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.

For some indicators (such as farmer attitudes) there are limited data currently available to assess long term 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. For intermediate outcomes relating to GHG emission intensity 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). However, when assessed over the most recent 2 years, the indicators suggest positive trends in the case of intermediate outcomes relating to pigs, beef, lamb and some key crops.

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 Mt CO_2 equivalent by 2020 compared to a 2007 baseline. Together these indicators suggest that, by early 2020, a 1.3 Mt CO_2 equivalent reduction in GHG had been achieved, around 28% of the estimated maximum technical potential[3],[4]. 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 here.

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 commissioned research project AC0226 - Quantifying, monitoring and minimising wider impacts of GHG mitigation measures[5]

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[6.] 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.

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.

- 18% of farmers reported that it was "very important" to consider GHGs when making decisions relating to their land, crops and livestock and a further 46% thought it "fairly important". These were increases of 5% and 4% respectively when compared to 2019 responses. 30% of respondents placed little or no importance on considering GHGs when making decisions or thought their farm did not produce GHG emissions.
- Overall, 66% of farmers were taking actions to reduce emissions, a 5% increase on the previous year. 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 (35%) and lack of clarity about what to do (39%) cited as barriers by this group. 42% did not believe any action was necessary, a decrease from 47% in 2019.

More details on farmer attitudes can be found in Section 3.1.

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

2 Uptake of mitigation methods

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 M tCO_2 equivalent (e) by 2020 compared to a 2007 baseline.

- By February 2020, approximately 0.9 Mt 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[7] reduction of 2.8 Mt 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 (0.9 Mt CO_2e). By 2020, uptake of these methods has been assessed to have delivered an estimated GHG reduction of 0.4 Mt CO_2e, around 40% of the maximum technical potential reduction.

More details on uptake of mitigation methods can be found in Section 3.2.

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

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 30% 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 show that the nitrogen balance decreased by 12% between 2018 and 2019. This was driven by an 8.7% increase in overall offtake (mainly via harvested crops) which more than offset a 0.8% decrease in inputs. The increase in offtake reflects a significant increase in overall harvested production compared to 2018. For more details of the soil nitrogen balance see Section 2.9.1.

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 GHG emissions intensity[8] 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.

- From 2007 to 2019 there have been many fluctuations in the FCR, more recently the FCR is at a higher level meaning more feed was used to produce 1 kg of pig live weight. The clean pig average carcase weight also rises steadily over this time period.

More details on the on the pig sector can be found in Section 2.7.

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

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 (see **Livestock indicators** note at the beginning of summary).

- Overall in 2020, bulls and rams with a high EBV were used either "always" or "most of the time" on 35% of farms breeding beef cattle and 19% of those breeding lambs. When compared to 2019 this is an increase of 2% on farms breeding cattle and a 2% decrease on those breeding lambs.

- For farms breeding lambs, uptake on lowland farms was greater than those in Less Favoured Areas (LFA) (20% and 15% respectively). For farms breeding beef cattle the uptake was lower on LFA's which were at 30% compared to 33% on lowland farms.

- There are differences between farm sizes, with uptake greatest on larger farms.

For more details on the beef and sheep sectors see Section 2.5 and Section 2.6.

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 feed) provides an indication of GHG emissions intensity 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 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 GHG emissions intensity.
- In the shorter term the ratio has decreased which has been mainly driven by an decrease in feed use

More details on the dairy sector can be found in Section 2.4.

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

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. The feed conversion ratio (FCR) is a measure of the amount of feed required (kg) to produce 1 kilogramme of poultry meat (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 have seen an overall improving (downward) trend. Over the last two years the FCR has remained at around the same figure with very slight fluctuations.

For more details on the poultry sector see Section 2.8.

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[20].

- From 2000 to 2014, there has been little overall change in the apparent nitrogen use efficiency of wheat. However, over the last three years yields have improved which has led to more wheat being produced per tonne of nitrogen applied. A significant increase in wheat yields for the 2019 harvest has driven the most recent increase in nitrogen use efficiency of wheat.
- Trends for winter and spring barley are similar to those for wheat. Over the last 10 years the intensity measure for winter oilseed rape has seen a light upward trend peaking in 2016.

More details on crop production can be found in Section 2.3 and Section 2.9.

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

9 Slurry and manure

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 Mt CO_2 equivalent (e) by 2020 compared to a 2007 baseline.

- Estimates indicate that the maximum technical potential[21] GHG reduction from uptake of mitigation methods relating to slurry and manure (which include types of storage, the use of liquid/solid manure separation techniques and anaerobic digestion (AD) systems) is approximately 1.5 Mt CO_2e.
- Uptake of these mitigation methods by February 2020 suggests that the GHG reduction achieved has been approximately 0.04 Mt CO_2e which is a similar level to 2017 and 2018.
- Estimates from the Farmscoper tool suggest that the use of manures and slurries for anaerobic digestion has a GHG reduction potential outweighing that from improved storage of slurries and manures. However, significant start-up and running costs are barriers to uptake. In 2020, survey data indicated that 3% of all farms processed slurries for AD; the same proportion as 2018.

For more details on slurry and manure see Section 2.9.2 and Section 3.2.

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

10 Organic fertiliser application

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 Mt CO_2 equivalent (e) by 2020 compared to a 2007 baseline.

- By February 2020, approximately 0.34 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[9]. This compares to an estimated maximum technical potential[10] reduction of 0.46 Mt CO_2e were all of these methods to be fully implemented on relevant farms.

For more details on organic fertiliser application see Section 2.9.2 and Section 3.2.

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

[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.
[4] The 2016 assessment includes potential GHG reductions associated to the processing of livestock manures by anaerobic digestion which were not included in earlier years.
[5]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
[6]The initial version of Farmscoper was developed by ADAS under Defra projects WQ0106 http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14421 and FF0204 http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17635&FromSearch=Y&Publisher=1&SearchText=FF0204&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description . The current version (version 3) used in the analysis here has been further developed and expanded under Defra project SCF0104.: http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=18702
[7] 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
[8] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.
[9] The assessment of the practices "Do not spread FYM to fields at high risk times" and "Do not spread slurry or poultry manure at high risk times" have been revised in 2017. Data for 2015 and 2016 have also been updated to reflect the change and allow a comparison

[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.