Indicator Framework Summary

Overview

The indicator framework has been designed to provide a leading indication of agriculture's progress in reducing its greenhouse gas (GHG) emissions. It consists of ten key indicators covering farmer attitudes and knowledge, intermediate outcomes relating to GHG emission intensity[1] of production in key agricultural sectors and the uptake of mitigation methods.

Updates for indicators 2, 9 and 10 are still pending, the commentary and summary table below therefore still relates to 2015 data. It is planned to update these with 2016 data later in the summer.

For some indicators (such as farmer attitudes) there are limited data currently available to assess long trends and the short term suggests little change. Where longer term data are available, a current assessment shows the overall picture to be mixed. Over the last 10 years there is a positive long term trend for the soil nitrogen balance (a high level indicator of environmental pressure) and for the derived manufactured nitrogen use efficiency[2] for barley, oilseed rape and sugar beet. However, for intermediate outcomes relating to GHG emission intensity[6] for the livestock sector there has been either little overall change in the longer term trend (e.g. feed conversion ratios for poultry) or some deterioration (e.g. feed conversion ratios for the pig finishing herd). When assessed over the most recent 2 years, the indicators suggest positive trends in the case of intermediate outcomes relating to pigs, dairy, key crops, poultry and the soil nitrogen balance.

Indicators 2, 9 and 10 focus on the uptake of particular mitigation methods (including those relating to organic fertiliser management and application) and provide a measure of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 $MtCO_2$ equivalent by 2020 compared to a 2007 baseline. Together these indicators suggest that, by early 2015, a 1.1 Mt CO_2 equivalent reduction in GHG had been achieved, around 31% of the estimated maximum technical potential[3]. A key component has been the uptake of practices relating to nutrient management, such as the use of fertiliser recommendation systems.

The current status of each of the individual indicators has been summarised below. Symbols have been used to provide an indication of progress:

Clear improvement	✓	Little or no change	≈
Clear deterioration	✗	Insufficient or no comparable data	…

Full, detailed assessments for each indicator which include information on data sources, methodology and statistical background can be found at:
https://www.gov.uk/government/statistical-data-sets/greenhouse-gas-emissions-from-agriculture-indicators

Livestock indicators: the indicators focused on livestock give an insight into the efficiency of production where this can impact on GHG emissions and are intended to be viewed within the context of animal welfare regulations and legislation. To examine the wider potential implications of GHG mitigation measures, including animal health and welfare, Defra

[1] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.
[2] Calculated as the quantity of crop produced per unit of applied manufactured nitrogen fertiliser.
[3] Maximum technical potential is the amount that could be saved if all mitigation potential was enacted regardless of cost assuming no prior implementation of measures.

commissioned research project AC0226 - Quantifying, monitoring and minimising wider impacts of GHG mitigation measures[4]

Methodology 2013 onwards

Indicators 2, 9 and 10 use estimates of potential and achieved GHG emission reductions that have been calculated using the FARMSCOPER tool developed by ADAS for Defra[5.] The data feeding into this model are drawn from a variety of sources including land use and livestock population data from the June Agricultural Survey. The majority of the data relating to the uptake of the mitigation methods within these indicators are from Defra's Farm Practices Survey and the British Survey of Fertiliser Practice. From 2013, in order to gain a more refined picture of the level of uptake of mitigation measures, responses from these surveys have, wherever possible, been divided into those from farms within and outside Nitrate Vulnerable Zone. This was not done for the initial assessment in November 2012.

[4] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17780&FromSearch=Y&Publisher=1&SearchText=AC0226&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description

[5] Cost-curves for mitigating multiple water pollutants, ammonia and greenhouse gas emissions on farms – FARMSCOPER decision support tool, USER-GUIDE and economic analysis for pollution mitigation methods - WQ0106
http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14421

Overarching indicators

1 Attitudes & knowledge

Assessment: behaviour change can be a long process. Measuring awareness of the sources of emissions and intentions to change practice can provide a leading indicator of uptake of mitigation methods and help to highlight motivations and barriers. However, changing attitudes are not the only driver for the adoption of mitigation methods; research suggests that business sustainability and financial implications are important drivers for change.

- 9% of farmers reported that it was "very important" to consider GHGs when making decisions relating to their land, crops and livestock and a further 39% thought it "fairly important", small decreases for both since 2015. Just over half of respondents placed little or no importance on considering GHGs when making decisions or thought their farm did not produce GHG emissions.
- Overall, 57% of farmers were taking actions to reduce emissions, again a small decrease on 2015. Of these, larger farms were more likely to be taking action than smaller farms.
- For those farmers not undertaking any actions to reduce GHG emissions informational barriers were important with both lack of information (26%) and lack of clarity about what to do (30%) cited as barriers by this group. 47% did not believe any action was necessary, an increase on 2014 (41%) and 2015 (40%).

