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## Soil Nutrient Balances England Provisional Estimates for 2014

Soil nutrient balances provide a method for estimating the annual nutrient loadings of nitrogen and phosphorus to agricultural soils. They give an indication of the potential risk associated with losses of nutrients to the environment; losses which can impact on air and water quality and on climate change. The nutrient balances are used as a high level indicator of farming's pressure on the environment and of how that pressure is changing over time. The balances do not estimate the actual losses of nutrients to the environment but significant nutrient surpluses are directly linked with losses to the environment.

Nutrient balances are of direct relevance to a number of European directives including the Air Quality Directive, Water Framework Directive and Habitats Directive. The nitrogen balance for England has also been adopted by Defra as a Structural Reform Plan indicator to monitor farming's environmental performance.

### Summary of key results

#### Nitrogen

- Provisional estimates for 2014 show that the nitrogen balance for England was a surplus of 85 kg/ha of managed agricultural land. This is a decrease of 3 kg/ha (-4%) compared to 2013 and a reduction of 23 kg/ha (-21%) compared to 2000, continuing the long term downward trend.
- The reduction between 2013 and 2014 has been driven by increase in offtake (particularly harvested crops and crop residue). This more than offset a smaller increase to inputs (mainly from inorganic manufactured fertilisers).
- The main drivers for the overall reduction in the surplus since 2000 have been reductions in both the application of inorganic (manufactured) fertilisers and manure production (due to lower livestock numbers), although this has been partially offset by a reduction in offtake (particularly for forage) over the same period.

