nutrient content and availability to animal requirements. Consider using feed technology and additives to improve feed use efficiency
[16] From Annex 1: Livestock health - maintain optimum health status of all livestock through proactive health planning and close monitoring of performance e.g. through weighing of stock to identify need for interventions. Consider the benefit of expert veterinary advice in health planning linked with the appropriate diet, feeding regime and housing for the breed.

In our original Framework for Action (2010), we stressed that "the GHGAP is intended to be a living document, responsive to changes in policy and knowledge, and requiring regular change and refinement over time. As more data is generated and better understanding of agricultural systems is achieved on the basis of targeted research, it is highly likely that the scale of abatement potential will need to be modified (higher or lower) and the actions that are most feasible and likely to bring about the greatest impact will become more clearly defined". This perspective has not changed. This means that there is no certainty that even those areas of highest potential efficiency gains will deliver the estimated abatement.

Whilst these may be priorities for potential mitigation and efficiency gains, it is not feasible that these are always the focus of our activity in any particular year. This is due to the inter-linkages and inter-dependencies between many of the on-farm actions. For example, good nutrient management is underpinned by good soil management and for the livestock sector there is an opportunity to integrate feed and fertiliser strategies; animal health and nutrition are also inextricably linked. In addition sectors are frequently inter-dependent; with some of the biggest gains potentially coming from cross-sector co-operation *e.g.* improved N fertiliser use. As we have already stated, the future work of the GHGAP will provide the opportunity to be more proactive in our approach in promoting these key actions.

A pilot information hub – the Farm Efficiency Hub - to test the concept of providing advisers with consistent messages and access to the latest advice and science (actions 1 and 2[17])

Driving the implementation of on-farm practices requires the industry to improve the use of science to continuously update technical advice and decision making tools - a key GHGAP objective. Farmers and their advisers are currently faced with a daunting amount of information from many different sources, and there are circumstances when advice focused on one outcome can conflict with advice focussed on another.

The strength and value of the GHGAP has been clearly demonstrated during the development of the Farm Efficiency Hub (FEH). It is unlikely that such a co-ordinated response across the industry could have been conceived or achieved in this short timescale in the absence of the GHGAP.

The AHDB has led the GHGAP's investigation of the feasibility and need for an information hub - an electronic library - to quality assure and manage the relevant resources and tools that the industry currently utilises in an *ad-hoc* manner. The Steering Group agreed that the industry was likely to benefit from a more co-ordinated approach to storing and accessing information from a common source. The proposed FEH will function on the principle of offering universal access to all information so facilitating maximum value from each farm visit. It is also hoped that it will present an opportunity for greater collaboration in the creation of new materials and advice.

The primary user at which the system will preferentially be directed would be the farm "adviser" or the technically aware farming business. However, material prepared to convey information and advice to farmers in general as well as "higher-level" technical information will also be held. The content will include "packaged" technical information, derived from

[17] GHGAP Action 1: Feasibility study to assess need for an information hub. GHGAP Action 2: Pilot information hub will be ready for testing by selected advisers

primary papers and reports and configured for the primary users as well as the primary literature on which this information was founded.

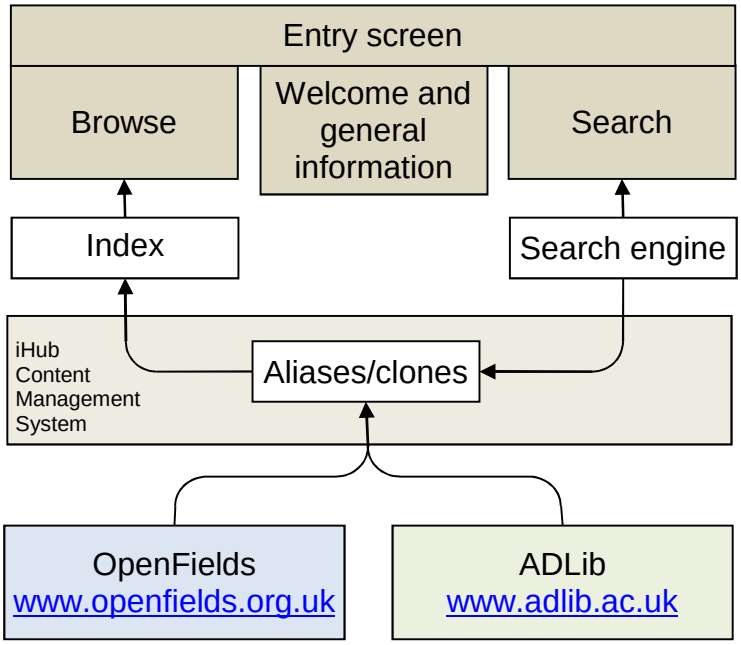
The development of the pilot Farm Efficiency Hub has been entrusted to the University of Hertfordshire and Harper Adams University College. The former has experience running the Defra funded ADLib[18] service and more recently Business Link, whilst Harper Adams provides OpenFields[19] for its students and other stakeholders. The partnership will allow the Farm Efficiency Hub to gain access to existing ADLib resources and the academic paper archives offered by OpenFields. Both institutions and their systems offer the GHGAP additional benefits

- the opportunity to engage with the next generation of advisers and farmers
- value for money by building on existing systems and expertise

The pilot Farm Efficiency Hub costing £45,000 has been funded by the AHDB, in the main, with contributions from the AIC and NFU. Figure 3 provides an outline of the Hub.

GHGAP members have played an active role in assessing existing resource materials, identifying new science and information, seeking to ensure quality and directing the development of the Farm Efficiency Hub. Our collective expertise has been invaluable in identifying an initial index of resources to populate the Hub.

Figure 3: Overview of concept of Farm Efficiency Hub



Eleven tasks have been identified to deliver the specification for the Farm Efficiency Hub. These are:

- Website design and creation
- GHGAP Collection in OpenFields and document approval
- Technical development of OpenFields assets within ADLib
- Technical development of the OpenFields web service

[18] http://www.adlib.ac.uk/adlib/
[19] http://www.openfields.org.uk/

- Development of the OpenFields web service
- Implementation of index and search tools
- Development of related document link assets
- Population with approved material (100 publications collated to date)
- Document conversion
- Pre-piloting
- Refinements

The pilot Farm Efficiency Hub is due to be ready at the end of April 2012. The pilot will not be 'live' *i.e.* will not be available to the wider industry, but will provide sufficient functionality to be able to assess its potential usefulness during the next phase of the GHGAP. If feedback is favourable, additional resource will be required in the next phase to ensure that the FEH is fit for purpose - to fully populate and resource the development and maintenance of this interactive library and to promote it to the advisory community. A process to identify the required resource will then be put in place. A fully functioning FEH will not be an output of the next phase of the GHGAP, unless external funding can be secured. See Annex 2 for a preview of the FEH.

Active participation in discussions on Defra's integrated Advice Project - linking to the anticipated role of the Farm Efficiency Hub (supporting action 2[20])

GHGAP members agreed to the development of the pilot Farm Efficiency Hub on the understanding that the facility ought to have longer-term value to the industry, beyond the current focus on priority farm actions for GHG mitigation. The general consensus is that resource materials supporting GHG mitigation also achieve other farming objectives and that the Farm Efficiency Hub should be enlarged, over time, to offer a comprehensive collection of resources relating to the range of advice provision to farmers.

The value of having a central library interface, which both industry and government can both contribute to, and draw from, is also being discussed in:

- Defra's Integrated Advice Pilot (IAP)[21]
- The Natural Environment White Paper review of Industry-led Initiatives
- AHDB-facilitated meeting for a greater level of consistency and co-operation in applied research, training and advice provision
- Defra's Farm Advisory Service (FAS[22]) Stakeholder meetings

There is an appetite to build on the experiences of the past and to improve the level of co-operation between the bodies serving farmers with information and advice. However, as the responsibility for this task is shared and cannot rest with any single body, success and ambition will depend on a part Government, part industry funding base.

It is against this background that the next steps for the Farm Efficiency Hub will be decided, *i.e*. the extent to which it will be populated with resources, quality controlled, promoted and deemed credible for widespread use. The GHGAP believes that the Farm Efficiency Hub can make a significant contribution to the Foresight Report on The Future of Food and

[20] GHGAP Action 2: Pilot information hub will be ready for testing by selected advisers
[21] IAP project aimed to develop a novel farmer-focused approach to delivery of flexible, integrated advice that balances farm business objectives with Defra policy objectives and integrates measures to achieve multiple wins
[22] FAS

Farming's priority of improving advisory services to farmers, land managers and food producers in tackling the challenge of food security.

Closer working with the GHG Platform – 'measuring' the progress made by farmers and growers (action 10[23])

The Agricultural Greenhouse Gas Research Platform[24] is a research programme with a total investment of £12.6 million, funded by Defra and the devolved administration governments. It seeks to improve the accuracy and resolution of the GHG reporting system by providing new experimental evidence on the factors affecting emissions and statistics relevant to changing farming practices in the UK. It will provide the evidence for a UK specific method of calculating methane and nitrous oxide emissions that will reflect the adoption of mitigation practices by the industry, enabling forecasting and monitoring of performance against target emissions reductions set by the UK Climate Change Act. This will build upon previous research, combining field experimentation, modelling and scoping of data sources to fill knowledge gaps.

An important requirement of the improved inventory is the ability to incorporate uptake of mitigation practices within the agriculture sector. The inventory model will therefore be future-proofed to account for abatement strategies, as research identifies the potential of individual practices for reducing emissions on farm. Within the revised inventory, it will therefore be possible to represent the impact of uptake of mitigation practices explicitly or implicitly. Explicit representation will be possible for practices that directly influence the emission process, resulting in a reduction in the emission factor, for example, dietary change in livestock. Other mitigation measures that do not directly influence the emission process but change the size and source of emissions will be represented implicitly (*e.g*. through the pool of soil N from which N_2O emissions derive or the number of ruminants from which enteric CH_4 emissions arise).

The Greenhouse Gas Inventory will therefore not explicitly track progress for all of the measures listed within the Action Plan, as the direct effect of some of the farm-efficiency focused measures on emissions is not known (*e.g.* the effect of farmers' positive response to the Professional Nutrient Management Campaign, or of farmers implementing herd health plans). The uptake of these practices will however be represented through the size of the emissions source (e.g. the amount of nitrogen applied and numbers of replacements). Measures that could directly influence the emissions process, for instance dietary change, breed, or adjusting the rate and timing of fertiliser N application, will be explicitly represented through specific modifiers to emission factors , if sufficient evidence is found of an effect within the GHG Research Platform or related projects.

Ways of supplementing the inventory with useful activity data will therefore need to be kept under review to help monitor progress against each of the priority areas. Overall input-output statistics for agriculture will also offer useful indicators of progress in resource use efficiency, and hence estimates of GHG emissions intensity.

Communication between the GHGAP and the GHG Platform is on-going and a member of the latter sits on the GHGAP Steering Group which helps to facilitate this process. GHGAP partners are also actively working with the Platform, providing in-kind resource and expertise.

[23] GHGAP Action 10: Work closely with GHG Platform to ensure industry information sources are used to help monitor progress in emissions reductions

[24] http://www.ghgplatform.org.uk/Home/WhatistheGHGResearchPlatform.aspx

A formal linkage exists between the GHGAP and Defra's 'GHG research platform policy group', which manages the inventory development project research will enable the relationship between the Inventory reports and the future GHGAP reports to be developed, and data gaps to be identified.

GHGAP communication

Communication is vital to the GHGAP achieving its objectives. Our on-farm actions are the basis for clear and consistent messages tailored to the target audience and are being bought to life by practical demonstration and individual experiences. We have begun to harness a range of influences, including throughout the supply chain, to encourage improvements in efficiency to deliver reductions in GHG emission per unit of output.

Outcomes

- ✓ Industry networking – spreading the word (action 3)
- ✓ The supply chain – roadmaps show the way (action 4)
- ✓ Key messages – 15 on-farm actions provide the foundations for consistency for over 2000 events (actions 6)
- ✓ Demonstration farms, farm visits, farmer events and case studies – sharing practical learning by doing (action 7)
- ✓ GHGAP logo – potential for co-branding to raise visibility of actions which cut GHGs (action 8)

Industry networking – spreading the word (action 3[25])

In our first phase Delivery Plan we recognised that there are a large number of other organisations and networks that can play a role in helping the GHGAP meet its objectives. We highlighted that it was not possible, nor was it appropriate for the GHGAP to seek to assume oversight or influence over the initiatives and activities already in place. We felt it was important that organisations continue to have ownership of their own initiatives, which are tailored to the specific needs of their sectors. However, we did acknowledge that it was vital that there was a common strategic understanding of how initiatives fit with and contribute to achieving the objectives of the GHGAP.

The broad representation on the Steering Group has facilitated this action as the range of organisations have utilised their existing networks to strengthening links with and gain the support of other service providers (see case study below), the trade press and the supply chain for the GHGAP's on-farm actions.

A subset of the meetings held is recorded for reference in annex 4. Business arrangements of a commercial nature and those associated with the delivery of the Roadmaps for livestock and cereals and oilseeds have been numerous and are not specifically recorded but developments resulting should transpire in benchmarking studies, roadmap reports, and in other published statistics *etc*.

[25] GHGAP Action 3: Continue liaison with other farming organisations, service providers and their networks and trade press

It is not possible to quantify the value of the relationships that the GHGAP has and will continue to build, but our belief is that working in partnership will create the conditions to facilitate change.

The supply chain – roadmaps show the way (action 4[26])

The sector Roadmaps have gained respect for their approach of focussing on tangible gains for the farmer through improved productivity and for their engagement with the supply chain. The Dairy Roadmap brings producers, processors and retailers round the table where joint commitments have led to "significant developments throughout the supply chain from the use of nutrient management on-farm….to transporting milk to retail outlets". Phase three of the Beef and Sheep Roadmap includes for the first time "significant input from retailers, detailing measures they are taking to reduce emissions in their supply chain, complementing the on-farm actions already investigated in the roadmap". The Pig Industry Roadmap demonstrates that success relies on many factors which have to be addressed together and has highlighted the importance of trade as part of the solution. The HGCA board has just approved the publication of "An environmental roadmap for the UK cereals and oilseeds industry: greenhouse gas emissions". One of its aims is to identify a route to assist the UK cereals and oilseed industry to meet its contribution to agriculture sector targets to reduce greenhouse gas emissions.

Defra provides the secretariat for the Food Supply Chain Mitigation Group. This offers a formal forum for organisations (including members of the GHGAP Steering Group) to be briefed on GHG mitigation at various stages in the supply chain, in the context of wider sustainability issues. However over the past year the GHGAP has deliberated how it might maintain and build on the supply chain relationships created by the Roadmaps and elsewhere. The Steering Group agreed that whilst the Food Supply Chain Mitigation Group provides a useful forum for engagement for Defra, the GHGAP partners feel that they would be better served by direct engagement with the supply chain in order to develop fruitful long-term relationships. Members of the Steering Group have many regular meetings with various actors in the supply chain and it is envisaged that the GHGAP will be a regular topic of conversation on such occasions.

Established relationships along the supply chain are already bearing fruit. LEAF in partnership with Asda launched a new guide in 2011 to help farmers improve the long term sustainability of their soil (see more in Soil and Land Management section).

[26] GHGAP Action 4: Establish dialogue with retailer and other key organisations in the supply chain

Arla has been an active supporter of 'Tried & Tested' - the nutrient management partnership featured in the GHGAP work programme. Specific pages on the benefits of Nutrient Management Planning for dairy farmers were jointly created for Arla's farmer's guide. Arla then collaborated with the British Grassland Society on a Morrisons project to improve soil management and nutrient use. The resulting publication: "Grassland soils and fertilisers: digging out the answers," answered 54 questions asked by farmers, making information more accessible and reducing some of the confusion, which currently exists.

Copies have been distributed free to all dairy farmers in the Arla Foods Milk Partnership and to those who supply Morrisons through the Dairy Crest and First Milk companies. The feedback has been extremely positive: "Real issues are addressed with concise answers in plain English" and "this is the kind of book that I can dip into of an evening, quickly find the area that I am most interested in and get a farmer's answer".

The influence of the food and biofuel supply chains in GHG mitigation has been most evident from the plethora of activity in the carbon footprinting of products. Drivers include the Renewable Energy Directive requiring sustainability criteria for oilseed rape and wheat for biofuel, environmental footprinting of barley to meet the requirements of maltsters, and leading retailers' and major food processers' conditions for other products *e.g.* potatoes, milk *etc.* for their integrated supply chains (see the Management Skills and Advice section).

Key messages – 15 on-farm actions provide the foundations for consistency (action 6[27])

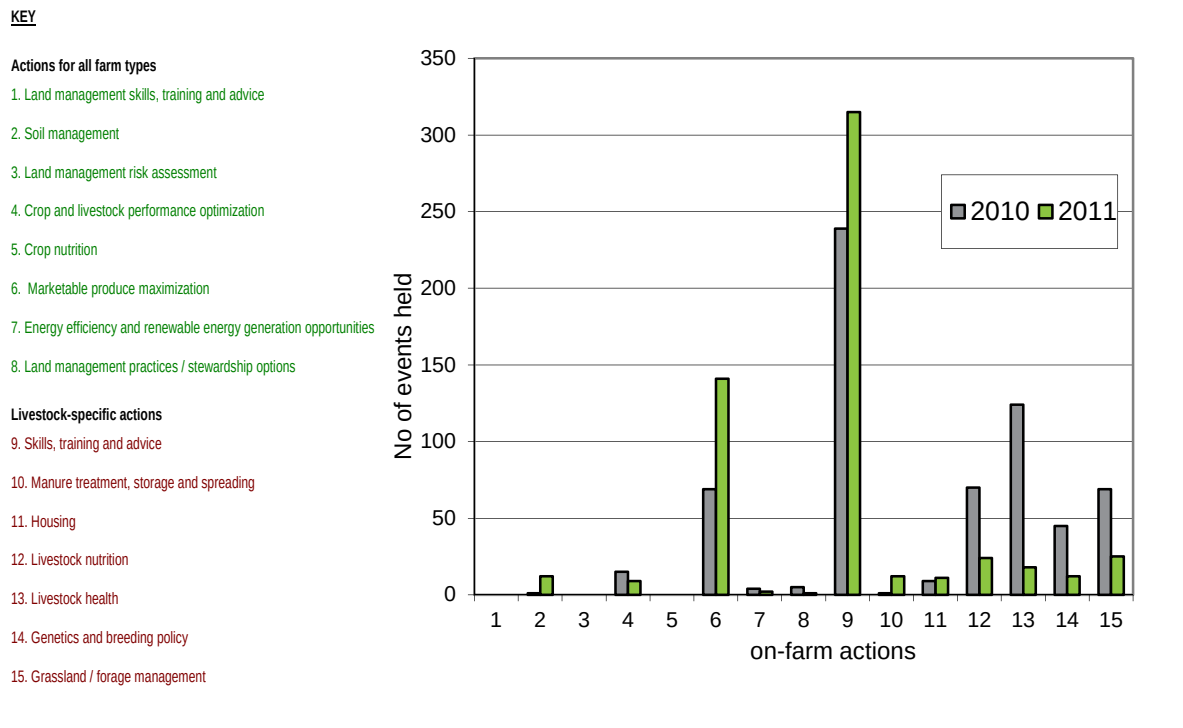
For our first phase Delivery Plan we carried out a strategic assessment of agricultural emissions to identify the principal sources and potential mitigation options. As a result we identified we identified a suite of actions to be implemented at farm level in order to achieve production efficiencies and thereby reduce emissions per unit of production. The collective expertise of GHGAP partners proved invaluable in pinpointing the actions, which are largely based on existing best practice guidance. The suite of actions is fundamental to consistent messaging across the partnership and beyond.

