Indicator 10: Organic fertiliser application

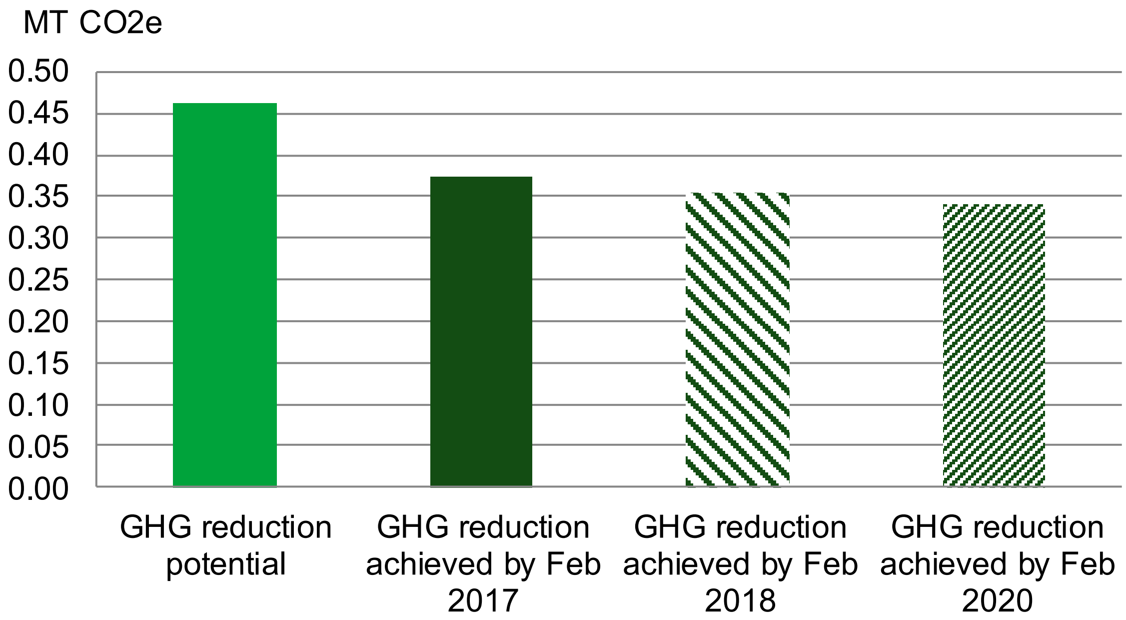
Rationale: the form, method and timing of application for organic fertilisers can influence associated greenhouse gas (GHG) emissions. Monitoring these factors provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 $MtCO_2e$ by 2020 compared to a 2007 baseline.

Indicator: progress is measured by the reduction in GHG emissions delivered through the uptake of a range of organic fertiliser application methods. (Note: indicators 2, 9 and 10 cover different mitigation methods. Indicator 2 covers general farm practices, indicator 9 covers slurry and manure management and indicator 10 covers organic fertiliser).

Desired outcome: increased uptake of these mitigation methods will be reflected by an improvement in the estimated GHG emission reductions.