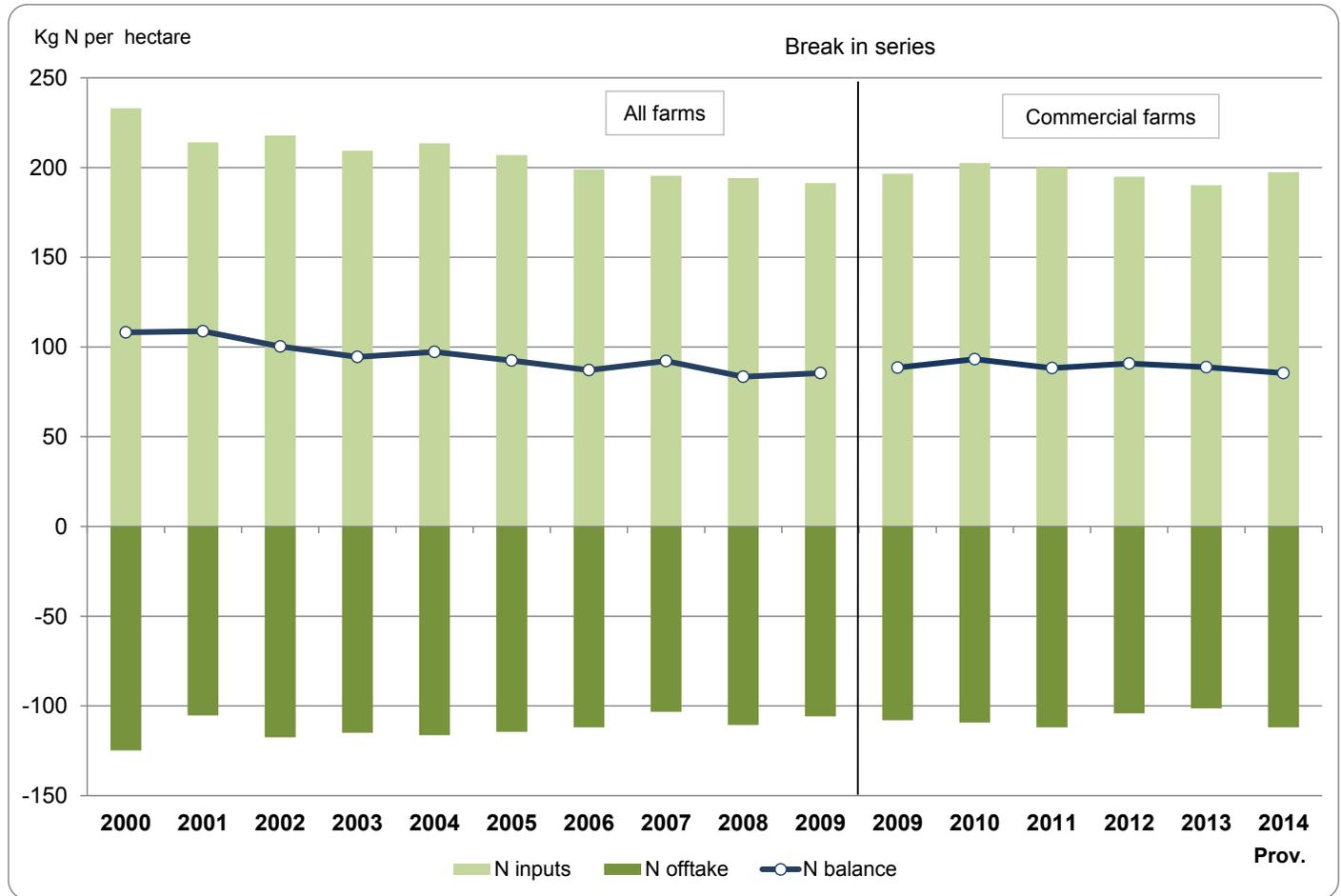
#### Phosphorus

- Provisional estimates for 2014 show that the phosphorus balance for England was a surplus of 4 kg/ha of managed agricultural land. This is a decrease of 2 kg/ha (-30%) compared to 2013 and a reduction of 5 kg/ha (-57%) compared to 2000.
- As with nitrogen, the reduction between 2013 and 2014 has been driven by an increase in offtake which offset a much smaller increase in inputs. In the longer term the trend is downward, again with similar drivers to nitrogen.

## Detail

### England Nitrogen Balance

Chart 1: Summary of Nitrogen balance for England, 2000 to 2014 (kg N per hectare)



For the period 2013 to 2014 the key points are:

- The reduction of 3 kg/ha (-4%) has been driven by an increase in offtake (via harvested crops and crop residue) This reflects the more typical weather conditions of 2014 compared to the 2013 harvest which was affected by poor planting conditions in autumn 2012 and the cold spring in 2013. This offtake increase more than offset an increase in inputs (mainly from inorganic manufactured fertilisers) over the same period.

For the period 2000 to 2014 the key points are:

- A 21% fall in the total surplus per hectare of managed agricultural land in England from 108 kg/ha in 2000 to 85 kg/ha in 2014.
- The main driver for the lower surplus has been a reduction in inputs of 36 kg/ha (from 233 kg/ha to 197 kg/ha) largely due to reductions in inorganic fertiliser applications and manure production (reflecting lower numbers of livestock). This has been partially offset by a reduction of 13 kg/ha (from 125 kg/ha to 112 kg/ha) in the nitrogen offtake (particularly forage).
- The series break is due to changes<sup>1</sup> in farm survey data collection.

<sup>1</sup> See <https://www.gov.uk/structure-of-the-agricultural-industry-survey-notes-and-guidance> for further information.