The actions as written (see Annex 1) are not meant to be used directly with farmers and growers; rather the targets are the many stakeholders (including non-GHGAP partners) delivering advice and information to farmers. Again we felt that it was important for organisations to continue to have ownership of their own initiatives and that the clear language of the actions could then be tailored to the specific needs of their audiences.

We highlighted in the previous section the synergies delivered by the GHGAP through the visibility of existing work programmes. Some GHGAP partners have analysed how their own programmes are delivering for each of the on-farm actions. Figure 4 shows the focus of EBLEX events over the past two years and demonstrates how members of the GHGAP are already actively promoting improvements in farming practice in target sectors.

[27] GHGAP Action 6: Commission development of key messages

Figure 4: number of EBLEX events delivering the GHGAP's messages



Analysis in Defra's most recent Agricultural Statistics and Climate Change[28] publication suggested that for some farmers there is a gap in the understanding of GHGs from agriculture and of mitigation measures that they could adopt. This is perhaps not surprising. The key message for the majority of the target audience will be improving production efficiency; the contribution of various actions to GHG mitigation may not be explicit.

Demonstration farms, farm visits, farmer events and case studies – sharing practical learning by doing (action 7[29])

The LEAF Demonstration Network consists of both Demonstration Farms and Innovation Centres that span England (and Scotland). The Demonstration Farms are working farms whilst the Innovation Centres research and pioneer new approaches to push forward the boundaries of integrated farm management through research and development. Work continues throughout the year to refresh the network and LEAF hope to launch two new Demonstration Farms in Essex and Suffolk in 2012.

In autumn 2011, LEAF's members' events roadshow began with events in Yorkshire, Cornwall, Kent, Leicestershire, Wiltshire and Herefordshire. In addition to utilising the Demonstration network, the connection with research is strengthened through Technical Field days - 48% of farmers who attended the Technical Field Day held in conjunction with Harper Adams University College said it "made them think".

[28] Agricultural statistics and climate change (December 2011)
[29] GHGAP Action 7: Information and case histories identified and farmer "champions" identified to communicate benefits.

NIAB-TAG's National Agronomy Centres provide easy access and proactive communication on agronomic research. The first two centres have now been established, at the NIAB TAG Morley Centre in Norfolk and at the NIAB TAG Winchester Centre in Hampshire. A key aim of the centres is to ensure that independent research provides clear unambiguous information to the whole industry. Each centre is hosting a number of key agronomic trials on a range of crop types and subjects. Research will be demonstrated during the season with results and conclusions available in a range of formats.

The NIAB Innovation Farm in Cambridge works to improve knowledge transfer and uptake of crop genetic innovation between science, academics and industry and improving awareness and understanding of the enormous benefits on offer from harnessing the genetic potential of plants. Amongst its demonstrations on climate change are crops showing suitability to inputs and cultivations, *e.g.* better nutrient use efficiency or reduced tillage.

AIC supply trade companies help to communicate the link between their broader advice and GHG mitigation. This is done during on-farm visits and through their farmer events and open days *etc*.

The Organic Research Centre (ORC) launched a Participatory Research and Demonstration Network in July 2011 in order to help producers have direct input to research projects and access to new research findings that will have relevance for their business. Producers within the network also have access to training and mentoring by the ORC research teams so that they can undertake their own research. Work is currently on-going within the network on reduced tillage and the development of cereal and legume mixes that can provide greater resilience to the effects of climate change.

GHGAP logo – potential for co-branding to raise visibility of actions which cut GHGs (action 8[30])

Farmers are already confused and bewildered by the range of initiatives operating across the sector. The GHGAP has therefore intentionally kept a low media profile in order to avoid confusion and "initiative and information overload" amongst farmers and other primary audiences. It is therefore not surprising that Defra project AC0222[31]) found that only 39% of farmers surveyed were aware of the GHGAP.

We believe that the development of the logo is an important achievement; providing a clear demonstration of the collective, integrated activities that the partnership is and will be delivering. GHGAP partners have agreed each organisation should take every opportunity to co-brand their own material with the GHGAP logo to begin to raise awareness of mitigation. Examples appear in annex 5. Guidelines for use of the logo have been developed by the Steering Group.

[30] GHGAP Action 8: Develop concept of branding of advice
[31] AC0112 http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17110&FromSearch=Y&Publisher=1&SearchText=ADAS&GridPage=1&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description

The GHGAP logo was chosen to highlight the priority areas for on-farm actions:

On-farm actions

In our first phase Delivery Plan we identified a suite of actions to be implemented at farm level in order to achieve production efficiencies and thereby reduce emissions per unit of production. In the earlier section on GHGAP co-ordination, we described how GHGAP partners had added value by agreeing strategic priorities from this suite of on-farm actions and provided examples were provided of initiatives already delivering advice and information in these areas. The following sections in this report on progress provide more detail.

Table 4 below provides a summary of all activities initiated or influenced by GHGAP partners to deliver changes in on-farm practice. In the absence of robust indicators of activity, we have used a mixture of short and long-term qualitative and quantitative information to try and paint a picture of the status of advice and on-farm practice as the industry strives to improve its efficiency.

Table 4: summary of GHGAP activity (2010-2012) to deliver on-farm actions in GHGAP priority areas

Priority areas	Outcomes	Status
Management skills and advice	For advisers • Establish potential for training standards for feed advisers embracing the GHGAP • Add Nitrogen Use Efficiency and its link to GHG mitigation to crop nutrition CPD • Vet CPD in the beef and sheep sector, linking health, nutrition and performance recording For farmers and growers • Levy Board management and business training	Complete On-going On-going On-going
Crop nutrient (and crop health) management	• Develop Steering Group collaboration with Tried & Tested network, new partner: AIC Feed sector and work programme to identify priorities • On-going development of farmer tested tools to fill gaps in nutrient management planning – targeting livestock farms but relevant to all farms • Development of designated nutrient management website • Promotion of professional services FACTS Qualified Advisers, confidence in soil analysis • Add value to campaign to cover livestock nutrition in the context of all farm nutrients, see livestock nutrition below	Complete On-going On-going On-going In preparation
Livestock	• Commission work to produce Tried & Tested	Underway

nutrition	Ruminant Feeding plan • Look at alternatives to soya and promotion of uptake of sustainable products,	On-going
Livestock health	• Create industry-wide initiative Pig Health Improvement Project (BPEX) • Promotion of Mastitis Control Plan and tackling lameness in ruminant livestock (DairyCo)	On-going On-going
Energy efficiency and renewable generation	• Meeting increased demand for information on energy efficiency and renewables	On-going
Improved genetic potential	• Review of existing wheat and oilseed rape varieties responding well to low N – with view to varietal selection by Nitrogen Use Efficiency (ADAS, HGCA) • New varieties post 2020, plant breeders & Steering Group • Promotion of how to use Estimated Breeding Values to select genetically improved stock with improved performance (EBLEX)	On-track Post 2020 On-going On-going
Other indirect effects on the carbon footprint of farm products	• Reduce carbon emissions from compound animal feed manufacture (reduction of 23% from 1990 baseline) (AIC) • Reduce carbon and nitrous oxide emissions from nitrogen fertiliser manufacture (EU emissions set to halve by 2015) (AIC and Fertilizers Europe)	On-track On-track (UK ahead)

Management skills and advice

management skills and advice

The GHGAP encourages continuing professional development (CPD). Survey data suggests that the majority of arable-orientated farms receive input from a professional adviser/agronomist (e.g. BASIS, FACTS) or business adviser. The coverage is less significant in livestock areas. This is because livestock orientated farmers will be more usually influenced by vets, animal nutrition consultants and the feed supply industry. It is through these channels that we are exploring where potential gains for GHG mitigation, are being further explored, as part of professional integrated advice provision.

Accredited farmer training is also an important and developing area, delivered by AHDB sectors, LEAF, LANTRA, colleges etc where the link between resource efficiencies and GHGs is being communicated.

Outcomes

Advisers

- ✓ Crop nutrient management advice – adding GHG mitigation to FACTS[32] CPD
- ✓ Animal feeding advice – establishing training standards, embracing the GHGAP

Farmers and growers

- ✓ Linking improving efficiency and GHGs led by "carbon' footprinting"
- ✓ The pig industry assisted by BPEX have an accreditation scheme

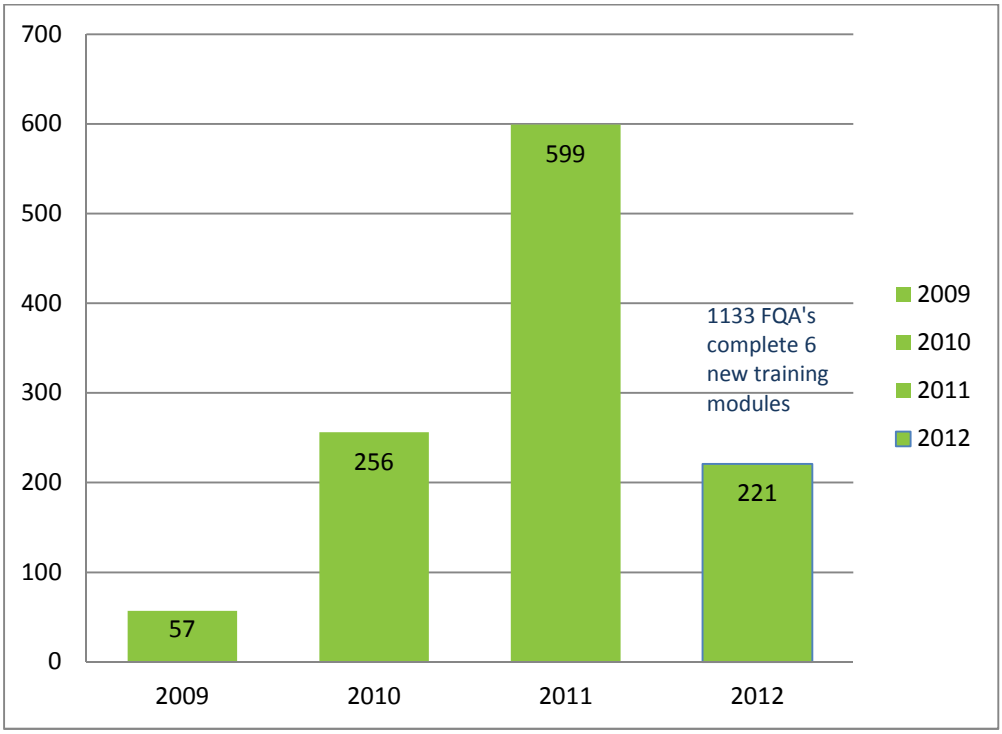
Crop nutrient management advice – adding GHG mitigation to FACTS CPD training

In our first phase delivery plan, we committed to training FACTS Qualified Advisers ensuring that they are up-to-date on delivering climate change related advice and messages as part of a wider 6 module CPD training programme on Nutrient Management Planning. AIC's representation on both the FACTS Management Committee and involvement in the GHGAP, helped to influence the development of the training syllabus. The syllabus anticipates the skills and knowledge that FACTS Qualified Advisers, will require to help farmers improve the efficiency of nitrogen use, and mitigate nitrous oxide emissions, as part of their overall integrated nutrient management advice.

All FACTS Qualified Advisers (FQAs) are required to complete all 6 modules of training by the end of 2014, in order to retain their professional status. Already 49% of FQAs have taken the training so far out of 2300, 56 have attended the Train the Trainer course and so the rate of training appears on track (Figure 5).

[32] Fertiliser Advisers Certification and Training Scheme

Figure 5: Number of FACTS Qualified Advisers taking 6 additional CPD training modules in nutrient management - a new requirement for all professionals



All FACTS Trainers and FACTS Information Service subscribers have received a copy of the GHGAP first phase delivery plan. Their attention has been drawn to their important role in the delivery of the relevant 15 on-farm actions.

"At the other end of the supply chain, the nitrogen fertiliser industry should also be recognised for its massive investment in technologies to reduce its GHG emission, more particularly nitrous oxide emissions from nitrogen fertiliser manufacture. The UK is ahead of the game in halving emissions by 2015, to meet EU agreements"

Chairman of AIC Fertiliser sector, Mike Buchan, GrowHow

Animal feeding advice – establishing training standards, embracing the GHGAP

Most companies in the animal feed supply sector already appreciate the value of in-house training, and some are developing their staff competence to enable them to advise the farmer of the benefits of a whole farm approach to using nutrients more efficiently *i.e.* balancing feed and fertiliser inputs. However the established and more recent investments in staff training are not formally recognised. Until now there has been no obvious advantage to the industry in training transparency.

In 2011, Animal Feed manufacturers and merchants of AIC established a Feed Carbon Group in support of the GHGAP and to strategically address associated issues involved in

providing a sustainable feed supply. The AIC Feed sector consists of 130 companies - representing 95% of the UK's feed supply sector.

An AIC workshop was held on 1st February 2012, attended by 126 individual members to investigate the creation of a register/directory of feed advisers trained to a recognised standard. It was agreed that there is a requirement for greater transparency in the numbers and skills of feed advisers, consultants and sales representatives, and recognition of their contribution to improved efficiency in animal nutrition and hence GHG mitigation. The GHGAP is the driver for proposals which are now been drafted for wider consultation.

This new development will go a considerable way to developing and quantifying advisory networks and their capabilities in support of the livestock sector. It will complement the achievements of the animal feed compounders in reducing the energy consumed to produce feed materials and the improvements made to their composition and quality.

"Some tough business decisions have been made at our compound feed mills, both to rationalise the number of feedmills and to invest in technical improvements. This has enabled the feed sector to reduce its carbon emissions from compound animal feed manufacture by 23% since 1990. Coupled with developing diets with improved conversion efficiencies, and commitments to sustainable sourcing of feed materials, the feed supply industry is serious about the contributions that it is making to sustainable livestock industry and in so doing GHG mitigation"

Chairman of AIC Feed sector, Tony Bell, BOCM Pauls

The feed sector has also invested heavily in improving the required amino acid balance of pig and poultry diets, to lower overall crude protein intakes and reducing excreted nitrogen, at risk of loss as nitrous oxide. Similarly, feeding programmes and dietary rations for beef, sheep and dairy are continually being developed to improve feeding efficiencies. AIC data from 1990 indicates falling nitrogen (N) content overall in compound feeds as a result of nutritional developments. In 2006 annual N inputs were 14% lower than in 1990. AIC will update the calculations for the next phase of the GHGAP delivery plan.

Linking improved efficiency and GHGs – led by "carbon footprinting[33]"

In the first phase Delivery Plan we recognised the value of "carbon footprinting" in helping to raise awareness of GHGs and hotspots of emissions and inform the decision making of farming businesses about adopting or enhancing on-farm actions, in an integrated way. However the uncertainty associated with agricultural emissions and the limited ability to adequately reflect many mitigation practices highlights the current limitations of such life cycle assessments.

The Roadmaps have responded to interest and misinformation by producing representative "carbon footprints" for their respective sectors. In the recently published DairyCo "carbon footprinting" study[34], the average carbon footprint figure for GB milk production was calculated as 1,309g CO_2e per litre of milk. In Down to Earth[35], EBLEX reported an average

[33] The term "carbon footprinting" includes all relevant GHGs for agriculture *i.e.* CO_2, nitrous oxide and methane

[34] DairyCo study: a total of 415 GB dairy farms, varying in size, system and geographical location, participated in the study; footprint ranged from 832 to 2808 (g CO2e/l).

[35] Down to earth

footprint for beef of 12.65kg CO2 eq/kg liveweight and for sheep, 11.86kg CO_2 eq/kg liveweight.

The EBLEX data demonstrates differences between farming systems. For example for sheep, lowland and upland flocks have a footprint just under 11 kg CO_2e. In contrast the footprint of an average hill farm is over 14kg. It is likely the higher figure for hill farms represents the more extensive nature of hill sheep production which utilises generally poorer vegetation and forage and, as a consequence, is associated with lower outputs in terms of lambs and carcase weights, with longer finishing periods. However to balance this, many of these areas could not sustain another form of food production and while their footprint might be slightly higher, the wider benefits to landscape management and biodiversity need to be considered beyond the simple comparison of GHG emissions.

Both DairyCo and EBLEX studies reinforce the GHGAP's message – that whilst the type of system employed by an individual farmer can impact upon their overall carbon footprint, there appear to be opportunities to reduce GHG emissions within all systems

> *The key to success is to maximise farm efficiency, whatever the enterprise type. The common challenge for any producer is to find the right balance of enterprise system and management techniques to maximise the output for food production, while minimising impact on the environment and ensuring profitability for their business*
>
> *EBLEX (Down to Earth, 2011)*

The CLA's CALM Calculator[36] has been developed in a way that makes it distinctive and addresses some of the issues in relation to "carbon footprinting" or product based calculators. CALM is an activity-based calculator that is available online showing the balance between annual emissions of the key GHGs and carbon sequestration associated with the activities of land-based businesses. This activity-based approach for farms and estates is distinct from product-based carbon footprint calculators. These are often calculated on a life-cycle basis, accounting for activities upstream and downstream of the farming business. To bring about change, farm businesses need to focus on the activities in their own business, rather than looking at the activities of their suppliers and purchasers. For this reason CALM follows the most widely-used, internationally-agreed, accounting guidelines for Government and businesses to understand, quantify and manage GHG emissions. The calculator also assesses the impact of Environmental Stewardship options. This is calculated as a partial budget to estimate what would be saved following entry into Stewardship or what has been saved where the business is already in the scheme. It is not a measure of carbon capture (sequestration) but the annual change in emission pre and post entry, although some of the changes, such as new grass margins on arable land do sequester carbon (where they remain in place).

The HGCA is beginning a project to develop a "carbon footprint" protocol and promote a freely available prototype tool for the UK cereals and oilseed sector. The aim is to provide a consistent "carbon footprinting" approach. The project includes a stakeholder engagement plan to ensure industry-wide understanding and endorsement of the protocol. An additional aim will be to ensure the tool can be adapted or enhanced as scientific knowledge, commercial expectations or political drivers in the UK and wider agricultural markets evolve. HGCA's knowledge transfer priorities are on improving soil management and nutrient use in the cereals and oilseeds sector (supported by applied research). The weight and sphere of

[36] http://www.calm.cla.org.uk/

HGCA's influence is enhanced by the joint programme of work with the Tried & Tested, Catchment Sensitive Farming partnership.

The Potato Council commissioned and published a report in November 2011 on 'Building the evidence base - potatoes a low impact crop'[37]. This presents a consensus view of the impact on the environment of potatoes grown in the UK and steps being taken to minimise or mitigate these effects. This has been used at workshops and meetings to highlight opportunities to improve soil management and nutrient use (and Nitrogen Use Efficiency) by the crop (see crop nutrition management section)

The Organic Research Centre (ORC) held producer-focussed conferences in 2010, 2011 and 2012, which provided advice on best practice to organic producers, on most of the priority areas within the GHGAP. The conferences included sessions on soil, crop and livestock management, energy efficiency and renewables, grassland and forage management and genetics and breeding. The 2012 conference included an IOTA (Institute of Organic Training and Advice) organised session on carbon footprinting livestock systems, which highlighted some of the issues and sources of information/advice on this area.

The ORC initiated the SOLID (Sustainable, Organic and Low Input Dairy Systems) project in 2011 with the aim of improving the technical performance and economic competitiveness of organic and low input dairy systems in Europe. It includes a large component of farmer participation. Input has been provided by the ORC to a series of IOTA Technical Leaflets[38] which provide a summary of the key practical farming recommendations arising from organic research. ORC have also been assisting the development of the Soil Association's Low Carbon Farming Project[39], which is planning a number of on-farm training events to help farmers identify emission reduction measures. The project will be developing an online, user-friendly benchmarking facility to aid farmers and growers in improving farm practices to reduce emissions and technical guidance documents on a variety of topics relating to emission reduction in agriculture. Work is also on-going in the field of sustainability assessment and the network has provided direct input to the development of the EASI (Energy and Emissions Assessment Tool) and PG (Public Goods) tools.