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

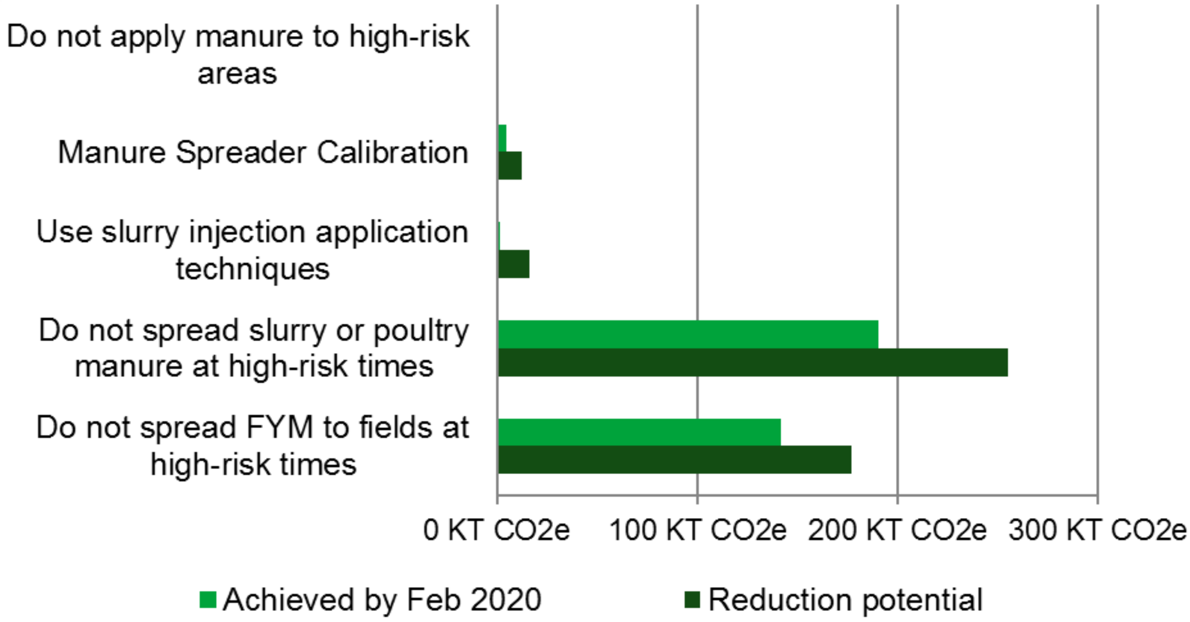
GHG reduction based on uptake of organic application methods



By February 2020, approximately 0.34 MT Kt CO_2 equivalent (e) reduction in GHG emissions had been achieved from the uptake of the mitigation methods within this indicator. This is a decrease of 0.01 MT compared to the 2018 level[1] and compares to an estimated maximum technical potential[2] reduction of 0.46 MT CO_2e were all of these methods to be fully implemented on relevant farms.

The headline indicator is made up of five mitigation methods[3] relating to organic fertiliser application practices. Progress for each of these is shown in the chart below.

Potential and achieved GHG emission reduction: organic fertiliser application methods



Emission reduction calculated using Farmscoper

Note: use of band spreading application techniques (not shown) is included in the indicator but as a qualitative assessment only.

The uptake of each mitigation method has been assessed, wherever possible, using relevant survey data. In some cases where precise data are not available (i.e. Do not apply manure to high-risk areas), the default Farmscoper uptake rate has been assumed, based on an assessment of uptake by ADAS. This default value is a pre-determined level of adoption set within the model[4]. For some of the mitigation methods data are currently available to make the short term assessment only; as data continues to be collected it will be possible to assess longer term trends.

Mitigation method	Assessed by	Uptake by 2020 (unless stated)
Do not apply manure to high-risk areas	No suitable survey data	(a)
Manure Spreader Calibration	% of farms testing at least once a year, whenever a significant change in slurry/manure characteristics or whenever manure / slurry tested	39% (FPS)(b)
Use slurry injection application techniques	% of farms using slurry injection application	8% (BSFP 2019)
Do not spread slurry or poultry manure at high-risk times	Proportion of fields where slurry was not spread between November and February	76% (BSFP 2019)
Do not spread FYM to fields at high-risk times	Proportion of fields where FYM was not spread between November and February	79% (BSFP 2019)
Use band spreading application techniques	% of farms using band spreading application	14% (BSFP 2019)

(a) Farmscoper default uptake rates of 80% within NVZs and 50% outside NVZs used.

(b) Farmscoper default uptake rates of 50% within NVZs and 25% outside NVZs used.