**Table 1: Nitrogen balance for England, 2011 to 2014 (kg N per hectare)**

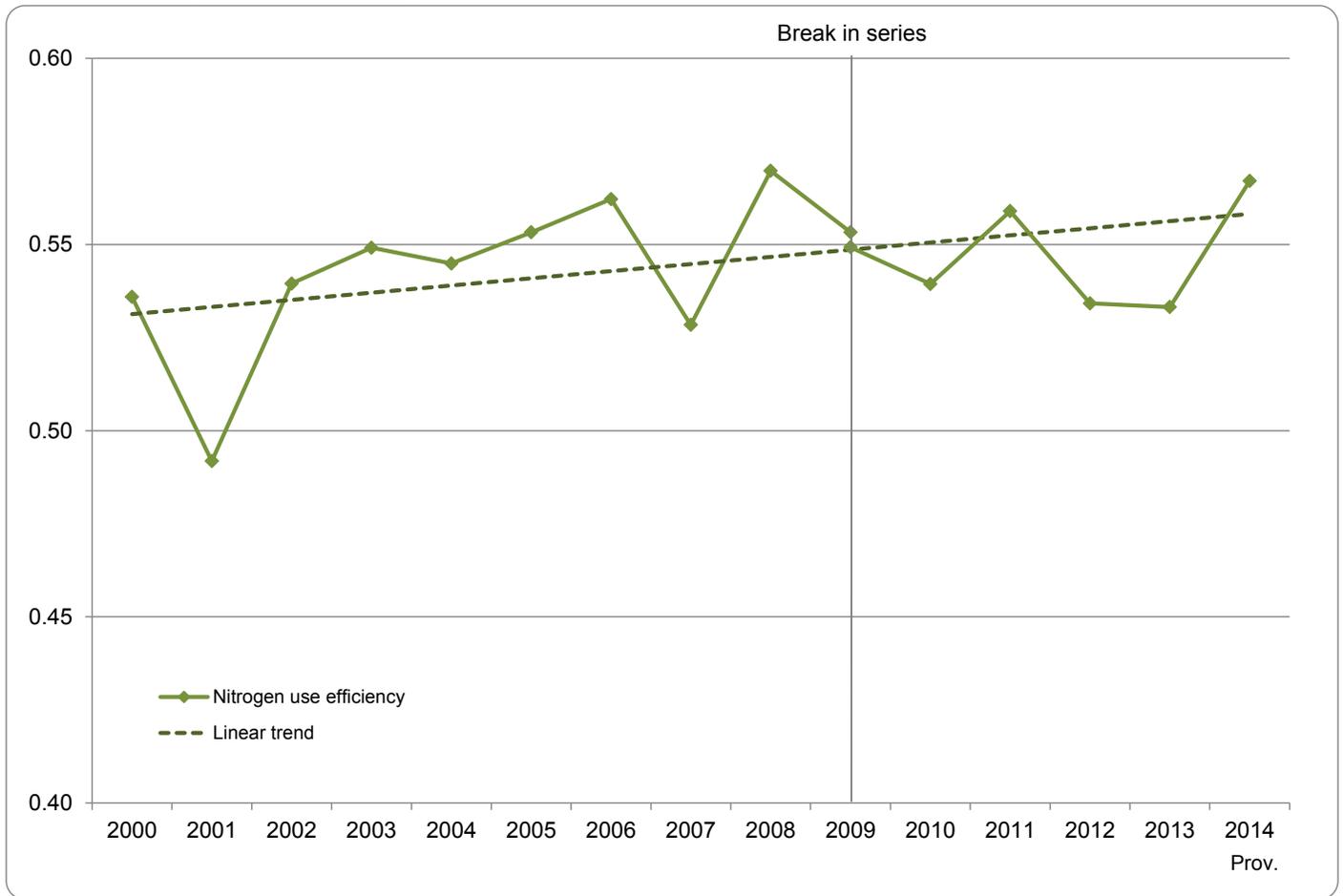
|                                       | Kg N per hectare |             |             |             |                  |
|---------------------------------------|------------------|-------------|-------------|-------------|------------------|
|                                       | 2011             | 2012        | 2013        | prov. 2014  | % change 2013/14 |
| Total Inputs                          | 200.1            | 194.9       | 190.2       | 197.4       | 4%               |
| Total Offtake                         | 111.8            | 104.1       | 101.4       | 112.0       | 10%              |
| <b>BALANCE (Inputs minus Offtake)</b> | <b>88.3</b>      | <b>90.8</b> | <b>88.8</b> | <b>85.5</b> | <b>-4%</b>       |