EBLEX run an annual programme of abattoir live to dead and selection events for farmers and industry advisers to develop skills in the area of selection of cattle and sheep for slaughter, thus minimising the waste associated with sending stock for slaughter at the wrong specification. In 2010-2011, DairyCo worked with dairy farmers on over 13,000 occasions through discussion groups, open meetings, *etc*. The aim was to help farmers actively plan and taking control of their farm business and their future to optimise productivity and competitiveness by implementing best practice and new research.

The Pig Industry Professional Register (PIPR)[40] aims to build the existing skills in the current dedicated workforce, and help attract new people to the industry. Members must undertake to keep themselves up-to-date and constantly review their practices and procedures in the light of progress and knowledge. A record of activity and progress is maintained for each member independently by City and Guilds.

In terms of overall management control of emissions from farms which fall within the scope of Integrated Pollution Prevention and Control Regulations (IPPC, now Industrial Emissions Directive), recent Environment Agency figures suggest that 97% of all IPPC pig and poultry

[37] Potatoes a low impact food crop
[38] IOTA review
[39] Low Carbon Farming
[40] PIPR

units fall into compliance bands A & B. This is a very good score and is second only to the compound animal feed sector which is also covered by IPPC. This is very encouraging and demonstrates that the sector is already performing well in terms of efficiencies in managing animal feeding practices, housing and manure management.

Potential indicators of change in management, skills and advice

In future we will continue to report on the uptake of CPD courses amongst advisers and farmers and on the results of “carbon footprinting” studies.

Crop nutrient (and crop health) management

Good nutrient management is important for all farm sectors – improving profitability and environmental protection. For the cropping sector, the industry is focussing on the potential efficiency gains from the continuous improvement in the accuracy of in-field measurements and good soil management, to optimise returns on inputs. Farmers tend to be proactive and responsive to new tools and technologies and up-to-date advice. The potential efficiency gains in the livestock sectors are likely to come mainly from concerted efforts to improve manure management and in the take-up of integrated nutrient management planning (linked to animal feeding practices). Industry has an existing and sophisticated network for co-ordinating and targeting its activities through the Tried & Tested campaign in partnership with Catchment Sensitive Farming. The GHGAP benefits from this existing dedicated and collaborative approach, which also benefits nitrous oxide reduction derived from farm nutrients.

Outcomes

- ✓ GHGAP builds on existing cross-industry collaboration - working with the Tried & Tested (T&T) campaign, targeted for the livestock sector but covering all sectors
- ✓ Tens of thousands of farmers have sought nutrient management information – illustrating success of Tried & Tested
- ✓ Professional technical visits by FACTS Qualified Advisers to farmers. - mentioning links between nutrient management and GHGs
- ✓ Farmers involved in trying and testing new tools *e.g.* Think Manures guidelines with an initial demand 10,000, FACTS brochure sent to 20,000, nutrient management packs to 35,000
- ✓ Increasing demand for soil analysis and fertiliser spreader testing since 2007

GHGAP builds on existing cross-industry collaboration - working with the Tried & Tested (T&T) campaign

The Tried and Tested campaign was launched by the Professional Nutrient Management Group (AIC, CLA, FWAG, LEAF and NFU, with support from the Levy Boards) in 2008 to improve the status of nutrient management across all farms, to the benefit of the farm business and to reduce the risk of nutrient loss to water (and ammonia) through the more efficient management of all nutrient sources. There are direct synergies between the objectives of this campaign, and the nutrient management actions in the GHGAP for nitrous oxide mitigation. The GHGAP partners and Professional Nutrient Management Steering

Group collaborate to continually review work programmes 18 months - two years ahead (see Annex 6).

Tens of thousands of farmers have sought nutrient management information – illustrating success of Tried & Tested

Some 35,000 farmers have sought Tried & Tested's nutrient management resources and packs since the campaign began four years ago in 2008. These have been requested via the dedicated farmer helpline or via other organisations supporting the campaign, either with on-farm presence or via events etc. The website www.nutrientmanagement.org receives 2000 visitors per month at peak time for decision-making.

The campaign is supported by other bodies which have a role in influencing farmers' decisions in relation to nutrient management: BPEX, EBLEX, DairyCo, HDC, BBRO, PLC, and HGCA. EA, Defra and RSPB have also supported the development of one of the key tools promoted by the campaign - the Tried & Tested Nutrient Management Plan.

Farmers involved in trying and testing new tools e.g. *Think Manures guidelines with an initial demand 10,000, FACTS brochure sent to 20,000, nutrient management packs to 35,000*

The success of the campaign is attributed to the fact that the communications are presented as 'produced by the industry, for the industry', and now bear the now well established 'Tried & Tested' brand – both imparting an added degree of trust and credibility with the farmer. All resources and the supporting website display the logos of the all the key industry bodies, and of Defra and the Environment Agency, when relevant.

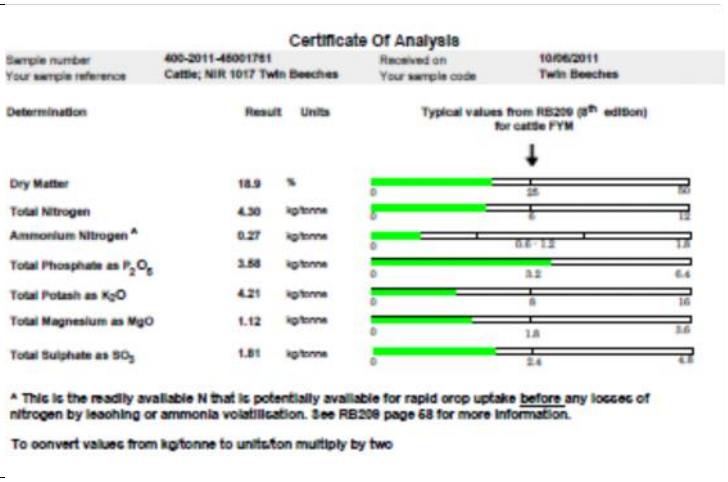
The Tried & Tested network makes an analysis of gaps in the tools and services which farmers will find most beneficial and commits to addressing them. The target farmers are generally those who do not receive regular professional advice such as that recognised by FACTS and BASIS. The new resources, the Tried & Tested Nutrient Management Plan (2008), New to Nutrient Management guide (2011), Think Manures (2011)[41], were all based on farmers informing the Tried & Tested team of what they needed and then trying and testing the products as they were developed.

Another useful development worth mentioning is the commercialisation, in 2011, of a new technique for the rapid and improved analysis for livestock manures and slurries using Near Infra-red Spectrometry (NIRS)[42]. The technique, the outcome of a LINK research project, been promoted at events (Figure 6), sector specific meetings and in publications by the individual levy bodies.

Given the variability in the nutrient content of solid manures and slurries, and increasing awareness of the value of nutrients available in organic manures, it is likely that farmers will be interested in a tool which will help them to optimise their fertiliser use. It will be promoted also through the Tried & Tested website.

[41] T&T resources
[42] NIRS

Figure 6: AHDB demonstrating the near-infrared spectral analysis (NIRS) of manures and slurries for rapid determination of nutrient content at Grassland and Muck (2011)



Certificate Of Analysis

Sample number	400-2011-45001761	Received on	10/06/2011
Your sample reference	Cattle; NIR 1017 Twin Beeches	Your sample code	Twin Beeches

Determination	Result	Units	Typical values from RB209 (8th edition) for cattle FYM
Dry Matter	18.9	%	0 – 25 – 50
Total Nitrogen	4.30	kg/tonne	0 – 6 – 12
Ammonium Nitrogen ^	0.27	kg/tonne	0 – 0.6 – 1.2 – 1.8
Total Phosphate as P_2O_5	3.68	kg/tonne	0 – 3.2 – 6.4
Total Potash as K_2O	4.21	kg/tonne	0 – 8 – 16
Total Magnesium as MgO	1.12	kg/tonne	0 – 1.8 – 3.6
Total Sulphate as SO_3	1.81	kg/tonne	0 – 2.4 – 4.8

^ This is the readily available N that is potentially available for rapid crop uptake before any losses of nitrogen by leaching or ammonia volatilisation. See RB209 page 68 for more information.

To convert values from kg/tonne to units/ton multiply by two

The Organic Research Centre was involved in a Defra funded Legume LINK[43] project, with the aim of improving the nitrogen use efficiency in UK arable systems. A number of farmer-focussed events and workshops have been held over the course of the project.

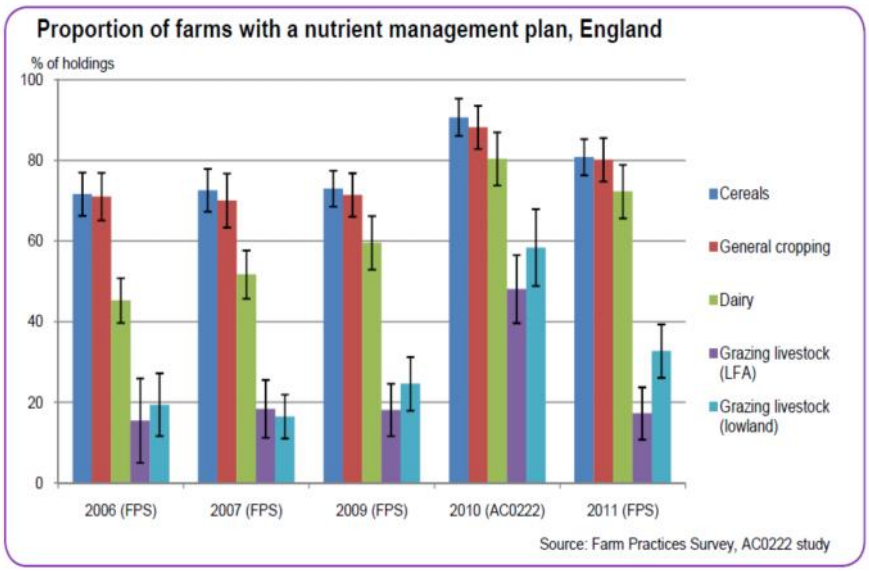
Potential indicators of change in nutrient management practices

Nutrient management planning

It is apparent that the proportion of grazing livestock farms with a nutrient management plan is less than for the cereals and general cropping farms. This general message supports the priorities of the Tried & Tested campaign to provide tools and resources to help the livestock grazing farms, in particular, to adopt some of the basic principles of good nutrient management. A comprehensive report[44] on the status of nutrient management overall published by Tried & Tested is available

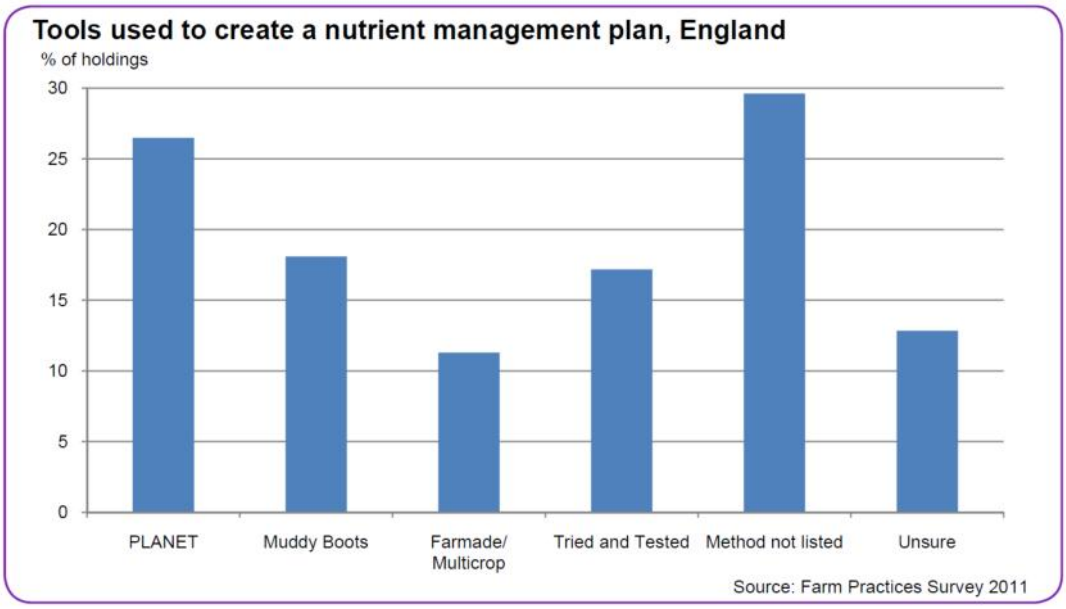
[43] Legume LINK
[44] PNMG report

Figure 7: proportion of farms with a nutrient management plan (from Agricultural Statistics and Climate Change, 2011)



The interest in the Tried & Tested nutrient management plan (as we indicated earlier in this section) is therefore helping to fill the gaps in knowledge and tools that we identified for some livestock farmers. The Farm Practices Survey (2011) suggested that Tried & Tested was used on more than 15% of holdings (Figure 8). Given that this basic level, simple to use tool was produced specifically to help farmers get started or gain clarity on nutrient management planning, and was only introduced in 2008, it would be fair to assume that the T&T campaign has made a significant impact on those farmers who were not using any formal planning process, or any existing tools, such as Planet[45] or other commercial products.

Figure 8: tools used to create a nutrient management plan



[45] www.planet4farmers.co.uk

The 2011 Farm Practices Survey also suggested that the joint effort by the industry to help communicate the importance of nutrient management on farm and to offer appropriate tools and services, is having positive affect on farmer responses (see Table 5 below):

Table 5: change in nutrient management planning practice (from Farm Practices Survey, 2011)

Nutrient management planning practice	2009	2011	% change
Holdings with a nutrient management plan	51%	62%	11%
Frequency with which the nutrient management plan is updated	65%	77%	12%
Proportion of holdings that have seen an environmental benefit in having a nutrient management plan	25%	30%	5%
Proportion of holdings with a manure management plan	62%	67%	5%

Increasing demand for soil analysis and fertiliser spreader calibration since 2007

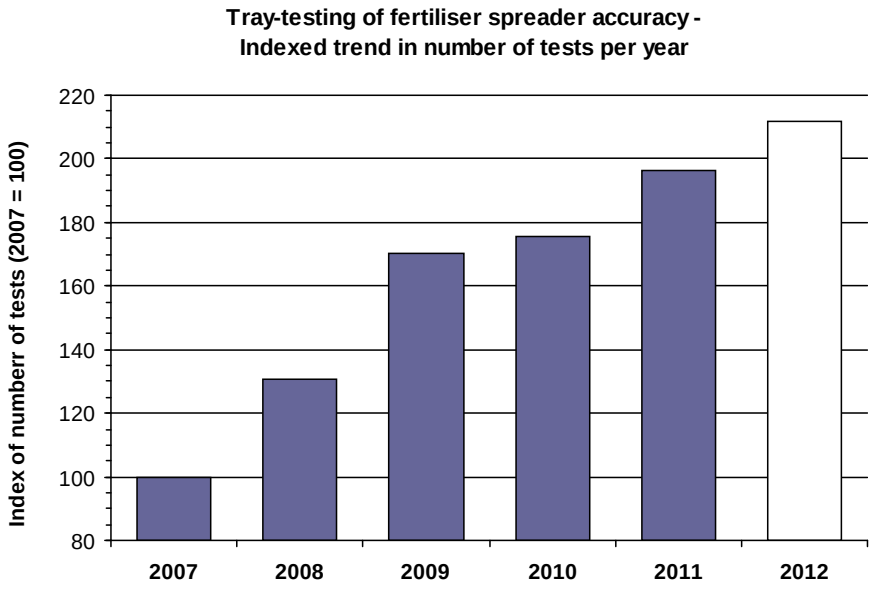
The demand for fertiliser spreader calibration services has doubled, since 2007 (Figure 9)

All good nutrient management planning depends on good soil sampling techniques, soil analysis (reliable results back from the analytical laboratories), and accurate application of recommended nutrients. GHGAP partners intend to work with the Defra statistics team, in Phase II of the GHGAP Delivery Plan, to help verify some of the data from the Defra Farm Practices survey against the results from the British Survey of Fertiliser Practice and industry statistics. In the meantime, AIC, on behalf of GHGAP partners has been able to obtain some statistics[46] (commercial in confidence) from the UK soil laboratories (Professional Agricultural Analysis Group (PAAG) and from a spreader company. For the data provided by the PAAG laboratories, see the section on Soil and Land Management.

These data show that the demand for fertiliser spreader calibration services has doubled, since 2007 (Figure 9)

[46] PAAG report

Figure 9: change in the number of fertiliser spreaders tested



Further evaluation of the adoption of in-field technologies (sometimes described as precision farming techniques) will also be conducted by GHGAP partners and Defra in Phase II.

Similarly, means of collecting more information on the methods of application for manure, slurry and other organic materials require further investigation. However, there is some encouraging data reported in the DairyCo water survey in 2011[47] - over 53% of farmers surveyed were using slurry injection techniques, up from 37% in 2010.

Apparent Nitrogen Use Efficiency (NUE)

Arable crops

Over the last 20 years GHG emissions per crop tonne have reduced significantly through improvements in yield, soil management and nitrogen fertiliser application. For example, from 1990 to 2010 yields in the UK:

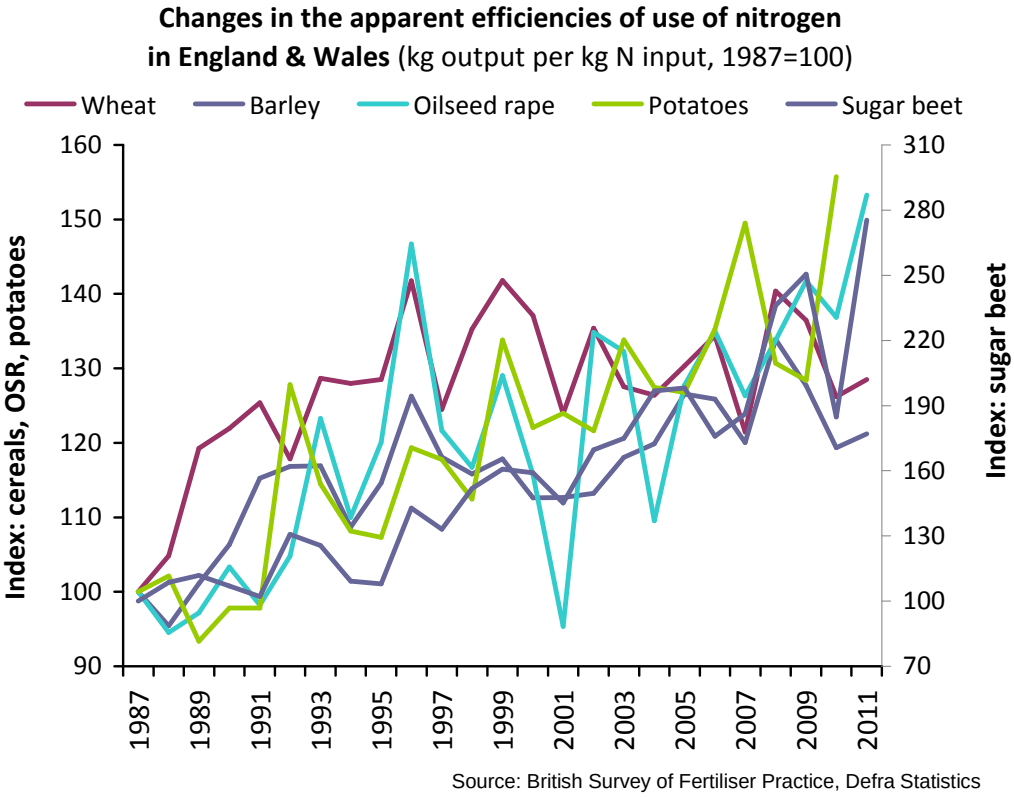
- wheat yields (tonnes per hectare) increased by 18%
- barley, oats and oilseed rape yields increased by 16%, 20% and 6% respectively
- and sugarbeet and potatoes, 40% and 17% respectively.