Do not apply manure to high-risk areas

Applying manures close to water courses creates a high risk of the rapid spread of pollutants, which can in turn lead to GHG emissions. Avoiding spreading manure to high risk areas can provide an estimated maximum technical potential reduction in GHG emissions of 1.2 Kt CO2e. There is currently no suitable survey data to assess uptake of this mitigation method. However, using the Farmscoper default uptake levels (see above table and Indicator Methodology) it is estimated that a reduction in GHGs of 1.1 Kt CO2e has been achieved by 2020.

Manure spreader calibration

Manure spreader calibration can ensure evenness of application helping to minimise risks such as leaching and run off. Efficient use of manure can also, in some cases, lead to a reduction in the need for manufactured nitrogen fertiliser. The Farm Practices Survey asked questions about manure spreader calibration for the first time in 2013. In 2020 the results showed that 39% of farms spreading slurry or manure calibrated their spreader at least once a year or whenever there was a significant change in manure or slurry characteristics, or whenever manure or slurry was tested. Until more data are collected on this the Farmscoper default uptake levels have been used (see table above and Indicator Methodology). The estimated uptake of this practice has achieved a reduction in GHGs of 5.1 Kt CO2e which is around 41% of the estimated maximum technical potential.

Use of slurry injection application techniques

Methods of slurry application can have a bearing on GHG emissions; slurries have a high nitrogen content in available forms, leading to high levels of both direct emissions and indirect emissions from ammonia losses.

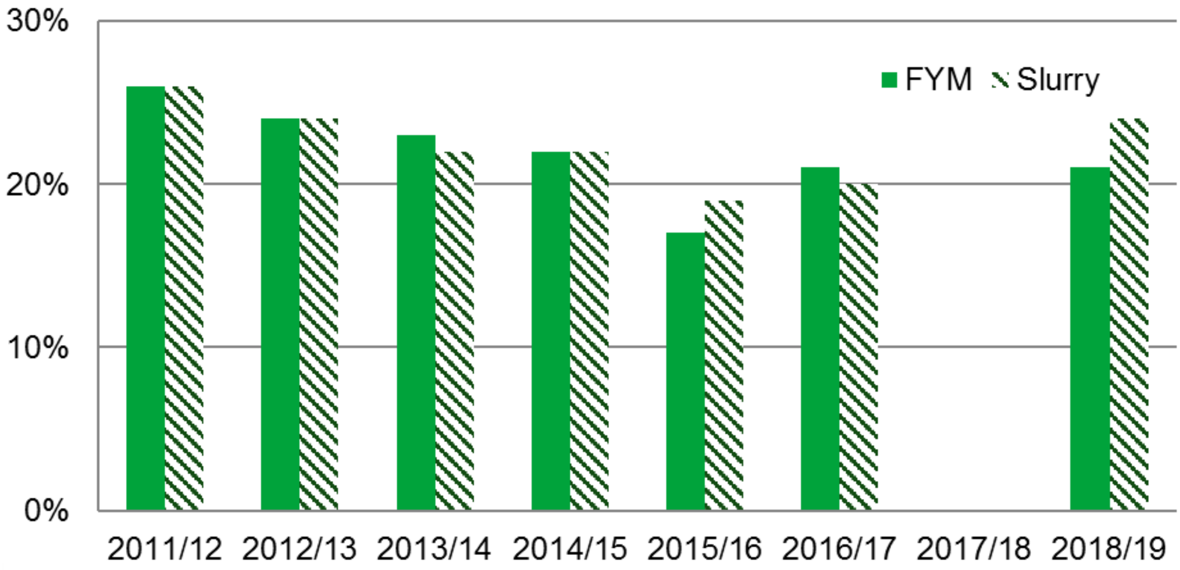
Certain methods of application, such as injection, can help mitigate these losses. Estimates of uptake suggest that using slurry injection techniques could give a maximum technical potential GHG reduction of 16.5 Kt CO2e. Current uptake of this practice is estimated to have achieved a reduction of 1.7 Kt CO2e.