**Table 2: Detailed nitrogen balance sheet results, 2011 to 2014 (thousand tonnes of N)**

|                                       | Thousand tonnes of N |              |              |              |                  |
|---------------------------------------|----------------------|--------------|--------------|--------------|------------------|
|                                       | 2011                 | 2012         | 2013         | prov. 2014   | % change 2012/13 |
| <b>TOTAL INPUTS</b>                   | <b>1,594</b>         | <b>1,568</b> | <b>1,550</b> | <b>1,597</b> | <b>3%</b>        |
| <b>Fertilisers</b>                    | <b>821</b>           | <b>803</b>   | <b>770</b>   | <b>824</b>   | <b>7%</b>        |
| Inorganic fertilisers                 | 766                  | 756          | 725          | 777          | 7%               |
| Total organic fertilisers             | 55                   | 47           | 45           | 57           | 4%               |
| <b>Manures</b>                        | <b>561</b>           | <b>558</b>   | <b>563</b>   | <b>567</b>   | <b>1%</b>        |
| Livestock Manure Production           | 574                  | 571          | 577          | 581          | 1%               |
| Cattle                                | 369                  | 365          | 364          | 366          | 0%               |
| Pigs                                  | 41                   | 42           | 45           | 45           | -1%              |
| Sheep and goats                       | 76                   | 78           | 81           | 81           | 0%               |
| Poultry                               | 83                   | 80           | 82           | 84           | 3%               |
| Other livestock                       | 5                    | 5            | 5            | 5            | 5%               |
| Withdrawals                           | -13                  | -13          | -14          | -14          | 0%               |
| <b>Other inputs</b>                   | <b>212</b>           | <b>207</b>   | <b>216</b>   | <b>206</b>   | <b>-5%</b>       |
| Atmospheric Deposition                | 108                  | 111          | 112          | 105          | -7%              |
| Biological fixation                   | 96                   | 87           | 95           | 92           | -3%              |
| Seeds and Planting Material           | 8                    | 9            | 8            | 8            | -1%              |
| <b>TOTAL OFFTAKE</b>                  | <b>891</b>           | <b>838</b>   | <b>826</b>   | <b>905</b>   | <b>10%</b>       |
| <b>Total Harvested Crops</b>          | <b>486</b>           | <b>445</b>   | <b>433</b>   | <b>501</b>   | <b>16%</b>       |
| Cereals                               | 353                  | 328          | 320          | 375          | 17%              |
| Oil crops                             | 80                   | 74           | 62           | 70           | 12%              |
| Pulses and Beans                      | 17                   | 13           | 17           | 20           | 18%              |
| Industrial Crops                      | 14                   | 12           | 14           | 16           | 10%              |
| Other Crops                           | 21                   | 16           | 19           | 20           | 3%               |
| <b>Total Forage</b>                   | <b>395</b>           | <b>382</b>   | <b>385</b>   | <b>390</b>   | <b>1%</b>        |
| Harvested Fodder Crops                | 25                   | 25           | 31           | 29           | -7%              |
| Pasture                               | 370                  | 358          | 354          | 361          | 2%               |
| <b>Crop residues</b>                  | <b>10</b>            | <b>10</b>    | <b>8</b>     | <b>14</b>    | <b>69%</b>       |
| <b>BALANCE (Inputs minus Offtake)</b> | <b>703</b>           | <b>730</b>   | <b>723</b>   | <b>691</b>   | <b>-4%</b>       |
| <b>Managed area (thousand ha) (a)</b> | <b>7,967</b>         | <b>8,043</b> | <b>8,147</b> | <b>8,088</b> | <b>-1%</b>       |