Current Status	Long term (last 10 years): ...	Short term (last 2 years): ≈

2 Uptake of mitigation methods (2015 data - see Overview)

Assessment: there are a wide range of farm practices that can reduce GHG emissions from agriculture. Monitoring the uptake of these mitigation methods provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 $MtCO_2$ equivalent (e) by 2020 compared to a 2007 baseline.

- By February 2015, approximately 1Mt CO_2e reduction in GHG emissions had been achieved from the uptake of the key mitigation methods within this indicator. This compares to an estimated maximum technical potential[6] reduction of 3.1Mt CO_2e were all of these methods to be fully implemented on relevant farms.
- Mitigation methods related to nutrient management (e.g. fertiliser spreader calibration) collectively provide the greatest potential emissions reduction (1.4 Mt CO_2e). By 2015, uptake of these methods has been assessed to have delivered an estimated GHG reduction of just over 0.5Mt CO_2e, around 36% of the maximum technical potential reduction.

Current Status	Long term (last 10 years): ...	Short term (last 2 years): ≈

[6] Maximum technical potential is the amount that could be saved if all mitigation potential was enacted regardless of cost assuming no prior implementation of measures

Overarching indicators

3 Soil nitrogen balance

Assessment: the soil nitrogen balance is a high level indicator of potential environmental pressure providing a measure of the total loading of nitrogen on agricultural soils. Whilst a shortage of nutrients can limit the productivity of agricultural soils, a surplus of these nutrients poses a serious environmental risk. The balances do not estimate the actual losses of nutrients to the environment (e.g. to water or to air) but significant nutrient surpluses are directly linked with losses to the environment.

- The nitrogen surplus (kg/ha) in England has fallen by 25% since 2000. The main drivers have been reductions in the application of inorganic (manufactured) fertilisers (particularly to grass) and manure production (due to lower livestock numbers), partially offset by a reduction in the nitrogen offtake (particularly forage).
- Provisional figures for 2015 show that the nitrogen balance fell by 4% compared to 2014. This has been mainly driven by a small decrease in offtake (particularly harvested crops) while overall, inputs changed little or saw decreases compared to the previous year.

Current Status	**Long term** (last 10 years): ✓	**Short term** (last 2 years): ✓

Sector specific indicators

4 Pig sector: feed conversion ratio for finishing herd (GB)

Assessment: the feed conversion ratio is a measure of the amount of feed required to produce 1 kilogramme of pig live weight. More efficient use of feed has the potential to reduce greenhouse gas emissions intensity[7] and improve productivity (see **Livestock indicators** note at the beginning of summary).

- The feed conversion ratio (FCR) for the pig finishing herd deteriorated from around 1995 to 2009, albeit with some fluctuations, an indication that more feed has been required to produce 1 kg of pig live weight. This suggests higher levels of GHG emissions from the GB finishing herd over this period.
- Several factors could explain this including the trend towards heavier finishing weights, changes in production systems and disease. As the FCR is a broad indicator of feed use efficiency and GHG emissions, it is not possible to separate the effects of different factors (such as type of feed) on GHG emissions from the finishing herd.
- Since 2010 there has been an improvement in the FCR although again with some fluctuations. This indicates improvements in feed use efficiency and reduction in GHG emissions. It is too early to say if this improvement represents a longer term trend.

Current Status	**Long term** (last 10 years): ✗	**Short term** (last 2 years): ✓

[7] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.

Sector specific indicators

5 Grazing livestock sector: beef and sheep breeding regimes

Assessment: the selection of useful traits can help improve herd and flock productivity and efficiency which can in turn influence GHG emissions intensity. The Estimated Breeding Value (EBV) is an estimate of the genetic merit an animal possesses for a given trait or characteristic. The EBV is used here as a proxy measure for on-farm GHG emissions intensity[8] (see **Livestock indicators** note at the beginning of summary).

- Overall in 2016, bulls and rams with a high EBV were used at least "most of the time" on 33% of farms breeding beef cattle and 21% of those breeding lambs. This was virtually no change on 2015 levels.
- For farms breeding lambs, uptake on lowland farms was greater than those in Less Favoured Areas (LFA) (24% and 13% respectively). For farms breeding beef cattle uptake was again greater on lowland farms (33%) compared to LFA farms (27%).
- There are differences between farm sizes, with uptake greatest on larger farms.