In 2019, British Survey of Fertiliser Practice data indicated that 8% of farms in England were using a deep or shallow injection application method for slurry. Year on year fluctuations in uptake of slurry injection techniques shown within the chart may be a result of the small sample sizes (slurry application methods were sought from around 160-200 farms in each year).

Avoiding the spreading of slurry, poultry manure or farm yard manure at high risk times[5]

Of the mitigation methods considered within this indicator, those focused on avoiding spreading farm yard manure (FYM), slurries or poultry manure at high risk times have been assessed as offering the greatest potential reductions in GHG emissions. Slurries and manures can produce emissions at application (as well as during storage) and if they are applied to the land in the autumn and winter months there is also a risk of surface run off and leaching, which can lead to indirect emissions. Autumn and winter can also be a time when applications are less effective as there is little or no crop uptake. Current uptake suggests that not spreading FYM, poultry manure or slurries at these high risk times delivered a total estimated GHG reduction of 190.3 Kt CO2e which is around 76% of the reduction potential.

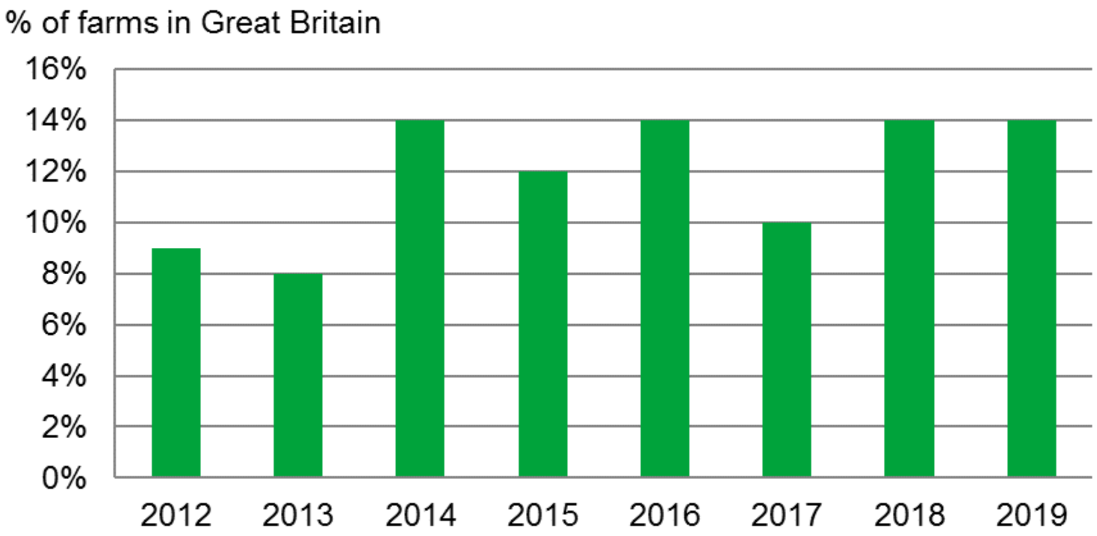
Proportion of fields spread with FYM or slurry between November and February, England



Source: British Survey of Fertiliser Practice

Band spreading

Uptake of band spread application techniques



Source: Survey of Fertiliser Practice

Both slurry injection and band spreading application techniques are also effective mitigation methods for ammonia (which is associated with secondary GHG emissions). In the case of band spreading, modelling work suggests that the practice may be associated with marginal increases in direct nitrous oxide emissions. However, uptake will be monitored within this indicator (on a qualitative basis only) after consideration of the positive impact of this practice on other pollutants. British Survey of Fertiliser Practice data show that, in 2019, 14% of farms in Great Britain used band spreading application; uptake has fluctuated since 2010 (6%), this fluctuation may be a result of the small sample sizes (slurry application methods were sought from around 160-200 farms in each year).