(a) excludes rough grazing

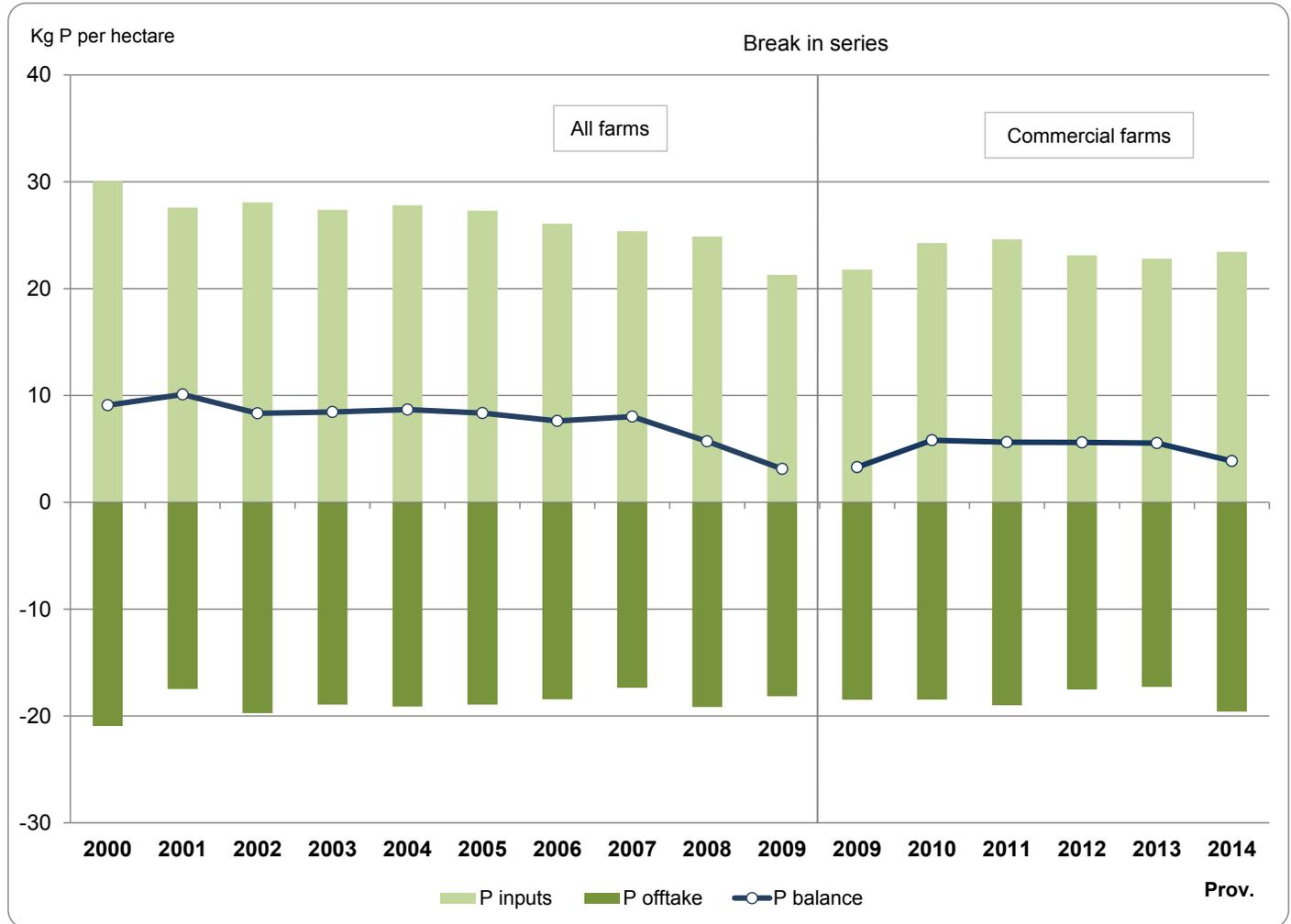
**Chart 2: Nitrogen use efficiency, 2000 to 2014**



Nitrogen use efficiency provides an indication of the efficiency with which the nutrients applied are taken up by the crops and forage. It is calculated as the ratio of inputs to offtake (whereas the balance is inputs minus offtake). A value of 1 would indicate that the application of nutrients precisely matches the crop requirements.

## England Phosphorus Balance

**Chart 3: Summary of Phosphorus balance for England, 2000 to 2014 (kg P per hectare)**



For the period 2013 to 2014 the key points are:

- There has been a reduction in the surplus of 2 kg/ha (30%) compared with 2013. As with nitrogen, this has been driven by an increase in offtake (via harvested crops and crop residue) which has more than offset an increase to inputs (mainly from inorganic manufactured fertilisers).

For the period 2000 to 2014 the key points are:

- Provisional estimates for 2014 show a fall in the total surplus per hectare of managed agricultural land in England from 9 kg/ha in 2000 to 4 kg/ha in 2014, a reduction of 57%.
- The main driver for the fall has been the reduction in inputs (from 30 to 23 kg/ha), due mainly to reduced fertiliser applications and manure production (as a result of declining livestock populations). The level of offtake has also reduced although to a lesser extent (from 21 to 20 kg/ha).
- The reductions in the surplus between 2007 and 2009 were due to increased offtake from harvested crops in 2008 and a sharp reduction in fertiliser applications in 2009.
- The series break is due to changes<sup>2</sup> in farm survey data collection.