Current Status	Long term (last 10 years): ...	Short term (last 2 years): ≈

6 Dairy sector: ratio of dairy cow feed production to milk production

Assessment: using milk yields in conjunction with trends in inputs (such as feeds) provides an indication of GHG emissions intensity[8] in the dairy sector. The ratio of dairy cow compound and blended feed production to milk production is used here as proxy measure for on-farm GHG emissions intensity (see **Livestock indicators** note at the beginning of summary). It is recognised that the picture is complex and this indicator is not ideal. Firstly, it considers production of feed rather than overall dry matter consumption but, perhaps more importantly, it does not attempt to assess the consumption of concentrates produced by on-farm mixing, or of grazed or conserved forage. We will continue to investigate other data sources such as survey data and farm benchmarking data to improve this indicator.

- Although there have been some fluctuations over the period since 2005 the rate of increase of compound and blended feed production has outstripped that of average milk yields suggesting an increase in emissions intensity.
- In the shorter term ratio fell between 2013 and 2015, although it is too early to say if this improvement will be sustained.

Current Status	Long term (last 10 years): ✗	Short term (last 2 years): ✓

[8] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.

Sector specific indicators

7 Poultry sector: feed conversion ratio for table birds

Assessment: more efficient use of feed has the potential to increase productivity and reduce GHG emissions intensity[9]. The feed conversion ratio (FCR) is a measure of the amount of feed required (kg) to produce 1 kilogramme of poultrymeat (dressed carcase weight). The indicator provides an overall measure of feed efficiency. Within this there are differences between production systems and species. It is used here as a proxy measure for on-farm GHG emissions intensity (see **Livestock indicators** note at the beginning of summary).

- There was a slight upward trend in the overall FCR for table birds between 2001 and 2008, suggesting a possible increase in GHG emissions intensity.
- There was some improvement in the FCR between 2010 and 2013 and the last two years have seen an overall downward trend with the moving average currently standing at the lowest level seen since 2001.

Current Status	Long term (last 10 years): ≈	Short term (last 2 years): ✓

8 Cereals and other crops: manufactured fertiliser application

Assessment: more efficient use of nitrogen fertilisers has the potential to increase productivity and reduce risks to the environment. The ratio of the weight of crops produced to the weight of manufactured nitrogen fertiliser applied provides a proxy measure for the intensity of GHG emissions[9].

- Since 2000, there has been little overall change in the apparent nitrogen use efficiency of wheat. More recently, a reduction in the yield trend (particularly due to weather conditions in 2012) led to less wheat being produced per tonne of nitrogen applied although an improving trend has been seen in the last 2 years.
- For winter barley, spring barley, winter oilseed rape and sugar beet there has been an overall upward trend in production per unit of applied manufactured nitrogen fertiliser over the last 10 years. In the shorter term, as with wheat, an improving trend is seen.

Current Status	Long term (last 10 years):	Short term (last 2 years):
Wheat	≈	✓
Winter barley	✓	✓
Spring barley	✓	✓
Winter oilseed rape	✓	✓
Sugar beet	✓	✓

[9] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.

Sector specific indicators					
9 Slurry and manure (2015 data - see Overview) **Assessment:** systems for the management of manure and slurry are relevant to the control of environmental risks to air and water including GHGs. Monitoring uptake of relevant mitigation methods provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production GHG emissions by 3 $MtCO_2$ equivalent (e) by 2020 compared to a 2007 baseline. • Estimates indicate that the maximum technical potential[10] GHG reduction from uptake of mitigation methods relating to slurry and manure (which include types of storage and use of liquid/solid manure separation techniques but exclude anaerobic digestion (AD) systems) is approximately 0.018 Mt CO_2e. • Uptake of these mitigation methods by February 2015 suggests that the GHG reduction achieved has been around 0.004 Mt CO_2e. • The use of slurries for anaerobic digestion has a significant GHG reduction potential, far outweighing that from improved storage of slurries and manures. However, there are significant start-up and running costs leading to very low levels of current uptake. In 2015, survey data indicated that 2% of all farms processed slurries for AD, a small increase on earlier years (from 2008) when the level was around 1%.					
Current Status	**Long term (last 10 years):**	**...**	**Short term (last 2 years):**	**≈**	
10 Organic fertiliser application (2015 data - see Overview) **Assessment:** the form, method and timing of application for organic fertilisers can influence GHG emissions. Monitoring these factors provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 $MtCO_2$ equivalent (e) by 2020 compared to a 2007 baseline. • By February 2015, approximately 0.06 Mt CO_2e reduction in GHG emissions had been achieved from the uptake of the mitigation methods (which include the timing of applications and application methods) within this indicator. This compares to an estimated maximum technical potential[10] reduction of 0.33 Mt CO_2e were all of these methods to be fully implemented on relevant farms.					
Current Status	**Long term (last 10 years):**	**...**	**Short term (last 2 years):**	**≈**	

[10] Maximum technical potential is the amount that could be saved if all mitigation potential was enacted regardless of cost assuming no prior implementation of measures.