Over the same period nitrogen fertiliser use (tonnes per hectare) has remained stable. The result has been a significant fall in GHG emissions per crop tonne, indicated by increasing NUE (as indicated in Figure 10).

[47] DairyCo water report

Figure 10 below shows the apparent increase in the use of nitrogen, in England and Wales for wheat, barley, oilseed rape, potatoes and sugar beet.

Figure 10: changes in the apparent nitrogen use efficiency of major crops in England and Wales



Changes in grassland and forage management
Comment on the efficiency of nitrogen management on grass and forage crops and the development of indicators of progress, will be explored in Phase II.

Crop health and quality

The availability of crop protection products and associated advice by BASIS registered professionals helps to protect around 50% of current crop yields. Therefore the link between crop protection, productivity and therefore GHG intensity per crop tonne is significant.

99% of UK arable area receives input from a BASIS registered farmer or professional agronomist/consultant/adviser. Most professional advisers on crop production hold the BASIS and FACTS qualification (as a minimum) and offer integrated advice on crop protection planning and nutrient management planning with associated guidance and written recommendations. Members of the BASIS Professional Register (circa 4500, of which 2500 are active on farm) including AIC, NIAB-TAG members, self-employed advisers and those working for agronomy groups, have received communications and presentations referring to the GHGAP.

HDC's work on varietal selection for disease resistance and for crop quality is also helping to reduce loss/wastage and improve GHG output per unit of produce.

Soil and land management

Good soil management underpins a productive and sustainable farming system. Selecting appropriate management systems and approaches alongside an assessment of the capability of the land can help reduce GHGs. Soils are also a significant store of carbon and so present an opportunity for mitigation. Including soil carbon in discussions with livestock farmers in particular, presents a more complete picture of the emissions and removals from their systems. GHGAP Partners have put in place several initiatives to tackle the gap in knowledge on soil management.

Outcomes

- ✓ Improving soil management skills – through advice and practice
- ✓ Collaboration with the supply chain - offering practical information and demonstration
- ✓ The importance of soil carbon – providing a range of benefits
- ✓ Cover crops – increasing interest from farmers

Improving soil management skills – through advice and practice

While accredited FACTS and BASIS courses cover soil and water, for those wishing to specialise further in the subject, BASIS offers a Soil and Water course (621 hold this qualification in addition to their core competence). The syllabus will be kept under review in light of new research and understanding on the relationship between soil management and soil carbon and nitrous oxide emissions. BASIS is also being consulted as part of the broader initiative launched in July 2011 by British Society of Soil Scientists which aims to offer leadership in enhancing training and skills in soil management, across all industries. Agriculture is relatively well catered for having already developed its accredited training course.

BPEX is seeking to improve soil management for outdoor pig keepers, managers and farm staff through training sessions and the compilation and use of a soil management plan. NIAB TAG's Soil and Farming Systems research work will explore the interrelated subjects of soil fertility, tillage systems and soil amendments. Factors such as cover cropping, cultivation and rotation strategy and their impact on soil characteristics and system performance will be evaluated.

The organic sector is looking at how non-inversion tillage might be incorporated into its farming systems. The Organic Research Centre (ORC) held a workshop in October 2011 on developing equipment, techniques and systems for organic arable farming in the UK. The

ORC is also involved in a collaborative project called TILMAN-ORG[48], involving 15 partners across 10 European countries. The project is helping to develop robust and sustainable arable cropping systems via the introduction of reduced tillage techniques combined with the strategic use of green manures in crop rotations.

The HGCA launched a £1.6million Soil Management research call last year to increase yield, business profitability and protect the environment for cereal and oilseed crops. The Potato Council has committed £750k to new agronomy projects to improve soil, nutrient and water management. Information from on-going agronomy projects is being delivered using the 'PCL grower collaboration sites' to demonstrate practical outcomes from the research.

Collaboration with the supply chain - offering practical information and demonstration

LEAF working with Asda launched 'Simply Sustainable Soils'[49] in 2011, a practical, hands-on guide offering farmers six simple steps to improve the performance, health and long term sustainability of their land. Looking at soil texture, structure, drainage and compaction through to nutrients and biological health, the guide helps farmers to get the best out of their soil and monitor changes in soil health.

A new collaboration between NIAB-TAG and machinery manufacturer Amazone from 2012 aims to provide farmers with practical information on the costs, efficiencies and agronomy impacts of different cultivation systems. The trials site at South Yorkshire will provide a shared platform for both organisations to use and learn from.

The importance of soil organic matter – providing a range of benefits

Agriculture and other land management practices have a positive role to play in climate change mitigation. There is significant potential to remove CO_2 from the atmosphere by the process of photosynthesis and storage as living biomass (vegetation) or as soil organic matter (carbon sequestration) but also considerable debate about the realistic mitigation potential[50].

Farmers are showing an increased interest in soil organic matter, recognising its benefits for workability, reduced erosion and improved water holding capacity. Implementing livestock and grazing management to improve soil organic formation with the associated sequestration is being promoted as an essential aim of good livestock practice. EBLEX has identified activities that are likely to lead to increased soil organic carbon:

On permanent grassland

- Maintaining the sward without reseeding
- Encouraging greater contribution of legumes in the sward
- Avoiding overgrazing and compaction
- Avoid heavy doses of slurry

On grass leys

- Aiming to maintain long leys rather than short-term leys
- Include deeper rooting species in seed mixtures
- Incorporate organic materials during cultivations
- Protecting surfaces on slopes

[48] TILMAN-ORG
[49] LEAF Simply Sustainable Soils
[50] Uncertainty associated with permanence, timescale, distribution within the soil profile and impact on other GHGs especially N_2O *etc*

The Organic Research Centre has contributed to a review on effects of organic farming practices on soil carbon sequestration: entitled Soil Carbon Sequestration and Organic Farming: An Overview of Current Evidence[51].

Cover crops – increasing interest from farmers

Cover crops can help to protect and enhance soil properties and in addition can help to manage a farm's nitrogen losses (especially on highly permeable soils) and improve weed control. In the crop nutrient management section we highlighted the Organic Research Centre's involvement in a Defra-funded Legume LINK project. Cover crops were shown to provide a number of benefits to arable farmers from all farming systems. The key messages to organic farmers were that diversity in cover crops is beneficial for productivity and weed control with additional advantages for biodiversity.

The Legume LINK project noted that the agronomic and economic advantages of using diverse cover crops in non-organic systems are currently not high enough to trigger sufficient private investment. This echoes the attitudes of NFU arable farmers[52] considering the incorporation of cover crops into their farming systems. They highlighted that the main difficulties were likely to relate to seed bed preparation. This includes not allowing 'frost tilth' to develop over winter and loss of soil moisture at cover crop incorporation stage. Other projected problems included expected technical / agronomic difficulties in cultivating and establishing cover crop, extra costs relating to fuel, machinery use, seed and labour, weed and pesticide problems, and retention of overwintered stubble would be prohibited, causing possible issues for Environmental Stewardship agreements. Despite these perceived difficulties in some circumstances, on some soils and in some cropping systems cover crops can play a very important role in crop and soil management and provide a range of benefits. Indeed, anecdotal evidence suggests that more and more farmers are starting to think about how they can better manage their soils and, for some cover crops help them do this.

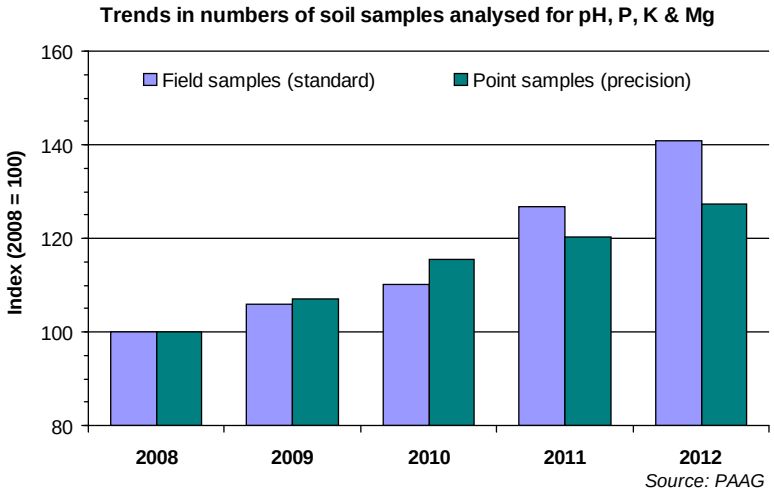
Potential indicators of change in soil and land management

Soil testing

The Farm Practice Survey of 2011 suggested that 70% of farms regularly test the nutrient content and 75% the pH of the soil[53]. These results appear encouraging but we would like to compare results against other data sets *e.g.* those from the British Survey of Fertiliser Practice. Collectively, UK soil laboratories Professional Agricultural Analysis Group (PAAG) has reported a growth in the volumes of soil samples received over the last five years. Standard (sometimes referred to as routine samples) have increased by more than 15% and in-field soil samples, used in support of managing in-field variability, have increased by 6%. (figure 11).

[51] Soil carbon sequestration
[52] 141 arable farmers surveyed during summer 2011. The sample taken offers statistical reliability to the 90% confidence level with a margin of error of +/-7%. A.Dinsdale, *pers.comm*.
[53] Agricultural statistics and Climate Change (December 2011)

Figure 11: Trends in numbers of soil samples analysed for pH, phosphorus, potassium and magnesium

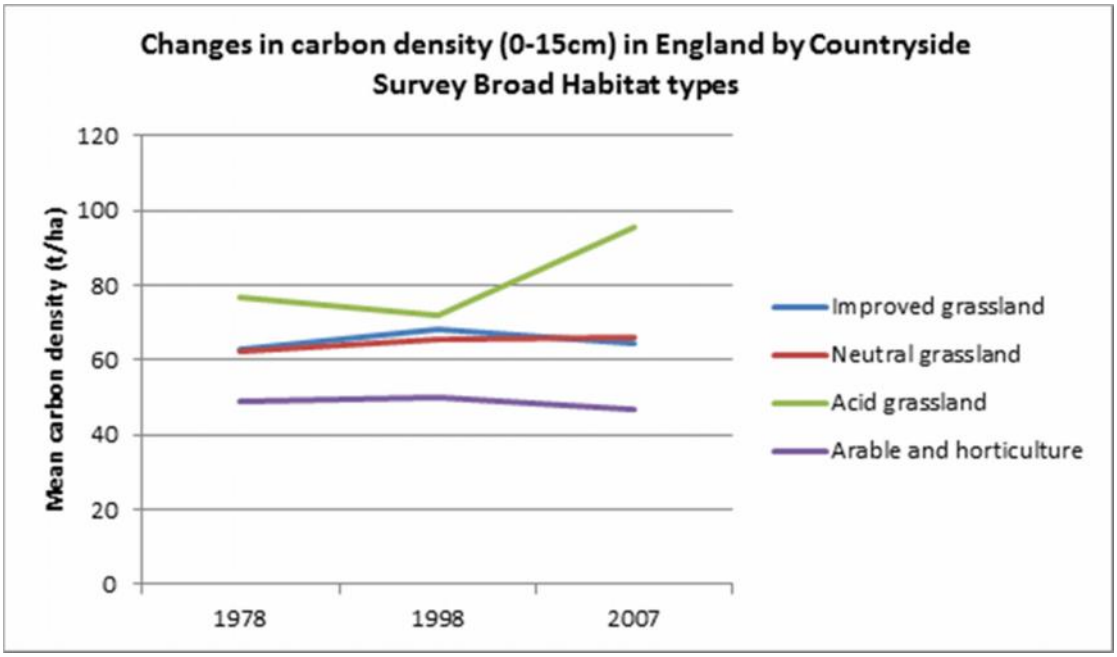


In 2011 EBLEX ran an extensive project with the Environment Agency and FWAG to raise awareness to the value of soil testing and improve farmers understanding of how to use soil testing results. 1000 farmers took up the opportunity to have free soil tests. A survey at the end of the project to assess farmer attitudes and uptake of information identified lower levels of soil testing currently in the beef and sheep sectors. However of those who took advantage of the soil test offer 95% reported an intention to make use of the information they gained from their soil test results and 96% would recommend soil testing to others. This demonstrates there is a way to go in terms of encouraging greater efficiency in nutrient use for the beef and sheep sector but that further work would provide positive results

Soil carbon

There is conflicting evidence about recent changes in soil organic matter content. Figure 12 below presents some recently published trends. There appears to be relatively stable and in some case increased soil organic carbon in grasslands, particularly permanent grasslands and semi-natural grazed habitats. However there appears to be a decrease in the carbon stored in arable soils.

Figure 12: changes in carbon density (0-15cm) in England by Countryside Survey Broad Habitat types[54]



In its recent Technical Information Note on Environmental Stewardship and climate change mitigation (TIN107)[55], Natural England sets out that climate change mitigation is an important objective of Environmental Stewardship. It states that a "small number of Environmental Stewardship options…reduce GHG emissions with minimal impact on farm productivity (for example, winter cover crops)", and hence are consistent with the approach of the Greenhouse Gas Action Plan. It also notes that "several Environmental Stewardship options can make a significant contribution to increasing carbon storage in the landscape. Some of these do not impact on farm production (for example, hedgerow restoration), whilst others restrict farming activity (for example, the buffer strip options)." With some caveats, TIN107 highlights that Environmental Stewardship uptake across England reduced GHG emissions by approximately 4 Mt CO2e per annum, excluding displaced production.

[54] Emmet *et al* (2010)
[55] NE TIN107

Livestock nutrition

Understanding the energy and protein requirements of livestock are critical to achieving production targets alongside planning what will be grown on-farm and what may need to be bought in. This provides an opportunity to integrate feed and fertiliser strategies. Improving feed conversion efficiency will reduce the emissions of methane and nitrous oxide. Animal health and nutrition are also inextricably linked.

Tackling feeding efficiency, working together on an industry standard ruminant feeding plan to fill a gap in delivery and finding alternatives to soya have been the focus of our work.

Outcomes

- ✓ Industry Ruminant Feeding Plan – creating a basic guide and tool - GHGAP partners working with Tried & Tested
- ✓ Improving feeding efficiency - Better Returns for farmers and for mitigation
- ✓ Addressing soya use - researching alternatives without compromising animal health and promoting the uptake of sustainable soy in feed

Industry Ruminant Feeding Plan – creating a basic guide and tool - GHGAP partners working with Tried & Tested

We have highlighted elsewhere in this report the gap in feed nutrient planning identified by GHGAP partners through their work on the Tried & Tested Nutrient Management Campaign. We will tackle this gap by commissioning an industry standard Ruminant Feeding Plan, specifically targeted at those farmers who do not receive specialist advice, namely the grazing livestock sector. The new Feed Management Plan (for dairy, beef and sheep) will be linked to health planning and will be promoted through Tried & Tested and other partners. The outputs from Defra project (FFG 1101) Feed Management on Livestock Farms, will be used to inform the process.

Improving feeding efficiency – Better Returns for farmers and for mitigation

Through the autumn of 2010 and winter of 2011 EBLEX's Better Returns Programme (BRP) delivered a campaign to raise awareness amongst producers of the most efficient methods and products for cattle and sheep nutrition. On farm events were supported by BRP manuals giving take home practical information. The materials were supplemented with both forage and feed directories, giving producers accurate advice on alternative feed and forage options which could fit their requirements and systems. EBLEX also launched an online Blend calculator designed to help producers utilise the feed resources available to them to best

effect, balancing the diet they require with the feeds available, thus ensuring both efficient use of feed resources and optimising performance of the animals fed.

> *"The nutrition message dovetails nicely into other work we do to encourage best utilisation of forage both as grazed grass and conserved and fed as part of a winter ration."*
>
> *EBLEX*

In addition a number of articles and top tips were placed in national farming journals to raise awareness and influence farmer thinking. A post event survey carried out by EBLEX of producers who attended a range of BRP events (which included the nutrition meetings) showed that 70% of producers adopted an idea learnt at the event, and 72% shared ideas they had learnt with other producers, showing a positive uptake of learning through the medium of workshops and events delivered by EBLEX.

The EcoPig project (EEDA & BQP), has successfully proved the benefits of feeding outdoor pigs in long troughs as opposed to the conventional floor method. Reduced feed and fuel use, carbon footprint, nitrate leaching and improved soil management are all positive outcomes. Results have given BQP the confidence invest over £1M to roll trough feeding across all their outdoor production sites (around of 25% outdoor sows). Other production companies have visited the site and are looking to implement changes in their businesses.

Addressing soya use - researching alternatives without compromising animal health and promoting the uptake of sustainable soy in feed

Imported soya is an essential protein ingredient for poultry diets, in the main and also for pigs and high performing ruminants. Questions have been raised about the sustainability of UK's reliance on soya, particularly in relation to the global GHG balance. Extensive work is underway by the animal feed companies of AIC, looking at alternative protein sources to soya but where it is required, to its responsible procurement. Soya inclusion rates are reported to have reduced by a half in the last decade to account for only 10% of the diet. There has been a corresponding increase in the use of home grown proteins.

The source of soya imports is reported to be mostly from Argentina (57%) with Brazil accounting for only 38% (source AIC). At present there is little RTRS (Round Table on Responsible Soy[56]) certified soya on the market but customer interest is increasing to the extent that FEMAS (Feed Materials Assurance Scheme[57]) and RTRS have recently launched a joint module for responsible soya supply. The module brings together the sustainability criteria of RTRS at farm level with the existing robust supply chain certification of the FEMAS scheme without adding significantly to auditing costs. A number of suppliers are also looking at extending their existing certification sustainability schemes such as Cargill TRIPLE S. As availability of RTRS and other certified sources of sustainable soya increases in the coming year we will be bring this to the attention of the industry. BPEX has facilitated activity to promote the uptake of sustainably produced soy products in livestock feeds as these reach market.

Programmes, including the Green Pig feeding trials of finishing pigs using peas and beans, are in place to reduce soya levels in feed and to help ensure that the soya used is itself sustainable. Results from the project are being disseminated, a total of five papers have been accepted for the British Society of Animal Science forthcoming conference. These

[56] http://www.responsiblesoy.org/
[57] FEMAS

include LCA analysis comparing diets including home grown proteins against those containing soy (including land use change impacts).