Data sources
This indicator uses 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. Data on the use of organic fertiliser application methods within this indicator are from the British Survey of Fertiliser Practice. Wherever possible data have been presented for England only. For a minority of mitigation methods there is no current survey information on uptake levels (i.e. manure spreader calibration and applying manures to high risk areas). In these cases default rates have been used from the model.

Indicator methodology
The "maximum technical potential[7]" and "achieved" GHG emission reductions have been calculated by linking data (measuring the uptake of mitigation methods) to the Farmscoper decisions support tool.

The Farmscoper tool quantifies farm-level environmental impacts, including emissions of nitrous oxide and methane, for over 100 on-farm practices including many of those in the Mitigation Method User Guide originally developed as part of Defra project WQ0106[6]. The latest version of Farmscoper, developed under Defra project SCF0104[6], allows the assessment of multiple farms (derived from Agricultural Census data) so the tool can be applied to a national scale.

Developments to this latest version mean the current estimates of achieved and potential mitigation may not be directly comparable with all previous years. However, estimates for 2015 to 2020 have been produced using version 3 of Farmscoper to allow some comparison.

Farmscoper allows the user to enter an estimate of present uptake of individual mitigation measures. Where possible uptake has been based on responses to the Farm Practices Survey and British Survey of Fertiliser Practice[8].

Where no current survey data are available, Farmscoper's default levels of uptake have been used. The default implementation rates are largely based on survey information (with a focus on data between 2006 and 2012) and, in a few cases, expert opinion.

As the Farmscoper tool is not sensitive to small changes in uptake, where survey data are available, the following uptake ranges were used (see table below).

Uptake ranges and corresponding averages

Uptake range (%)	Average input into Farmscoper
0	0
1-5	3
6-15	10
16-25	20
26-35	30
36-45	40
46-55	50
56-65	60
66-75	70
76-85	80
86-95	90
96-99	97
100	100

The mitigation methods included in the indicator have been chosen, as far as possible, to reflect stakeholder feedback, the farm practices to be targeted by the Industry's Action Plan[9] and to also acknowledge the indicators set out in the Committee on Climate Change's (CCC) 3rd progress report[10]. Methods that the Farmscoper tool identified as having no associated cost but a mitigation potential are also included where possible.

Statistical Background

Farmscoper

The project reports covering the development of the Farmscoper tool, including methodological details, can be found on file WQ0106, SCF0104 and FF0204.

Initial results from the Farmscoper "upscaling" tool[11] were validated against the national agricultural GHG inventory estimates. The Farmscoper estimate of total nitrous oxide and methane emissions from English agriculture for 2010 was 30.5 Mt CO2e (assuming no prior uptake of any Farmscoper farm practices) compared to the national inventory estimate of 28.9 Mt CO2e. This difference is well within the uncertainty bands[12] of the 2010 GHG Inventory Model, providing reassurance that the method gave a reasonable approximation of on farm emissions.

The project report covering the development of the Farmscoper tool, including methodological details, can be found on the ADAS website.

The British Survey of Fertiliser Practice

The British Survey of Fertiliser Practice (BSFP) is a voluntary annual survey. Respondents are selected from the population of agricultural holdings compiled using the June Agricultural Survey. Holdings of less than 20 hectares are not included in the sample. While these smaller holdings account for a significant proportion of all holdings in terms of numbers, they cover a much smaller proportion of the total area of crops and grass. The target sample size is 1,500 farms which is designed to achieve a nationally representative sample. In 2019 responses were received from 991 respondents from the main sample (66%); this was increased to 1,327 (88% of the target) by contacting 'reserves'. This is a smaller sample size than in previous years as following a statistical review which revealed limited impacted on standard errors associated with the major crops, the decision was taken to reduce it. The overall response rate from all those contacted was 48%. The survey year for 2019 corresponded to the 2019 season or harvest year.