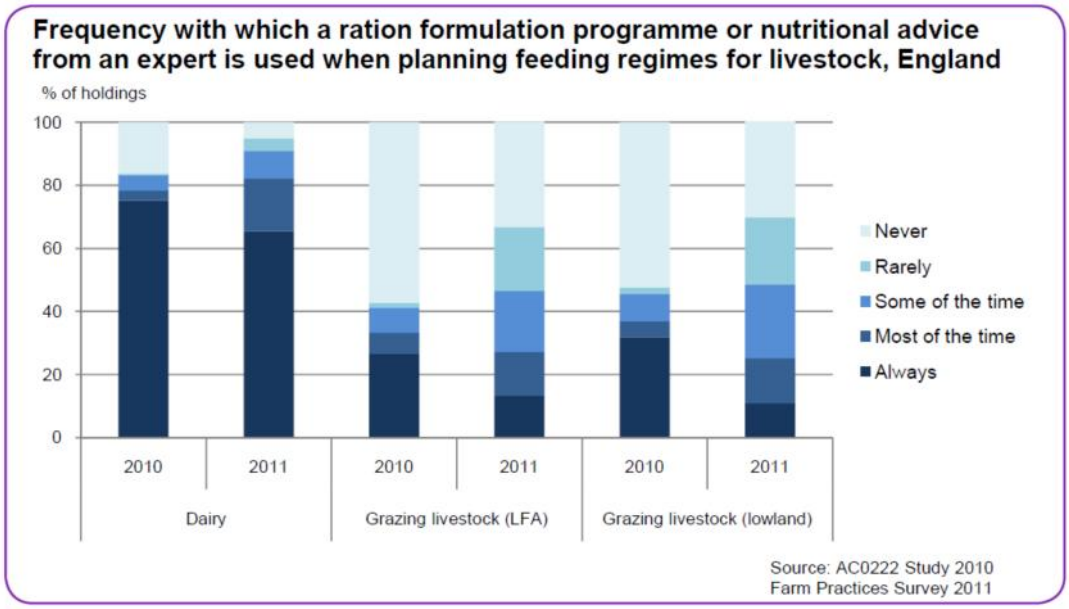
Some commercial producers are including beans in pig diets. Experience from one such farm which is mill and mixing its own feed is that including home grown beans at a rate of about 7% can be done without a detrimental impact on pigs performance. However it is not without its challenges. Beans are not that economical to grow due to variable yields but they are a useful break crop for this particular system The higher inclusion level of beans in the ration, the higher the need for supplementary amino acids as beans have a lower amino acid content than soya. Also higher bean inclusion can make the feed more dusty resulting in more oil in the ration which can adversely affect grading.

Co-products and by-products from the food and drink manufacturing sector and now, increasingly, from the bio-fuels sector continue to form pig feed. This contributes to efficient recycling and the off-setting of raw ingredient use. Not only are the nutritional value of these products utilised, rather than wasted, but food manufacturing costs are also reduced. It is estimated that the UK bio-ethanol industry will produce around one million tonnes of co-products a year - Dried Distillers Grains with Solubles (DDGS) which is high in protein (more than 30%). It is believed these will be of suitable quality and available in sufficient quantity potentially to make up a significant amount of finishing pig rations. This will substantially off-set cereal grain and protein meal (soy) use.

Potential indicators of change in livestock nutrition

Analysis in Defra's Agricultural Statistics and Climate Change publication suggested that the percentage of farmers using a ration formulation programme or nutritional advice from an expert when planning feeding regimes at least some of the time is significantly higher for dairy farms than for the grazing livestock farms[58] (Figure 13 below):

Figure 13: use of a ration formulation or nutritional advice from an expert



[58] Agricultural statistics and climate change, December 2011.

There is considerable difference between feed planning and nutrition formulation. A feed plan will not provide a ration formulation and we will work to unpick the differences in our conversation with Defra's statistics team to get agreement on a robust indicator(s) of progress.

Livestock health

Animal health is fundamental to efficient livestock production and is inextricably linked to nutrition and fertility.

Outcomes

- ✓ Tackling endemic disease – GHGAP members working collaborating with animal health professionals to deliver consistent messaging
- ✓ Improvement in pig health – the revolution has begun

Tackling endemic disease - GHGAP partners working collaboratively with animal health professionals

The DairyCo Mastitis Control Plan[59], part of a national mastitis initiative developed by veterinary surgeons and supported by DairyCo. The apparent resurgence of the disease in recent years and the lack of a structured, coordinated approach to understanding and solving mastitis problems in dairy herds, led to the industry's approach to encapsulate a diagnosis and a whole farm approach. This approach will require further education of farmers and their advisors and the DairyCo Mastitis Control Plan provides a transferable method for addressing mastitis problems and achieving mastitis control which can be used by farmers in consultation with suitably qualified and trained veterinary advisors.

The purpose of this DairyCo initiative is to identify a team of UK veterinary surgeons and other advisors to work in a collaborative manner to initiate and develop a widespread mastitis control scheme. Both DairyCo and the Organic Research Centre have initiated work to tackle lameness. The DairyCo Mobility Score system is now the industry standard for assessing lameness and is part of the DairyCo Healthy Feet Programme, a national mobility improvement programme, launched in 2011. DairyCo put together the package and trained "mobility mentors" who can be commissioned to develop a customised package from the programme for dairy farmers to reduce and control lameness The ORC published its "Healthy feet, happy feet, happy cows, better yields" bulletin.[60]

EBLEX and DairyCo delivered a project in 2010 on the sustainable control of worms (COWS). EBLEX research had suggested that beef farmers could improve the management of worm burdens in their cattle, and the application of products used to control them. A manual containing management guidelines for treating internal parasites in cattle was distributed widely to vets and consultants and was followed by a series of workshops aimed at vets in conjunction with the AHVLA. The aim was a consistent industry message which would operate in a similar way to the SCOPS principles in the sheep sector. The project subsequently targeted those in the industry selling products to producers using a simpler

[59] http://www.mastitiscontrolplan.co.uk/
[60] Leach, K. 2011. Healthy feet, happy feet, happy cows, better yields. The Organic Research Centre Bulletin. 105.

message. Farmer-focused meetings used vets who had attended the training workshops to deliver the guidelines in a very practical way. The EBLEX parasite control guide then helps producers select the right product to deal with their parasite challenge and lists its effective withdrawal period. The project has been supported with a number of articles in EBLEX Better Returns Programme bulletins and the wider farming press.

DairyCo and EBLEX support the Cattle and Sheep Health and Welfare Groups to tackle health issues in the ruminant livestock sector. The Cattle Health and Welfare Group (CHAWG) provides an industry forum that will encourage and coordinate a programme of economically focused improvements to cattle health and welfare across GB Farm Health Planning (the Sheep Group is currently updating its Terms of Reference). CHAWG's priorities are:

- Farm Health Planning
- Bovine Viral Diarrhoea
- Surveillance and reporting
- Dairy Cow Welfare Strategy

Improvement in pig health – the revolution has begun

Improving pig health will help to improve the efficiency of pigs and so the efficiency of resources used. BPEX is playing a leading role in the implementation of the 20:20 Pig Health and Welfare strategy launch by the Chief Veterinary Officer in August last year. Core in the early implementation is the national Pig Health Improvement Programme. The Programme was launched in July 2011 giving all producers chance to join this industry-wide drive to improve pig health. It builds from the successes of producers taking part in regional projects in Yorkshire & Humberside, East Anglia and East Midlands. In seven months over 1300 farms signed up. The five services offered by the scheme include Pig Health Scheme Reports, Local Health Mapping, Bespoke Biosecurity Action Plans, Disease Testing and Regional Support.

"Lower mortality, improvements in piglets per sow per year, better feed conversion, for example, are all 2 Tonne Sow targets which, when achieved, will help hit the Roadmap target reductions"

BPEX

Potential indicators of change in livestock health and fertility

The Farm Practice survey of 2011 reported that 71% of farms with livestock had a farm health plan. This is a 7% decrease on 2009. The decrease was driven by a reduction in the number of farms with an unrecorded plan; the percentage of farms with a written or recorded plan remained virtually unchanged. Of those farms currently without a farm health plan 14% were planning to complete one with some assistance over the next 12 months. In 2010 almost 95% of dairy farmers had a farm health plan.

Since its launch in 2010 the DairyCo Mastitis Control Plan has trained 146 veterinary surgeons and consultants on mastitis prevention, control and treatment and 354 farmers have enrolled on the scheme. By the end of 2011, almost 900 DairyCo Mastitis Control Plans were in place on farms across the country.

Energy efficiency and renewable generation

CO_2 emissions from energy and fuel use by agriculture are low, accounting for only 1% of the UK's emissions. However energy efficiency offers business benefits, particularly for the more energy intensive sectors – pigs, poultry and horticulture. Low carbon energy services present real diversification opportunities, whilst both lowering our own emissions and helping to decarbonise the energy that the UK uses throughout the economy. We believe that the emissions reduction potential of renewable energy within our industry could outweigh our emissions reduction target by a factor of six.

Outcomes

- ✓ Energy efficiency - reducing carbon and costs by changing behaviour
- ✓ Renewable energy – delivering diversification and decarbonisation

Energy efficiency – reducing carbon and costs by changing behaviour and implementing new technology

In the horticulture sector, GrowSave[61] is a flagship activity. It delivers a series of projects and resulting knowledge transfer to help horticulture to save energy. This website provides information on a number of areas where energy saving is possible and case studies too. GrowSave's key message is that energy efficiency reduces the carbon intensity (and cost) of growing protected crops. Recent work by the Potato Council has shown that closer monitoring of electricity use in potato stores can significantly reduce bills, as well as helping to meet increasingly tight carbon footprint requirements being introduced by the supply chain. Project R401[62] has been monitoring commercial potato stores for their energy consumption over a season.

In its "carbon footprinting" study DairyCo found that energy use on dairy farms is a very small component of a farm carbon footprint but there are opportunities for cost and carbon savings, with milking, milk cooling and plant washing the areas that indicated the greatest potential reductions. As a result of its participation in the Energy, Environmental, Ecology and Agricultural Systems (EASI) project[63], the Organic Research Centre concluded that addressing domestic energy use will result in savings, in addition to paying attention to energy intensive processes, such as grain drying and flame-weeding in arable systems, which would help to reduce emissions significantly. In addition the project found that regular calibration of machinery and maintenance can result in large increases in production efficiencies through energy saving.

[61] www.growsave.co.uk
[62] R401
[63] ORC website. Dec 2010

Renewable energy – delivering diversification and decarbonisation

In February 2011, the NFU launched its new Farm Energy Service[64] to provide its members with independent on advice on energy efficiency and renewables. The NFU believes that the Service will improve the resource use efficiency of businesses, alongside providing diversification opportunities and making a significant contribution to decarbonising the UK economy.

A number of GHGAP partners also provide information and advice on renewables *e.g.* BPEX[65] and Farming Futures[66]. REsolved renewables[67] is an ADAS company that has been specifically set up to help farmers make the most of the renewable energy opportunities on their land.

Potential indicators of change in energy efficiency and renewables

FITs for the future – farmers respond to incentives to integrate clean energy into their businesses

According to the Farm Practices Survey, almost 5% of commercial holdings were producing renewable energy on the farm in 2010, with the most popular technologies being biomasses, such as slurries, food and plant waste for anaerobic digestion to produce biogas, and willow, wood wastes and crops for biodiesel. Approximately 92% were using the energy produced for the household and very few were selling the energy to the market.

More recent information[68] suggests that the feed-in tariffs introduced in 2010 have incentivised uptake of the range of renewable technologies available so that:

- One in six farmers (or farmers and growers) will be generating solar electricity by summer 2012
- One in five farmers and growers are/will be producing clean electricity by this summer
- Almost one third of all farmers and growers are involved in some form of renewable energy production and supply

DairyCo's water report[69] (2011) highlights similar levels of uptake with over 14% of dairy farmers surveyed having installed solar technology and almost 8% putting up wind turbines over the past year.

Energy efficiency

From 1990, there has been an overall decrease in the volume of fuel used by the industry and with total agricultural output similar to 1990 levels; the volume of fuel per unit of output has fallen over the past 22 years[70].

[64] http://www.nfufarmenergyservice.com/
[65] BPEX RenewableEnergy
[66] http://www.farmingfutures.org.uk/
[67] http://www.re-solved.co.uk/Welcome.aspx
[68] NFU survey 2011. Results based on survey of 405 farmers across England & Wales. Stratified sample based on the proportion of common main farm types per region of England and Wales
[69] DairyCo water report
[70] Defra Agricultural Statistics and Climate Change, December 2011.

Direct energy use in horticulture and poultry is about two orders of magnitude larger than more field-based farming systems. Heating dominates, followed by ventilation, feeding and manure management on poultry farms.

The recently launched Farm and Forestry Improvement Scheme (FFIS[71]), includes items which promote energy recovery/saving and we expect it to act as a catalyst to greater uptake of technologies such as energy efficient heat exchangers.

Anaerobic digestion – can it still deliver one-fifth of the 3Mt CO_2e target?

Our Framework for Action (2010) highlighted the potential for anaerobic digestion (AD) to deliver multiple environmental benefits including low-carbon energy, abatement of greenhouse gas emissions and stimulation of good nutrient recycling. We set out its critical role in potentially delivering one-fifth of the abatement (by capturing methane lost from manures and slurries) required of the industry by 2020. This was based on an ambition of deploying 1000 farm-based anaerobic digesters by 2020.

However, the substantial potential for abatement of fugitive methane emissions from handling of manures and slurries (previously estimated at 0.6 MtCO2e/year) can only be realised if there is widespread uptake of improved technologies that divert a substantial proportion of animal manures away from conventional uncovered on-farm storage. Total UK manure and slurry arisings are about 90 million tonnes; encouraging the processing of 20% of this quantity with new technologies such as anaerobic digestion will require such investments to be cost-effective, supported by income from the sale of energy services as well as the financial benefits of improved nutrient management. Currently available AD plants are limited by economies of scale to larger farms or possibly groups of farms, and they need to show a good energy performance in order to justify their capital cost. Co-digestion of agricultural residues such as manures together with high-energy feedstocks such as food waste or silage is recognised as the way forward, but the growth of on-farm AD in Britain is held back by a number of factors, which together threaten the attainment of GHG reductions through better manure handling.

Farmers proposing to process food waste in AD plants have been subject to planning delays and refusals, but government guidance for local planning authorities awaits DCLG's publication of the National Planning Policy Framework. Connections to the electricity or gas grid can also be expensive and time-consuming, with inconsistent outcomes in different parts of Britain. Members of the GHGAP partnership organisations participated with Defra in the 2011 development of the government's AD Strategy, which makes a number of recommendations for action. The multiple environmental benefits of widespread deployment of on-farm AD need to be more explicitly recognised and incentivised, by Defra-specific measures as well as through support for low-carbon energy. The Renewables Obligation administered by DECC, as well at the Feed-In Tariffs (FITs) and the Renewable Heat Incentive, are providing the strongest market stimulus to the uptake of AD at present. With around 80 newly-commissioned AD plants, of which about half are on farms or using farm-derived feedstock, the take-off of this sector has not yet been rapid enough to put it on a trajectory towards 1000 or more on-farm plants by 2020, and industry concerns remain about DECC's level of ambition for supporting AD through the FITs scheme.

[71] FFIS

Research

Research involving GHGAP partners ready for dissemination in Phase II

This list is not exhaustive but a sample of the current research in support of GHG mitigation and the potential value of the findings to all GHGAP partners responsible for taking the new knowledge to farmers and growers. The websites of levy bodies list their projects.

Soil management and optimisation of crop nutrition and animal nutrition management (linked to animal and crop health) feature strongly in the industry's applied funding priorities. Health improvement related research is also important as well as breeding programmes; however generally genetic improvements are either on-going and/or longer-term (*i.e.* post 2020). All these developments will offer farmers and growers new knowledge and solutions to improve their farming efficiencies to the benefit of their business performance and for GHG mitigation.

Crop nutrition (and crop health) management

Nitrogen management to reduce nitrous oxide emission from arable products (Inc. ADAS, AIC, CLA, HGCA, NFU)

Findings from the 5 year 'MIN NO' project - a Defra, Scottish Government LINK research consortium (involving 21 partners) including the GHGAP partners, above, are expected in 2014. The project will improve estimates of the relationship between nitrous oxide and the rate of mineral nitrogen fertilisers applied and identify practices, which could lower emissions. These will be considered in the context of the nitrous oxide projects of the GHG 'Research and Development' Platform, which includes work on organic manures and nitrification inhibitors (commercially available (as are urease inhibitors)), and available information on soil cultivations and soil types.

GHGAP partners will agree how to co-ordinate appropriate knowledge transfer, advice and communication of the new strategies for nitrogen fertiliser management and lowering the GHG emissions footprint for arable products: bread, sugar, oils, peas, chicken, whisky and biofuels.

Validation of tests predicting soil nitrogen supply (SNS) (with HGCA, ADAS and private companies, including AIC members)

This two year project reports in 2012 and results will be used to give assurance to farmers on which crops and situations reliably benefit from SNS testing. Better guidance on the use of soil analysis and greater precision in SNS prediction should help to reduce under achievement of yield potentials and optimise fertiliser use.

Automatic nitrogen fertiliser management for winter cereals (HGCA and AIC company representation)

The aim is to develop a commercially-viable system for automated fine-scale adjustment of fertiliser nitrogen on autumn sown cereals. Current precision of mineral N fertiliser is such that 43% of crops are fertilised within 50kg/ha of the optimum N rate. Automation could improve accuracy to 74%.

Value of controlling wheel compression in-field to reduce soil compaction and nutrient uptake efficiency (HGCA)

This project aims to reduce the risks associated with autumn wheelings of combinable crops using field and catchment evaluations and to test practical engineering solutions. Although the project focusses on reducing runoff and diffuse nutrient loss from fields the benefits are applicable to reducing nitrous oxide by improved nutrient uptake efficiency.

Soil and Land Management

On-going projects (HGCA)
Soil management has been identified an on-going and major research priority by levy payers – an extensive 5 year programme has recently been commissioned beginning with benchmarking existing farmer's views and information sources.

Livestock nutrition

Refining protein diets (alternative, reduced and 'protected' protein trials) (BPEX, and AIC members)
Numerous research programmes aim to achieve pig (and poultry) performance, with the required balance of amino acids, enabling reduced protein in the overall diet and reduced loading on the environment, risk of GHG emissions *etc*. Results of these trials are continually being released into the market place, in the form of new feed formulations, guidance and feeding advice.

Other BPEX projects are addressing pig finishing (growth and feed conversion).

Research into ruminant nutrition regimes (DairyCo, EBLEX and AIC members)
The research focusses on improving overall feeding efficiencies, thereby reducing methane and nitrous oxide. Levy bodies and the AIC Seed sector are also working on breeding of forage grasses and legumes (*e.g.* high sugar grasses, drought tolerance, lower protein) and on investigating the use of co-products in cattle rations. Feeding trials with different oat varieties are being tested by DairyCo and EBLEX. Results will mainly be available for dissemination by the end of 2014. The EBLEX Beef and Sheep Better Returns programmes, which target improving overall production efficiencies, publish results annually.

Improved genetic potential

A review of Profitable Lifetime index data and results on decoding of DNA to identify desired traits for increasing productivity, health and welfare, will be available for DairyCo to disseminate in 2012. DairyCo is also involved in on-going collaborative work with the industry to publish other indices such as for mastitis and carcass Estimated Breeding Values (EBVs).

Signet Breeding Services (part of EBLEX) is providing genetic evaluations to livestock producers to help them identify sheep and cattle with superior breeding potential. These performance recording and measurement services enable the industry to capitalise on genetic improvement to improve the efficiency and quality of production. Benefits include:

- Improving growth and carcase traits
- Increasing maternal efficiency

- Enhancing animal welfare
- Reducing the carbon footprint of ruminant production

Research is currently on-going to enhance

- Lamb survival - through the production of lambing ease EBVs and a research project looking at the genetics of lamb survival
- The efficiency of suckler cows though more effective modelling of cow mature size
- Cattle fertility and serving capacity through the provision of a Scrotal Circumference EBV
- The speed of genetic gain within breeding populations
- The utilisation of carcase data within beef breeding evaluations
- The measurement of terminal sire characteristics in sheep using computed tomography
- The screening of large populations of sheep and cattle through the use of data collected electronically

greenhouse
gas action plan

Next steps in delivery 2012-2015

Next steps in delivery

We believe that our work over the past two years vividly demonstrates that our response has been anything but "business as usual". Our partnership has been the catalyst for collective action. For example it is difficult to imagine the delivery of an initiative as (potentially) transformational as the Farm Efficiency Hub in such a short timescale in the absence of the GHGAP. Our member organisations are influencing the direction of travel of others in support of the GHGAP, for example the AIC has facilitated the introduction of a training standard for industry's animal feed advisers. We have added value to our own work - pooling resources, utilising the available expertise, agreeing shared priorities - setting the foundations for our commitment to a long-term programme of work.

The GHGAP is making the first steps to promoting integration - of messaging, advice, demonstration *etc* - across the Steering Group and the wider supply chain. Although focussed on GHG mitigation, the GHGAP believes that in the longer-term its activities could provide the catalyst for change across the entire industry - in the way that it communicates and delivers shared messages. This would support the current thinking amongst the industry of the need for closer cooperation and integration of the range of industry-led partnerships that promote environmentally beneficial management practices alongside increasing food production *e.g.* Campaign for the Farmed Environment, Voluntary Initiative on Pesticides, Tried & Tested and the GHGAP. The industry is proposing an evolution of the current industry-led partnership model which would result in more effective and broadly based strategic cooperation across these partnerships at a national scale with streamlined governance and technical meetings and across England collaborative delivery of better coordinated, locally-led environmental messages at a catchment or county scale using both new and established measures and tools.

Producer confidence in the future is fundamental to the success of any initiative. The most recent BPEX Confidence Survey[72] suggests that pig producers are not looking at the future with any degree of confidence. It appears that producers are continuing to tread water waiting for evidence from supply chain partners of stability and direction which will give them the confidence to invest for the future and grow their businesses. Despite this lack of confidence, pig producers are increasingly engaging with BPEX's work.

In our first phase Delivery Plan we said that "the GHGAP is a developing entity, and the overall approach will be responsive to changes in policy, scientific developments, and farming circumstances. The detailed approach may need to be refined to keep pace with such changes". This position is still relevant today, especially with a number of potential policy developments in 2012:

- Defra's review of progress towards reducing greenhouse gas emissions from agriculture. This will include a commitment to mapping policies and incentives to potential greenhouse gas emissions
- Natural Environment White Paper commitment 18 to "use the review in 2012 of the Campaign for the Farmed Environment and the Greenhouse Gas Action Plan, as well as the evidence from elsewhere such as on pesticides or voluntary action under the Water Framework Directive, to assess more generally the effectiveness of this kind of voluntary industry-wide approach"

[72] BPEX confidence survey

We therefore propose key actions for the next phase of delivery to 2015 when the revised inventory is published, in the spirit that we offered the first Delivery Plan:
"The complexities and challenges should not delay progress in taking steps to increase the implementation of on-farm actions to reduce GHG emissions. It is acknowledged that there is uncertainty about GHG emissions, and that technical solutions to their reduction in food production systems will take time and investment to deliver in the longer term. Nevertheless, there are a suite of actions that can be implemented on-farm to deliver improved efficiency of production and a reduction of emissions per unit production."

This delivery plan sets out for each of the GHGAP's priority areas, the lessons that we have learnt from the first phase of delivery and the actions that we aim to deliver during phase II from 2012-2015. After the publication of the Government's review of mitigation in agriculture, we will work with Defra to agree the GHGAP's reporting requirements and associated timelines to 2015.

GHGAP co-ordination

Driving GHGAP delivery

In our first phase Delivery Plan, we said that "lessons learnt from our initial activity would be applied to enhance our approach" for the second phase and that with "this experience and momentum the level of ambition would be stepped up". What we have learnt over the past two years is that it has at times been challenging to ensure co-ordinated activity across all our actions in the face of other pressures.

We believe that in order to function effectively, to oversee the complex landscape of activity and to drive the delivery of the GHGAP during the next phase that we do need to services of a programme manager or co-ordinator. This may only be necessary for the short-term, depending on the outcome of the Defra review of voluntary initiatives[73].

- **Steering Group action 1: consider options for funding a GHGAP co-ordinator in the context of greater integration between industry-led initiatives, the role of Farm Efficiency Hub and plans for overall funding and management.**

Monitoring progress

Our experience over the past year and in particular in writing this report reinforces our belief that monitoring the impact of the GHGAP's activities and hence changes in on-farm practice remain a challenge for both the GHGAP and for Government. As you will have seen in the first half of this document that in reporting on progress against our priority areas for on-farm actions we have had to rely on, in the main, on snapshots of activity – our own (through a range of projects and initiatives) and/or on-farm (relying on the outputs of the Farm Practices Survey and others). We have highlighted elsewhere the need for analysis of a range of data to get a better picture of the quantity and quality of on-farm practice. Capturing fine-grained information has always been a longer-term aim.

Whilst it has been too early to assign shifts in farm practice to the GHGAP's activities, we have also included indicators of the industry's long-term progress in improving efficiency and reducing emissions to provide some context for our work. The UK is amongst the lowest risk

[73] Natural Environment White paper, Commitment 18 says "We will use the review in 2012 of the Campaign for the Farmed Environment and the Greenhouse Gas Action Plan, as well as the evidence from elsewhere such as on pesticides or voluntary action under the Water Framework Directive, to assess more generally the effectiveness of this kind of voluntary industry-wide approach"

countries of high GHG intensity (OECD): with a nitrogen efficiency in the 61% to 90% range, and a nitrogen balance 0-100kg per ha[74]. The trend from 1990 shows a clear improvement in agricultural productivity overall i.e. the apparent efficiency by which the industry converts key farm inputs, such as nitrogen in fertilisers and feed protein, into farm outputs. In the light of the increasing demand for domestic food security a decline in national farm production is not a sustainable means of reducing GHG emissions. Usually data needs to be evaluated over 5-8 years, to be able to show significant changes, therefore statistics presented for the short-term need to be viewed with caution.

The situation is improving. We very much welcome the latest Agricultural Statistics and Climate Change publication from Defra and the development of the revised inventory under the direction of the GHG Platform. Our initial analysis of other sources of information *e.g.* Farm Assurance standards, suggests that these could help monitor progress of some of our on-farm actions. However, even these developments will still leave a gap. Datasets like the Farm Practice survey are simple in order to encourage a response and even the revised Inventory will not explicitly track progress for all of the measures listed within the Action Plan.

We know that Defra's statistics team have begun work on an indicator framework for the 2012 review of GHG mitigation from agriculture and we welcome the opportunity to provide input to this work. However we would also like to begin detailed discussions with Defra's statistics team on how we might work together to identify the most suitable indicators of change of on-farm practice to meet the industry's needs as well as Government's.

- **Steering Group action 2: Maintain oversight of mitigation activity to identify gaps in action or progress, in collaboration with others *e.g.* Defra's Research platform Policy Group, as appropriate**
- **Steering Group action 3: Evaluate and agree key indicators of activity and progress for the GHGAP with the GHG Platform and Defra Statistics team in order to better report on progress**

The Farm Efficiency Hub (FEH)

Having already established that there is a requirement for such an electronic library to improve the consistency and overall quality of advisory materials and services, it will be tested by a balanced representation of farm advisers, i.e. the primary users. The intention is to use focus groups and to gather direct GHGAP partner feedback. The aims are to seek feedback on the FEH itself and views on how to develop and promote its value, in the context of continuing improvement in the consistency and integration of farm advice.

Once the FEH functionality has been refined, based on user feedback, and its operational requirements are defined, GHGAP Partners will call a high-level workshop, to exhibit the hub and present the case as a part of the broader ambition for industry-led initiatives, and to centrally store both public and private sector generated advisory resources. Senior Defra officials and industry leaders will be invited.

- **Steering Group action 4: Test Farm Efficiency Hub (FEH) with adviser focus groups and collate feedback**
- **Steering Group action 5: Convene high profile workshop with senior Defra officials to exhibit the FEH and present the case for wider ambition in support of co-ordinated (integrated) advice delivery and industry-led initiatives**

[74] Agricultural Statistics and Climate Change, 1st Edition, Defra, National Statistics, 2011

GHGAP communication

Spreading the word

In our first phase Delivery Plan we set out the principle of utilising existing industry and Government initiatives, trusted networks and real-life demonstration to supply advice and information to help farmers and growers. We still believe that this is the right approach. If resource becomes available we would like to examine other forms of communication *e.g.* social media, to target sections of our audience.

The collective experience of the Steering Group suggests the GHGAP would be better served by direct engagement with the supply chain in order to develop fruitful long-term relationships than by participation in Defra's Food Supply Chain Mitigation group alone. We will seek to build new and enhance existing relationships during the next phase.

- **Steering Group action 6: Continue to identify opportunities for collaboration in communications within the GHGAP, with other farming organisations and service providers and the supply chain, and investigate the opportunities for greater exposure in the trade press**
- **Steering Group action 7: Subject to Steering Group approval, test the usefulness of social media engagement as a form of communication**

On-farm actions

The collective expertise of the Steering Group proved invaluable in identifying the on-farm actions and we have benefited from using these as the foundation for consistent messaging. Our work over the past two years demonstrates how members of the GHGAP are already actively promoting improvements in farming practice across our priority areas on the basis of these actions.

Our challenge for the future is to ensure that the on-farm actions remain relevant and reflect new knowledge and policy.

- **Steering Group action 8: Review the on-farm actions during every phase of Delivery to take into account new knowledge and policy. Next review in 2013 in response to Defra's mitigation review and Defra project FFG1124[75].**

Management skills and advice

Professional development amongst advisers and farmers

Building on the lessons learnt in the development of long standing professional advisory schemes, such as FACTS and BASIS, the AIC Feed sector, on behalf of the GHGAP, is in a knowledgeable position to develop a proportionate and cost effective approach for its own advisers. Before the GHGAP, proposals for a feed register/directory could not be justified. However, post GHGAP, expectations of the industry changed with the high profile of the livestock industry in connection with GHG emissions.

[75] The "Wider implications of GHG mitigation measures in English agriculture" project aims to highlight any possible impacts of the GHGAP on other environmental and welfare objectives whilst also identifying synergies.

In the year ahead proposals will be developed for wider consultation, with view to setting a training standard for those influencing feed management on-farm, and for proposals for training and database management etc. has led the response of commercial advisers to the challenge of reducing GHG emissions from agriculture. We have used the benefits seen by FACTS qualified advisers to encourage the feed industry to take its first steps to a British industry standard of professional development to help fill that gap identified in our first phase Delivery Plan "there is comparatively less penetration of advice on animal health and nutrition in the livestock sector". We will work to ensure synergies between the feed sector training, on-going FACTS CPD training and the Tried &Tested campaign.

- **Steering Group action 9: FACTS Qualified Advisers to continue to undertake new training**
- **Steering Group action 10: Draft plans for a register of feed advisers, consulting with BSAS (British Society of Animal Science), AHDB livestock sectors and others on administration and a standard of training for eligibility to remain on such a register. Agreed plans to be resourced and implemented (AIC to lead)**
- **Steering Group action 11: Use the Tried & Tested campaign (guidance and tools) to help raise the skills and understanding of farmers in the benefits of integrating animal feeding planning and crop nutrient planning on livestock farms (GHGAP partners on Professional Nutrient Management Group to lead)**
- **Steering Group action 12: Continue to promote the benefits of improving skills and training e.g. Continuing Professional Development schemes by AHDB livestock sectors**

"Carbon footprinting"

Whilst we believe that "carbon footprinting" can be a useful tool in stimulating discussion and highlighting hotspots of emissions, such approaches have caused some concern amongst farmers and growers *e.g.* lack of understanding about what the information is collected for, that any value and efficiencies gained will be captured further down the supply chain. In addition we have sensed that the overall message of improving productivity and efficiency has been misunderstood in some quarters because of the importance of yield in the footprint calculation, raising the possibility of a perverse outcome if undue emphasis is placed on productivity *(i.e.* only increasing output) rather than efficiency (increasing output relative to inputs). Furthermore, as the DairyCo carbon footprinting study suggests, that there is likely to be more variation between farms, than between production systems. The GHGAP is working towards improving the efficiency of resource use, be it nutrients, livestock, energy *etc* – across all farming systems, with each farm aiming to be as efficient as it can be.

We will continue to support the use of "carbon footprinting" as a useful tool to stimulate discussion about improvements in efficiency and to highlight hotspots of emissions, but importantly in the context of business and other environmental priorities. We will continue to report on footprinting studies as potential indicators of improvements in efficiency.

In addition to farmers' concerns about the footprinting process, there is considerable confusion about the range of tools, the consistency between tools and questions about their relevance to this business *i.e.* the focus to date has been on products whereas farmers are also interested in the footprint of their entire business and how the footprint is partitioned across their business. There are also concerns surrounding the exclusion of carbon

sequestration from the UK's carbon footprinting standards (PAS2050[76]). Although the evidence in this area is currently uncertain, some producers feel that the exclusion of this aspect places them at disadvantage. These are issues that GHGAP partners will seek to address.

- **Steering Group action 13: Continue to support "carbon footprinting" through various initiatives *e.g.* the development of a tool for the cereals and oilseeds sector (HGCA to lead), and consider options to meet the range of farmers' needs of "carbon footprinting"**

Crop nutrient management

The GHGAP has sought to add value by working towards more effective delivery without duplication. We have therefore supplied much of our nutrient management messaging, in particular for the livestock sectors, through Tried & Tested (T&T), as we indicated we would do in our first phase Delivery Plan. During T&T's lifetime, we have learnt that its simple-to-use paper-based nutrient management plan has provided an excellent introduction to those new to full/formal nutrient management planning, generally those in the livestock sector. This has been supplemented by the promotion of professional services to farmers which they can have confidence in, specifically, qualified agronomists: crop nutritionists (FACTS Qualified Advisers), crop protection specialists (BASIS Qualified), and laboratories analysing soils, participating in an annual Proficiency Testing Scheme.

During the next phase of T&T, we want to build on the interest in the crop nutrition campaign. Our aim is to create a new Tried & Tested tool, an animal nutrition plan for diary, beef and sheep farmers to aid the process of integrated nutrient management (see Livestock Nutrition section for more information). We also want to extend T&T's reach beyond its typical grassland farmer audience by linking with HGCA's nutrient and soil management activities.

In our first phase Delivery Plan, we stated that the GHGAP's success would depend on developing messages that increase awareness about how improving the efficiency of resource use, be it nutrients, livestock, energy *etc* - regardless of the farming system - makes good business sense. Whilst this remains a key message, we also want farmers to begin to make the link between efficiency and GHG mitigation, so that they do not see mitigation as "something else they have to do".

Defra's Agricultural and Climate Change Statistics publication (2011) reported that information on measures like the calibration of manure and slurry spreaders and the use of band spreaders to apply slurries were deemed too complex for a short question on the Farm Practice Survey of 2011. The GHGAP in conjunction with Tried & Tested will consider how to fill this gap and deliberate the most effective routes for further promotion of the accuracy of nutrient application.

We will also promote the relationship between Nitrogen Use Efficiency (NUE) and the correct soil pH and adequate supplies of phosphate, potassium, sulphur. NUE will be limited by any nutrient in short supply and also by poor soil condition.

[76] *PAS 2050* – Specification for the Assessment of the life cycle greenhouse gas emissions of goods and services.

- **Steering Group action 14: Continue to promote the Tried & Tested nutrient management plan, website and tools and the benefits of professional advice and soil analysis with a continuing focus on the livestock sector**
- **Steering group action 15: Sub group of GHGAP Steering Group and Tried & Tested Partners to meet and plan how best to promote the benefits of accurate nutrient application and the services available considering different sector needs**
- **Steering Group action 16: Promote strong linkages between nutrient and soil management activities e.g. between Tried & Tested and HGCA nutrient and soil management events**

Soil and land management

We know that good soil management underpins a productive farming system and therefore is an important factor in mitigation and in delivering other environmental benefits. We have learnt that farmers are increasingly interested in soil management and we will seek to build on this in the next phase through collective action. The new Soil and Water Management Centre at Harper Adams University College may present the GHGAP with new opportunities for collaboration and demonstration.

The Greenhouse Gas Platform will use computer modelling and literature review to improve our understanding of the effects of soil type and climate on nitrous oxide emissions. In future, the impact of reduced/zero tillage on N_2O emissions may also be investigated through reviewing the literature on this area, although this has not yet been confirmed. We know through our involvement in the MIN-NO[77] project there is a gap in research on the effects of soil condition and cultivation effects on nitrous oxide emissions and we will continue to discuss this issue with Defra. In the interim we will have to rely on other indicators of progress such as data on soil sampling. We believe that such information needs to be robust and will investigate how we might improve assessments in the future.

Soil carbon storage is an area that needs further research but in the interim we will seek to capitalise on farmers' interest in this area. We welcome the improvement in the LULUCF inventory and the merging of the agricultural and LULUCF inventories in 2015.

- **Steering Group action 17: Look for opportunities to promote the benefits of soil management and soil organic matter e.g. AHDB-HGCA, CSF project - running 70 farm events**
- **Steering Group action 18: Conduct further evaluation of Defra surveys in conjunction with the Defra Statistics teams to help identify the most reliable means of indicating progress in soil sampling**
- **Steering Group action 19: Evaluate contribution of Campaign for the Farmed Environment measures to GHG mitigation. This will be dependent on the future of the Campaign beyond the end of 2012.**

[77] 21 partners involved in £2million Defra LINK project (to research minimising nitrous oxide intensities of arable crop products)

Livestock nutrition

We know that the grassland sector is not as well served by advice as the arable sector. The GHGAP's focus over the next three years will be to try and fill the identified gap in ruminant feeding with a new freely available guide and tool. This will be based on the successful Tried & Tested nutrient management planning model and working with the wider industry to promote the outputs.

- **Steering Group action 20: Create a new guide and tool – a Tried & Tested Ruminant Feeding Plan with balance sheets. The Plan will show the link between feeding practices and animal health, and also the integration between grass and forage nutrition and feed management**
- **Steering Group Action 21: Promote the new plan through the Tried & Tested nutrient management network, specifically through EBLEX and DairyCo and AIC Feed sector, British Grassland Society, livestock consultants (but not exclusively) and through the supply chain for milk and beef products.**

Livestock health

Working collaboratively with GHGAP partners and with animal health professionals has yielded benefits and we will continue this approach throughout phase II. For example, after the feedback from its "Controlling worms sustainably" project, EBLEX and DairyCo hope to continue their farmer facing events, and consider more vets training days.

- **Steering Group action 22: Build on the early success of established programmes e.g. DairyCo's Mastitis Control Programme, and take opportunities to collaborate with animal health professionals**
- **Steering Group action 23: Work with the Cattle and Sheep Health and Welfare groups to tackle critical health issues relevant to the beef, dairy and sheep sector (EBLEX and DairyCo to lead)**

Energy efficiency and renewables generation

Since the introduction of the FITs we have seen farmers seize upon the opportunity presented, to diversify their business and to secure a long-term energy supply. Both renewables and energy efficiency have also proved a useful route through which to engage farmers about the subject of climate change mitigation. We will continue to provide farmers with advice and information in these areas.