BSFP data collection is undertaken mainly through face to face interviews with individual farmers. At data entry, any omitted responses, figures outside pre-agreed limits or other discrepancies are flagged for checking and followed up, often by contacting the survey respondent. Additionally, 10% of the interviews undertaken are subject to a call back by an independent reviewer to check responses as part of data quality assurance arrangements. The aggregated figures are checked for consistency and trend analysis against historic data and are subject to independent expert peer review.

The BSFP sample responses are raised to be representative of the national population by using the inverse of the achieved sampling fraction (i.e. the number of holdings in the population divided by the achieved sample size in each stratum) as the weight.

The validity of the derived weights are assessed by calculating a weighted crop area for the most extensively grown crops by this method and comparing this to the latest available crop area estimates from the June Agricultural Survey. Standard errors are calculated for key results (major crops) using standard survey statistical methodology.

The sampling variation/standard errors associated with the application rates reported for the main arable crops, all tillage and grass and further methodological details can be found on the fertiliser usage website.

The BSFP has National Statistics status. These are official statistics which have been assessed and comply with the National Statistics code of practice.

Farm Practices Survey (FPS)

The FPS is an annual, voluntary, postal survey conducted by Defra which collects information on a diverse range of topics relating to the impact of farming practices on the environment. Since 2011 the survey has focused on practices relating to GHG mitigation.

In 2020 the survey was sent to approximately 7,000 holdings in England. These holdings were targeted by farm type and size to ensure a representative sample. Thresholds are applied to ensure that very small holdings with little agricultural activity are not included in the survey. To be included in the sample, holdings had to have at least 50 cattle, 100 sheep, 100 pigs, 1,000 poultry or 20 hectares of arable crops or orchards. All results reflect only those holdings that exceed these thresholds. Sample sizes and response rates are shown on the following page.

Farm Practices Survey sample sizes and response rates

	2014	2015	2016	2017	2018	2019	2020
Sample size	6,000	6,000	6,000	6,000	6,000	6,000	7,000
Response rate	41%	44%	38%	39%	40%	38%	35%

Results are calculated using a standard methodology for stratified random surveys to produce national estimates. With this method, all of the data is weighted according to the inverse sampling fraction. Where reference is made to the type of farm in this document, this refers to the ‘robust type’, which is a standardised farm classification system. Farm sizes are based on the estimated labour requirements for the holding, rather than its land area.

Results from the FPS and the June Survey of Agriculture are designated National Statistics. These are official statistics which have been assessed and comply with the National Statistics code of practice.

[1]Estimates of achieved and potential mitigation for 2015 and 2016 have been produced using version 3 of the Farmscoper tool and may not be directly comparable with previous years which were produced using an earlier version of Farmscoper. See Indicator Methodology for more details.

[2] 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.

[3] 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” has been revised in 2017. Data for 2015 and 2016 shown in the chart on page 1 have been updated to reflect the change.

[4] The default implementation rates are based largely on survey data, in particular Defra Farm Practices Survey, with a focus on data between 2006 and 2012. A simple scoring system was used to estimate the range of uptake; this reflects the uncertainty in mapping farm practice survey questions to specific mitigation methods.

[5] 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” has been revised in 2017. Data for 2015 and 2016 shown in the chart on page 1 have been updated to reflect the change.

[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.

[8] 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 Nitrate Vulnerable Zones (NVZs) and those outside.

[9] http://www.nfuonline.com/Our-work/Environment/Climate-change/GHG-emissions---agriculture-s-action-plan/

[10] http://www.theccc.org.uk/reports/3rd-progress-report

[11] Prior to 2016 (when FARMSCOPER3 became available), the indicator was updated using the FARMSCOPER model in conjunction with an “upscaling” tool developed by Defra analysts. This allowed farm-level results to be used in the production of national estimates of impacts.

[12] 95% confidence intervals (Source: National Inventory Report 2010) are N_2O (soils): **+249%, -93%**; N_2O & CH_4 (manure management): **+/-25%**;CH_4 (enteric fermentation): **+/-16%.**