- **Steering group action 24: Continue to provide information on energy efficiency and technology through existing *e.g.* GrowSave, and the new initiatives *e.g.* Pig Improvement by Information Technology (PIVIT) project[78]**

[78] helps producers gain advantage from the use of remote monitoring technology at production sites

- **Steering Group 25: Continue to support and make the case for the installation of renewables and AD in particular because of its mitigation potential and other environmental benefits, including contributing to the Voluntary code of practice/Best practice guidelines for AD crop feedstocks**

By 2015 we aim to have achieved the following:

Priority area	Proposed action	Target date
Strategic co-ordination (and reporting)		
Steering Group action 1	Consider options for funding a GHGAP co-ordinator in the context of greater integration between industry-led initiatives, the role of Farm Efficiency Hub (FEH) and plans for overall funding and management	By end 2012
Steering Group action 2	Maintain oversight of mitigation activity to identify gaps in action or progress in collaboration with others *e.g.* Defra's Research Platform Policy Group, as appropriate	Throughout phase II
Steering Group action 3	Evaluate and agree key indicators of activity and progress for the GHGAP with GHG Platform and Defra Statistics team in order to better report on progress	Throughout phase II
Steering Group action 4	Test Farm Efficiency Hub (FEH) with adviser focus groups and collate feedback	By end 2012
Steering Group action 5	Convene high profile workshop with senior Defra officials to exhibit the FEH and present the case for wider ambition in support of co-ordinated (integrated) advice delivery and industry-led initiatives	By April 2013
Communication		
Steering Group action 6	Continue to identify opportunities for collaboration in communications within the GHGAP, with other farming organisations and service providers and the supply chain, and investigate the opportunities for greater exposure in the trade press	On-going
Steering Group action 7	Subject to Steering Group approval, initially assess the usefulness of social media as a form of communication	From 2013 to 2015
Steering Group action 8	Review the on-farm actions to take into account new knowledge and policy	In 2013

Management skills and advice		
Steering Group action 9	FACTS Qualified Advisers continue to undertake new training	By end 2014
Steering Group action 10	AIC to draft plans for a register of feed advisers consulting with members, with BSAS, AHDB livestock sectors and others on administration and a standard of training for eligibility to remain on such a register. Agreed plans to be resourced and implemented.	By Sept 2012 By mid 2013
Steering Group action 11	Use Tried & Tested campaign (guidance and tools) to help raise the skills and understanding of farmers in the benefits of integrating animal feeding planning and crop nutrient planning on livestock farms	By end of 2013 then on-going
Steering Group action 12	Continue to promote the benefits of improving skills and training *e.g.* Continuing Professional Development schemes by AHDB livestock sectors	On-going
Steering Group action 13	Continue to support "carbon footprinting" through • initiatives such as the development of a tool for the cereals and oilseeds sector (HGCA to lead) • considering options to meet the range of farmers' needs of "carbon footprinting"	Throughout Phase II By end 2013
Crop nutrient management		
Steering Group action 14	Continue to promote the Tried & Tested nutrient management plan, website and tools and the benefits of professional advice, and soil analysis, with a continuing focus on the needs of the livestock sector	On-going
Steering Group action 15	Sub-group of GHGAP and Tried & Tested partners to plan how best to promote the benefits of accurate nutrient application and the services available considering different sector needs	By mid 2013, then through to 2015
Steering Group action 16	Promote strong linkages between nutrient and soil management activities *e.g.* between Tried & Tested and HGCA nutrient and soil management events	Throughout Phase II
Soil and land management		
Steering Group action 17	Look for opportunities to promote the benefits of soil management and soil organic matter *e.g.* AHDB-HGCA, CSF project - running 70 farm events	Throughout Phase II
Steering Group action 18	Conduct further evaluation of Defra surveys in conjunction with the Defra Statistics teams to help identify the most reliable means of indicating progress in soil sampling	By end 2014
Steering Group action 19	Evaluate contribution of CFE measures (including farm stewardship) to GHG mitigation	By April 2014

Livestock nutrition		
Steering Group action 20	Create a new guide and tool – a Tried & Tested Ruminant Feeding Plan with balance sheets and showing the link between feeding practices and animal health and also the integration between grass & forage nutrition and feed management	By end 2012
Steering Group action 21	Promote the new plan through the Tried & Tested nutrient management network, and through the supply chain for milk and beef products	Through to 2015
Livestock health and fertility		
Steering Group action 22	Build on the early success of established programmes *e.g.* DairyCo's Mastitis Control Programme, and take opportunities to collaborate with animal health professionals	Throughout Phase II
Steering Group action 23	Work with the Cattle and Sheep Health and Welfare groups to tackle critical health issues relevant to the beef, dairy and sheep sector.	On-going
Energy efficiency and renewables		
Steering Group action 24	Continue to provide information on energy efficiency and technology through existing e.g. GrowSave, and the new initiatives *e.g*. Pig Improvement by Information Technology (PIVIT) project	On-going
Steering Group action 25	Continue to support and make the case for renewables and AD in particular because of its mitigation potential and other environmental benefits including contributing to the Voluntary code of practice/Best practice guidelines for AD crop feedstocks	On-going

After the publication of the Government's review of mitigation in agriculture, we will work with Defra to agree the GHGAP's reporting requirements and associated timelines to 2015.

Annex 1: On-Farm Actions to Reduce Emissions

In order to encourage the continued reduction of GHG emissions from agriculture, it is important to achieve clarity about the on-farm practices that can increase production efficiency and realise GHG emissions reductions per unit production. Experts in the industry partnership organisations have identified a suite of actions to achieve such efficiencies, which are largely based on high-lighting key existing best practice guidance.

Actions for all farm types

1. **Skills, training and advice** - seek appropriate training in land management and the application of crop inputs. If professional advice is sought, use only professionally qualified individuals

2. **Soil management** - follow good practice: avoid and rectify soil structural problems (*e.g.* by reducing wheelings and poaching, by sub-soiling, mole draining, adding organic matter). Use soil cultivations appropriate for the soil type and cropping situation without restricting crop growth and nutrient uptake. Monitor and amend soil nutrient status and pH following regular soil sampling and analysis

3. **Land management risk assessment** - grow crops and locate high output grazing livestock systems on land with characteristics capable of supporting sustainable production (e.g. based on soil type and depth, droughtiness, slope). Review enterprises and cropping that may not be suited to the land (e.g. intensity of dairy stocking; fields for growing milling wheat, potatoes, and vegetables)

4. **Optimise crop and livestock performance** - select varieties and breeds suited to local conditions and market requirements, using the natural environment to best effect, taking a whole farm approach (integrated farm management)

- **Consider selection of crop and animal breeds** which favour production efficiency and GHG mitigation

5. **Crop nutrition (underpinned by crop health)**
- Plan fertiliser and manure applications to each crop to optimise the supply of all nutrients from all sources. Use standard recommendations, and prepare a nutrient and manure application plan for each crop in each year, allowing for nutrient balances within the rotation:

- Make the most of the nutrient resources already available - account for the nutrients supplied from soils and manures.

- Optimise the quantity of nitrogen that is applied as fertiliser and manure N - ensure that all other crop inputs (including other nutrients, lime and crop protection products etc.) are optimised so that unrestricted crop growth is achieved with a high efficiency of nitrogen utilisation. This will reduce the risk of using unnecessarily high nitrogen application rates.

- Apply nitrogen from manufactured fertilisers and organic manures at times that match the crop uptake of nitrogen - avoid applying nitrogen when the soil is waterlogged, frozen or when the crop/grass is not growing. (Precise timings and recommended rates will be crop specific)

- Apply nitrogen and other nutrients at the optimum rate and evenly to the target area. Check and calibrate each fertiliser spreader/sprayer annually before fertiliser is applied and use headland devices. (Consider benefits of GPS technologies, if appropriate). Estimate the weight/volume and rate of application of each type of manure applied to each field

6. **Maximise marketable produce** – harvest/slaughter at optimum times. Handle livestock and crops to minimise losses and damage during transit, storage and processing

7. **Consider opportunities for energy efficiency and renewable energy generation** - in the efficient use and potential for on-site supply of electricity, heat and vehicle and heating fuels

8. **Adopt land management practices/stewardship options** which maximise environmental value, resource protection and carbon storage, e.g. buffer strips on compacted wet headlands offer potential GHG mitigation and carbon sinks

Livestock-specific actions

9. **Skills, training and advice** - consider additional benefit of using a ration formulation programme or nutritional advice from an expert when planning the feeding regime for your livestock

10. **Manure treatment, storage and spreading** - implement manure management practices that will reduce atmospheric emissions and water pollution during manure collection, storage and spreading. Use facilities and techniques which result in the best possible use of nutrients by a growing crop, including adequate slurry and dirty water storage capacity, slurry separation, anaerobic digestion, covered storage, low emission slurry spreading techniques and nutrient management planning

11. **Housing** - provide suitable housing and shelter for livestock appropriate to their needs and those of workers, including welfare, freedom from stress, minimising aerial and atmospheric pollutants, minimising disease pressures, providing optimum access to feed, water, light, shelter and warmth (where appropriate). Utilise materials which will withstand hard use but also do not harbour disease organisms and pathogens

12. **Livestock nutrition** - plan diets and feeding regimes to achieve desired productivity, efficiently making use of resources available including home grown crops and food industry origin co-products, carefully matching nutrient content and availability to animal requirements. Consider using feed technology and additives to improve feed use efficiency

13. **Livestock health** - maintain optimum health status of all livestock through proactive health planning and close monitoring of performance e.g. through weighing of stock to identify need for interventions. Consider the benefit of expert veterinary advice in health planning linked with the appropriate diet, feeding regime and housing for the breed

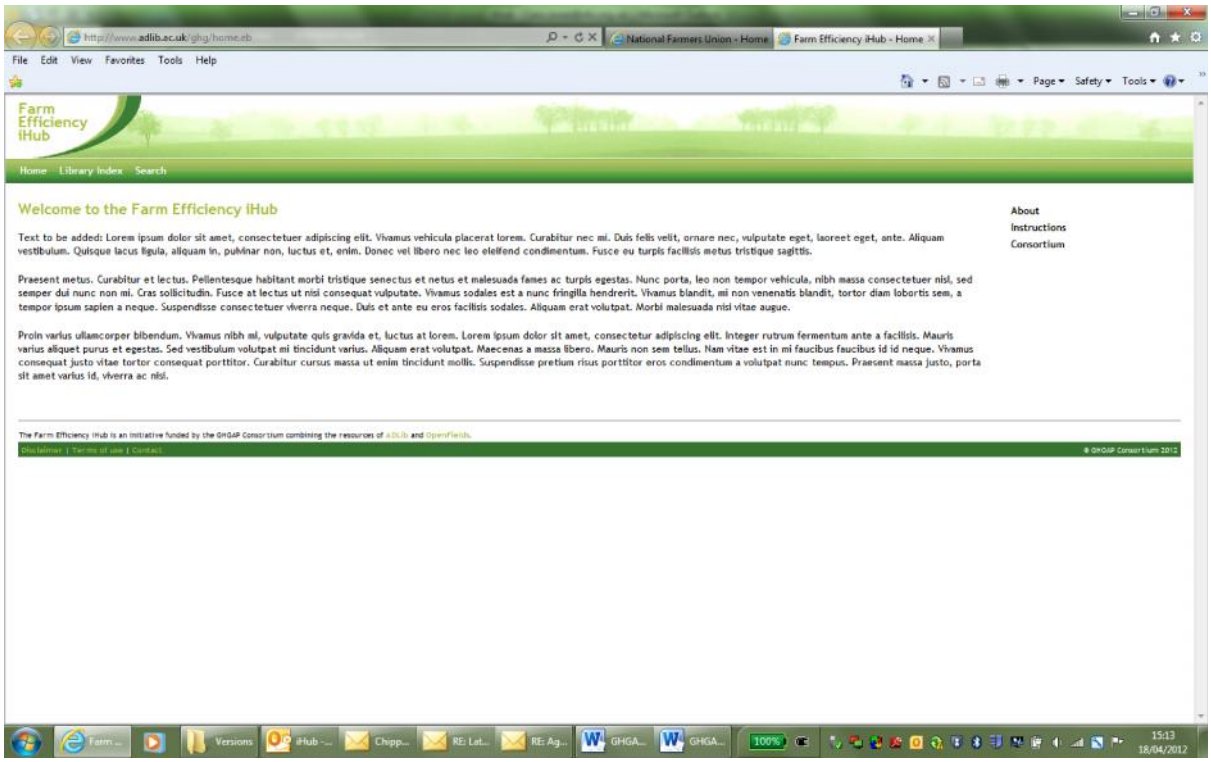
-consider vaccinations and anti-parasitics where appropriate
(participation in health schemes may raise the value of breeding stock)
-prioritise health and welfare issues, and implement testing for diseases if advised
-implement biosecurity measures

14. **Genetics and breeding policy** - select for traits which will benefit the farming system. Target efficient production and satisfy market needs with respect to products and product quality:

- Use bulls with a high PLI or Profitable Lifetime Index when breeding dairy cows
- Use bulls/rams with a high EBV or Estimated Breeding Value when breeding beef cattle/lamb

15. **Plan grassland management (and forage management)** to meet production objectives - use clover mixes to reduce the need for nitrogen application, high sugar grasses where appropriate, and utilise forage production efficiently

Annex 2: From the pilot Farm Efficiency Hub



Annex 3: GHGAP work-plan for 2011-2012: activities to promote the priority areas

Management skills and advice

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AEA			Tractor selection/optimal usage advice									
AHDB - BPEX	H&S training	H&S SHAD Pig Day										
AHDB - BPEX	Cedar Associates Mgt Training											
AHDB - BPEX	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT
AHDB - DairyCo	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan	Mastitis Control Plan
AHDB - DairyCo					Planning for Profit Workshops	Planning for Profit Workshops	Planning for Profit Workshops	Planning for Profit Workshops	Planning for Profit Workshops	Planning for Profit Workshops	Planning for Profit Workshops	Planning for Profit Workshops
AHDB - DairyCo	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+	Milkbench+
AHDB - DairyCo	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups	Business Discussion Groups
AHDB - DairyCo	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum	Fortnightly Datum
AHDB - DairyCo											Integrated Advice Pilot completion	
AHDB - EBLEX	Farmax feed planning project	Uplands conference	Progressive beef and sheep groups visit IBERS	Market lamb selection roadshow	Finishing options for dairy calves at Dairy Event	Business costings & C footprinting	Feed planning	Feed planning	Nutrient Management Focus	Nutrient Management Focus	Planning for this year's grazing	Feed planning
AHDB - EBLEX					Bedding materials options	College lecturers day	Sheep Breeders Round Table					
AHDB - HGCA	Grassland & Muck	Cereals (15th-16th)	Cereals in Practice	Autumn cultivations	Tillage	Sulphur application press article	AgriScot	Agronomists Conference	Phosphate	Auto-N press article	Legume benefits info sheet	
AHDB - HGCA	Promote NIRS	Open Days (ADAS, TAG, Broom's Barn)	Open days (SAC, PGRO)		Soil sampling	Soil management workshop with RRA	Tramline management			Agronomy Workshops		
AHDB - HGCA		Resource Use Efficiency press article	National Organic Cereals									
AHDB - Potato Council		Crop impact/ sustainability (report)	Crop impact/ sustainability (report)				British Potato 2011 - general mgt advice					
AIC						FACTS			FACTS			
LEAF			LEAF Marque Training						LEAF Audit 2012 available			
NIAB-TAG	Farming systems events	Farming systems events										
Tried and Tested (T&T) - AIC, CLA, FWAG, LEAF, NFU				Think Manures and New to Nutrient Management Guide	Think Manures and New to Nutrient Management Guide			NVZ regs				
ORC		Legume LINK farm event	National Organic Cereals; LegLINK demonstration			LegLINK article in ORC Bulletin			Producer conf: crop mgt sessions	LegLINK workshop		

The colour scheme reflects the various modes of communication *e.g.* blue = workshops and open-days, yellow = campaigns

Crop nutrient management including slurry and FYM management, use of legumes, and crop health

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AHDB - BPEX	Grassland and Muck show											
AHDB - BPEX	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow	2 tonne sow
AHDB - DairyCo	Dairy Wizard (slurry storage)		Nutrient Wise demos with BGS		BGS Conference							
AHDB - DairyCo	Reseeding Event at Duchy College											
AHDB - DairyCo	Grassland & Muck											
AHDB - DairyCo	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS
AHDB - EBLEX	Manure analysis NIRS							Nutrient mgt workshops	Nutrient mgt workshops	Nutrient mgt workshops		
AHDB - HGCA	Grassland & Muck	Cereals (15th-16th)	Cereals in Practice	Autumn cultivations	Tillage	Sulphur application press article	AgriScot	Agronomists Conference	Phosphate	Auto-N press article	Legume benefits info sheet	
AHDB - HGCA	Promote NIRS	Open Days (ADAS, NIABTAG, Broom's Barn)	Open days (SAC, PGRO)		Soil sampling	Soil management workshop with RRA	Tramline management			Agronomy Workshops		
AHDB - HGCA		Resource Use Efficiency press article	National Organic Cereals									
AHDB - Potato Council	NIRS for manure management	Phopshorus mitigation (WMPD)		Foliar nutrition (PiP)								
FWAG												Good nutrient mgt
FWAG	CSF	CSF	CSF	CSF	CSF	CSF	CSF	CSF	CSF	CSF	CSF	CSF
LEAF									LEAF Audit 2012 available			
Tried and Tested (T&T) - AIC, CLA, FWAG, LEAF, NFU	Farm Way grassland event	Cereals		Think Manures and New to Nutrient Management Guide	Think Manures and New to Nutrient Management Guide		Supporters conference	NVZ regs	LAMMA		Muck NW	
Tried and Tested (T&T)	Grassland and Muck				Dairy Event		Supporters conference					
Tried and Tested (T&T)	Green Week, Brussels											
ORC		Legume LINK farm event	National Organic Cereals; LegLINK demonstration			LegLINK article in ORC Bulletin			Producer conf: crop management sessions	LegLINK workshop		

Soil and land management

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AHDB - BPEX		Soil Mgt Plan training										
AHDB - BPEX	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT
AHDB - DairyCo	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events	Extension officer events
AHDB - DairyCo	Grassland mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS	Grassland Mentoring with BGS
AHDB - EBLEX		Home grown forage manual and rotations										
AHDB - HGCA		Cereals		Autumn cultivations	Tillage	Soil management workshop with RRA	AgriScot	Agronomists Conference	Tramline management	Agronomy Workshops		
AHDB - HGCA		ADAS Open Days			Soil sampling							
AHDB - Potato Council		Soil Cultivations	Irrigation & Soil structure (EMPD)				Soil Management Guide					
LEAF		Simply Sustainable Soils Guide	Simply Sustainable Soils Guide		Soils Guide (Dairy Event)	Soils topics	Soils topics		LEAF Audit 2012 available			
NIAB-TAG	Farming systems events	Farming systems events										
ORC	Ecosystem services event	Organic Agroforestry Event	Organic Agroforestry Event						ORC Annual Conference			

Livestock nutrition

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AHDB - BPEX	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT
AHDB - DairyCo	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter	Forage for Knowledge +newsletter
AHDB - DairyCo					BGS Conference		Pasture to Profit Conference					
AHDB - DairyCo					Re-print Feeding+							
AHDB - EBLEX	Options for cereal harvest and preservation	Launch of Home Grown Forage Directory		Grazing mtgs	Grazing mtgs	Feed planning	Feed planning	Feed planning	Assessing sward height for turn-out			
AHDB - EBLEX	Cattle trace element supplementation	Relaunch of brassica manual	Release blend calculator online		Promote silage analysis							
AHDB - EBLEX			Chicory meeting									
AIC	NMPlanning for animal feed											
LEAF									LEAF Audit 2012 available			
ORC									ORC Conf: Low Carbon Livestock Systems Session			

Livestock health

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AHDB - BPEX						2TS Focus on Health 3 day conference						
AHDB - BPEX	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT
AHDB - DairyCo	Lameness Review and Involuntary Culling Review	Large herd and Fertility Conference			Healthy Feet Programme							
AHDB - EBLEX	Ram MOT	Parasite control at grazing	Parasite control at grazing	Parasite control at grazing	COW MOT, Psoropic mange advice	Parasite control at housing		Pneumonia		Calf health issues	Bull MOT	
AHDB - EBLEX		Temple Grandin handling event				Regional cattle BVD event						
AHDB - EBLEX		Sheep lameness events										
LEAF									LEAF Audit 2012 available			
ORC									ORC Conf: Low Carbon Livestock Systems Session			

Energy efficiency and renewables generation

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AEA			Tractor selection/optimal usage advice									
AHDB - BPEX	Pig and Poultry fair											
AHDB - BPEX	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT
AHDB - DairyCo	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications	energy efficiency calculators and publications
AHDB - HDC	GrowSave: Energy Saving Technol Conference	Factsheet - energy saving for field veg	Training notes from Energy conference on web			Getting the best from env control systems for ornamental growers					GrowSave nursery meetings	GrowSave training workshops
AHDB - HDC	Spring mtgs info on www.growsave.co.uk											Nursery meeting info on web
AHDB - HDC	Energy News spring edition						Energy News autumn edition		Energy News winter edition			Energy News spring edition
AHDB - HDC				Factsheet - Reducing use of tractor mounted pesticide sprays in raspberry								
AHDB - HDC				Factsheet - Reducing use of tractor mounted pesticide sprays in apple								
AHDB - HGCA		Agrovista Biofuels event		Biocomposites								
AHDB - HGCA		Biofuel varieties										
AHDB - Potato Council		Store energy management								Store Energy Forum		
FWAG		Working with major retailer										
FWAG	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service	Renewable energy service
LEAF									LEAF Audit 2012 available			
NFU										Farm Energy Service launch		
ORC									ORC Annual Conference			

Improved genetic potential

	may	jun	jul	aug	sept	oct	nov	dec	jan	feb	mar	apr
AHDB - BPEX	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT	2 tonne sow KT
AHDB - DairyCo	Breeding briefings			Genetic Evaluations, bull proofs				Genetic Evaluations, bull proofs				
AHDB - EBLEX	Progessive flock and herd awards	On-farm breeding events	On-farm breeding events	On-farm breeding events	On-farm breeding events	Promotion of buying recorded stock			Promotion of buying recorded stock	Promotion of buying recorded stock		
AHDB - EBLEX	Recorded flock directory			Pedigree Guide: Marketing Pedigree Stock.	Inbreeding factsheet							
AHDB - EBLEX					Measuring cow mature size factsheet							
AHDB - HDC	Strawberry variety trial open day		Raspberry breeding			Brassica variety trials factsheets	Onion variety trials factsheets					
AHDB - HDC			Fruit for the Future event									
AHDB - HDC			EMSBC exhibit at Fruit Focus									
AHDB - Potato Council			Potato Genome report						New variety performance info			
ORC				Wheat breeding article in Organic Farming Magazine								

Annex 4: Networking

Meetings

	April '11	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan '12	Feb	Mar	April
GHGAP Steering Group	√					√			√			√	
GHG ihub Working Group		√	√		√	√	√				√		
Defra's Supply Chain GHG Mitigation Group			√				√						
Defra, industry updates		√		√		√		√		√	√	√	
Defra's Policy Research Platform													
Dairy Roadmap Steering Group							√						
BPEX Roadmap Steering													
EBLEX Roadmap Steering													
AHDB climate change Group													
AIC Fertiliser Agriculture & Environment Committee							√						
AIC Feed Carbon Group			√				√	√	√	√			
GHGAP briefings with farm supply trade companies		√	√	√	√	√	√	√	√	√	√	√	√
LEAF Advisory Board		√						√				√	
Professional Nutrient Management Steering Group			√			√			√				
Creation of general guide to Nutrition Planning (ruminants)						√				√			
FACTS Management Committee						√					√		
Assured Food Standards meeting				√									
Natural England							√						
Environment Agency							√		√				
Defra's Integrated Advice Project meetings							√		√				
Defra project review of nutrition guidelines for ruminants						√							
Industry conference presentations								√ 2			√		

Annex 5: Examples of co-branding

HGCA stand at Cereals 2011 (GHGAP logo in bottom left hand corner)

Extract from “Down to Earth. The beef and sheep roadmap – phase 3”. 2011

Soil carbon sequestration

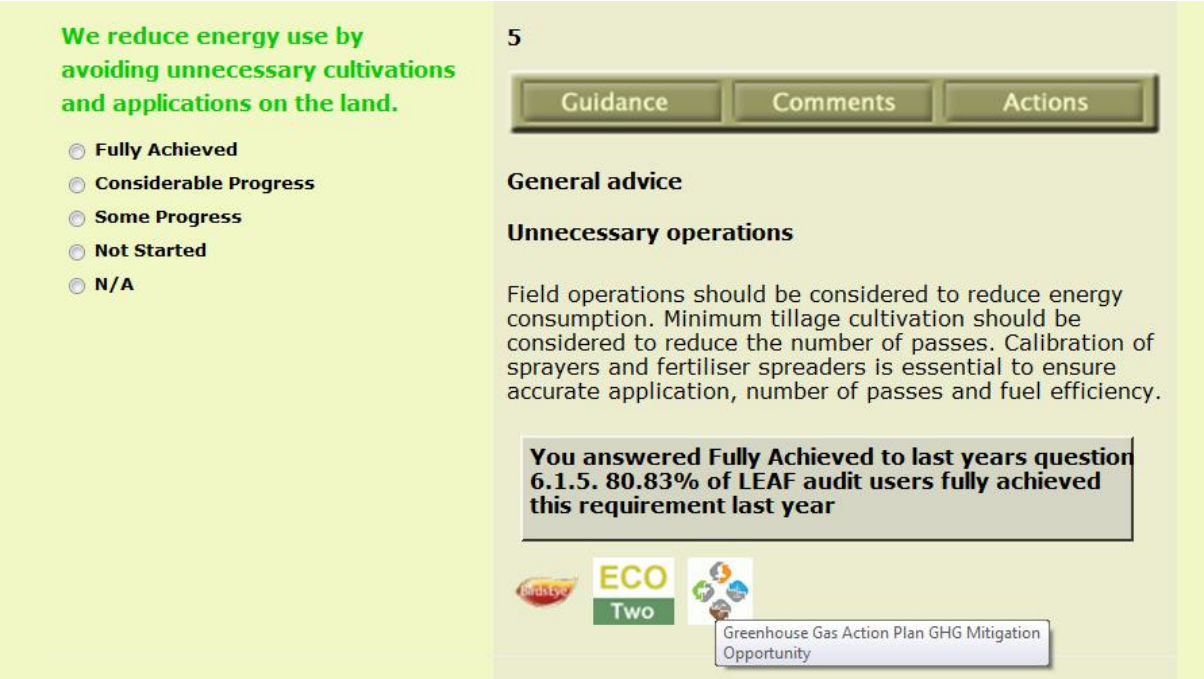
greenhouse gas action plan

“Agriculture and other land management practices have a positive role to play in climate change mitigation because there is significant potential to remove CO_2 from the atmosphere by the process of photosynthesis and storage as living biomass (vegetation) or as soil organic matter (carbon sequestration).”

In the ongoing debate about livestock production and its contribution to GHG emissions, storage of carbon in pastures and other grassland areas effectively managed by grazing beef cattle or sheep has often been cited as a mitigating factor. It is well documented that ruminants expel GHGs but there is less concrete analysis of the benefits they bring in managing areas of grassland that act as a carbon sink, actively taking carbon dioxide out of the atmosphere and storing it so it does not contribute to GHG levels. This could be a significant mitigating factor for livestock farming.

Commercial carbon footprinting services are now available to calculate individual farm carbon footprints on a unit of product basis. In most cases, these commercial services follow the Carbon Trust and BSI PAS 2050 Carbon Footprinting standard, introduced in 2008, which the E-CO_2 model used by EBLEX adheres to. However, it is important to recognise that the carbon footprinting methodology described within PAS2050 does not currently take account of soil carbon sequestration due to a lack of comparable evidence in this area. Currently, more extensive production systems, often based on unimproved permanent pasture, have high carbon footprints, yet the farmland often has high stocks of soil carbon. While, the carbon in this system may be in equilibrium and therefore the soil may not continue to sequester carbon, grazing the land does avoid shrub invasion and reduces the risk of wildfires which result in massive carbon dioxide release into the atmosphere.

LEAF audit 2012 extract



Annex 6: From the Tried & Tested workplan

EXTRACT FROM MEMORANDUM OF AGREEMENT between Natural England, members of the Professional Nutrient Management Group (AIC, CLA, FWAG, LEAF, NFU): April 2011-March 2013

Project Objectives

- To enable farmers and farm advisers to produce better nutrient management plans for their/their clients farms by providing technical information and tools on nutrient management planning, available in paper and web-based form;
- To reduce diffuse pollution from agriculture related to use of organic manures and fertilizers on farms and work towards the aims of the Water Framework Directive;
- To help farmers comply with the regulations on Nitrogen Vulnerable Zones introduced in the 2008 Nitrate Action Plan;
- To enable farmers to optimize fertilizer use, with related cost savings and environmental benefits, by more efficient use of organic manures and fertilizers
- To extend the availability of nutrient management advice to farmers in England, within and outside the Catchment Sensitive Farming priority catchments in the
- To promote the training of FACTS advisers, farmers and technical leads in nutrient management planning practices.

Project Outputs

- 5,000 additional copies of 'Tried & Tested' nutrient management plan booklets printed and 13,500 copies (including current stock) distributed to farmers and farm advisers; plus 350 pads of Tried & Tested Field record sheets
- 15,000 copies of 'Think Manures' slurry and manure companion printed and distributed to 15,000 farmers and farm advisers
- 10,000 copies of 'New to Nutrient Management Guide' printed and distributed to 10,000 farmers and farm advisers
- Develop 'Tried & Tested' Feed Plan including whole farm nutrient budgeting
- 10,000 copies of 'Tried & Tested' Feed Plan printed and distributed to farm advisers, feed merchants and farmers
- The web-site www.nutrientmanagement.org.uk will be maintained and developed further as a hub for nutrient management advice and best practice. The website will provide access to existing and new nutrient management publications produced under the project including 'Tried & Tested' nutrient management plan and electronic farm/field record sheets; case studies; Think Manures; Feed Plan and New to Nutrient Management (interactive web based tool and paper copy). Other decision tools and advice and information on nutrient management planning will also be added/linked to the website;
- 2000 Tried & Tested branded memory sticks uploaded with 'Tried & Tested' plan, NVZ booklets, The Fertiliser Manual and Think Soils and new related advice materials and distributed to farmers and advisers
- 3000 copies of FACTS brochure and promotion of use of FACTS Qualified Advisers;
- Evidence of soil nutrient status and farmers practices in nutrient management planning collated and reported;
- Provision of advice tools for use by Catchment Sensitive Farming Officers and their contractors;
- Develop 3 new case studies and update 10 case studies on nutrient management in different farming sectors on website

TIMETABLE FOR COMPLETION OF WORK AND BREAKDOWN OF KEY DELIVERABLES WITH CONTRIBUTIONS BY PROFESSIONAL NUTRIENT MANAGEMENT GROUP AND NATURAL ENGLAND (CSF) FOR EACH ITEM

Project Activities Plan

Changes and details of plans, such as costs/time, will be agreed in the quarter preceding the activity by the partners steering group and recorded in the quarterly reports

Quarter	**Activities planned/ outputs**	**Delivered by** *PNMG (partners), Project coordinator or contractor*	**Estimate cost £ Inclusive of VAT**	**Estimate Time input**	**Partners contri-bution £ value**	**Natural England (CSF) contri-bution £ Incl. VAT**
April-June 11	Promote Think Manures at Grassland and Muck Show 18-19 May, alongside Think Soils and Tried & Tested	Partners		5 days	2500	
	Promotion of Tried & Tested materials at Cereals 15-16 June					
	PNMG to publicise Think Manures to their members and other industry organisations, promote alongside Think Soils	Partners		5 days	2500	
	Support the case for a stand-alone version of MANNER – NPK and to publicise on website and distribute if required	Partners		5 days	2500	
	Develop 3 new case studies of farm nutrient management (including environmental and economic aspects) for website and regional press – SE, EE, EM to include 1 pig and 1 poultry case study	Partners		15 days	7500	
	Distribute 1000 Tried & Tested packs to farmers and advisers on request	Project coordinator (postage)	1000			1000
	Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog	Project coordinator, Contractor	50			50

	Professional Nutrient Management Group – project steering meeting Communications plan for the project developed Interim Report to Natural England with project delivery against milestones and to date Project coordinator worked 2.5 days per week on project in June	Partners Project coordinator Project coordinator	 2700	5 days	2500	 2700
July-Sept 11	Print 15,000 copies of Think Manures Design and artwork for New to Nutrient Management Guide Print 10,000 copies of New to Nutrient Management Guide Distribute 2500 Tried & Tested packs including Nutrient management plan, Think manures and New to nutrient management guide to farmers and advisers on request PNMG to publicise New to Nutrient Management Guide to their members and other industry organisations Co-ordinate PAAG and Proficiency Testing scheme and collate results of soil analysis survey – data collection and analysis and publish report on website and to partners Print 3,000 copies of FACTS brochure Distribution of the reprinted FACTS brochure Design questionnaire to	Contractor Partners, Contractor Contractor Project Coordinator (postage) Partners Partners (AIC lead) Contractor Partners	8500 2000 5500 2500 2000 1250	 5 days 5 days 15 days 3 days	 2500 2500 7500 1500	8500 2000 5500 2500 2000 1250

	be used with farmers to gather feedback on farm practices changes Event attendance Promotion of Tried & Tested materials and launch of Think Manures at Dairy and Livestock show Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog. CSF partnerships meeting to share best practice and related messages. Communications plan for the project reviewed and updated Professional Nutrient Management Group – project steering meeting Interim Report to Natural England with project delivery against milestones to date Project coordinator worked 2.5 days per week on project	Partners, Project coordinator Project coordinator Contractor Partners Partners Partners Project coordinator	50 4050	10 days 5 days 5 days	5000 2500 2500	50 4050
Oct-Dec 11	Update 10 case studies on farm nutrient management for website and press releases Distribute 2500 Tried & Tested packs including Nutrient management plan, Think manures and New to nutrient management guide to farmers and advisers on request Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog. Hold meeting for industry and supporters to promote	Partners Project coordinator (postage) Project coordinator Contractor Partners	2500 50 1000	10 days	5000	2500 50 1000

	Think Manures and new agreement					
	Liaise with Defra statistical team on Farm Practices Survey	Partners		2 days	1000 2500	
	Conduct questionnaire and collate results	Project coordinator		5 days		
	Professional Nutrient Management Group – project steering meeting	Partners				
	Communications plan and project plan reviewed and updated	Partners				
	Interim Report to Natural England with project delivery against milestones to date	Project coordinator				
	Project coordinator worked 2.5 days per week on project during quarter		4150			4150
Jan-Mar 12	CSF partnerships meeting to share best practice and related messages.	Partners		5 days	2500	
	Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog	Project coordinator, Contractor	50			50
	Order 2000 USB memory sticks	Contractor	5400			5400
	Event attendance	Project coordinator	1000			1000
	Distribute 2500 Tried & Tested packs including Nutrient management plan, Think manures, New to nutrient management guide and Feed plan to farmers and advisers on request	Project Coordinator (postage)	2500			2500
	Liaise with Defra stats re. British Survey of Fertiliser Practice and Defra's 'data mining project'	Partners	1000	2 days	1000	
	Conduct questionnaire and collate results	Project coordinator				

	Annual website fee to keep site on server	Contractor				1000
	Professional Nutrient Management Group – project steering meeting	Partners		5 days	2500	
	Communications plan and project plan reviewed and updated	Partners				
	Interim Report to Natural England with project delivery against milestones to date	Project coordinator				
	Project coordinator worked 2.5 days per week on project		4150			4150
April-June 12	Write 'Tried & Tested Feed Plan' (include reference to RUMA) and any professional assistance	Partners, Contractor	2500	20 days	10000	2500
	Design & Artwork of Feed Plan	Partners, Contractor	2500	5 days	2500	2500
	Print 10,000 copies of Feed Plan	Contractor	5500			5500
	PNMG to publicise Tried &Tested Feed Plan to their members and other industry organisations.	Partners		5 days	2500	
	Print 5,000 copies of Tried &Tested booklet	Contractor	3300			33000
	Print 350 A3 pads Field Record Sheets including minor updates	Contractor	3300			3300
	Conduct questionnaire and collate results	Project coordinator				
	Analyse questionnaire results and implement any necessary changes to delivery/messages	Partners		10 days	5000	
	Distribute 2500 Tried & Tested packs including Nutrient management plan, Think manures, New to nutrient management guide and Feed plan to farmers and advisers on	Project coordinator	2500			2500

	request Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog. Professional Nutrient Management Group – project steering meeting Communications plan and project plan reviewed and updated Interim Report to Natural England with project delivery against milestones to date Project coordinator worked 2.5 days per week on project	 Project coordinator Contractor Partners Partners Project coordinator	 50 4150	 5 days	 2500	 50 4150
Jul-Sept 12	Co-ordinate Professional Agricultural Analysis Group (PAAG) and Proficiency Testing Scheme for laboratories and collate results of soil analysis survey – data collection and analysis and publish report on website and to partners Event attendance Distribute 2500 Tried & Tested packs including Nutrient management plan, Think manures, New to nutrient management guide and Feed plan to farmers and advisers on request Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog. CSF partnerships meeting to share best practice and related messages. Professional Nutrient	Partners (AIC lead) Project coordinator Project coordinator (postage) Project coordinator Contractor Partners	 1000 2500 50	15 days 5 days 5 days	7500 2500 2500	 1000 2500 50

	Management Group – project steering meeting Communications plan and project plan reviewed and updated Interim Report to Natural England with project delivery against milestones to date Project coordinator worked 2.5 days per week on project	Partners Partners Project coordinator	 4150			 4150
Oct-Dec 12	Update and publish revised version of Nutrient Management Practices Report Distribute 2500 Tried & Tested packs including Nutrient management plan, Think manures, New to nutrient management guide and Feed plan to farmers and advisers on request Liaise with Defra statistical team on Farm Practices Survey Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog. Professional Nutrient Management Group – project steering meeting Communications plan and project plan reviewed and updated Interim Report to Natural England with project delivery against milestones to date Project coordinator worked 2.5 days per week on project	Partners Contractor Project coordinator (postage) Partners Project coordinator Contractor Partners Partners Project coordinator	1500 2500 50 4250	10 days 2 days 5 days	5000 1000 2500	1500 2500 50 4250
Jan-Mar 13	Distribute 2500 Tried & Tested packs to farmers and advisers on request	Project coordinator (postage)	2500			2500

	Monitor usage statistics on website, upload revisions and new items, focus on quarterly soil theme. To include blog.	Project coordinator, Contractor	 50			 50
	Liaise with Defra stats re. BSFP (British Survey of Fertiliser Practice) and 'Defra's data mining project'	Partners		2 days	1000	
	Event attendance	Project coordinator	1000			1000
	Annual website fee to keep site on server	Contractor	1000			1000
	CSF partnerships meeting to share lessons learnt,	Partners		5 days	2500	
	Professional Nutrient Management Group – project steering meeting	Partners		5 days	2500	
	Final report provided to Natural England on paper and electronically including - project delivery against milestones, statistics of number of 'Tried & Tested' and other publications sent to farmers/advisers, survey reports, event reports, evaluation of website usage statistics and feedback on Tried & Tested and website and feedback from PNMG with lessons learnt on what went well/not so well in the project, improvements for future projects, issues and opportunities for future work and partnerships. Project coordinator worked 2.5 days per week on project	Project coordinator	 4250			 4250
TOTAL			**100,000**	**211 days**	**105,500**	**100,000**