<sup>2</sup> See [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/182206/defra-stats-foodfarm-landuselivestock-june-junemethodology-20120126.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182206/defra-stats-foodfarm-landuselivestock-june-junemethodology-20120126.pdf) for further information.

**Table 3: Phosphorus balance for England, 2011 to 2014 (kg P per hectare)**

|                                       | Kg P per hectare |            |            |            |                  |
|---------------------------------------|------------------|------------|------------|------------|------------------|
|                                       | 2011             | 2012       | 2013       | prov. 2014 | % change 2013/14 |
| Total Inputs                          | 24.6             | 23.1       | 22.8       | 23.4       | 3%               |
| Total Offtake                         | 19.0             | 17.5       | 17.3       | 19.6       | 13%              |
| <b>BALANCE (Inputs minus Offtake)</b> | <b>5.6</b>       | <b>5.6</b> | <b>5.5</b> | <b>3.9</b> | <b>-30%</b>      |

**Table 4: Detailed phosphorus balance sheet results, 2011 to 2014 (thousand tonnes P)**

|                                       | Thousand tonnes of P |              |              |              |                  |
|---------------------------------------|----------------------|--------------|--------------|--------------|------------------|
|                                       | 2011                 | 2012         | 2013         | prov. 2014   | % change 2013/14 |
| <b>TOTAL INPUTS</b>                   | <b>196</b>           | <b>186</b>   | <b>186</b>   | <b>190</b>   | <b>2%</b>        |
| <b>Fertilisers</b>                    | <b>92</b>            | <b>83</b>    | <b>82</b>    | <b>84</b>    | <b>3%</b>        |
| Inorganic fertilisers                 | 59                   | 57           | 57           | 59           | 3%               |
| Total organic fertilisers             | 33                   | 26           | 24           | 26           | 5%               |
| <b>Manures</b>                        | <b>99</b>            | <b>99</b>    | <b>100</b>   | <b>101</b>   | <b>1%</b>        |
| Livestock Manure Production           | 99                   | 99           | 100          | 101          | 1%               |
| Cattle                                | 58                   | 57           | 57           | 58           | 1%               |
| Pigs                                  | 8                    | 8            | 9            | 9            | -1%              |
| Sheep and goats                       | 12                   | 12           | 12           | 13           | 0%               |
| Poultry                               | 20                   | 19           | 19           | 20           | 3%               |
| Other livestock                       | 2                    | 2            | 2            | 2            | 5%               |
| Withdrawals                           |                      |              |              |              | -                |
| <b>Other inputs</b>                   | <b>4</b>             | <b>5</b>     | <b>5</b>     | <b>5</b>     | <b>-1%</b>       |
| Atmospheric Deposition                | 3                    | 3            | 3            | 3            | -1%              |
| Seeds and Planting Material           | 2                    | 2            | 2            | 2            | 0%               |
| <b>TOTAL OFFTAKE</b>                  | <b>151</b>           | <b>141</b>   | <b>141</b>   | <b>158</b>   | <b>13%</b>       |
| <b>Total Harvested Crops</b>          | <b>86</b>            | <b>78</b>    | <b>78</b>    | <b>94</b>    | <b>20%</b>       |
| Cereals                               | 61                   | 56           | 57           | 71           | 23%              |
| Oil crops                             | 16                   | 15           | 13           | 14           | 13%              |
| Pulses and Beans                      | 2                    | 2            | 2            | 2            | 18%              |
| Industrial Crops                      | 3                    | 3            | 3            | 3            | 10%              |
| Other Crops                           | 3                    | 3            | 3            | 3            | 0%               |
| <b>Total Forage</b>                   | <b>64</b>            | <b>61</b>    | <b>61</b>    | <b>62</b>    | <b>2%</b>        |
| Harvested Fodder Crops                | 5                    | 5            | 6            | 5            | -7%              |
| Pasture                               | 59                   | 56           | 56           | 57           | 3%               |
| <b>Crop residues</b>                  | <b>2</b>             | <b>2</b>     | <b>1</b>     | <b>2</b>     | <b>69%</b>       |
| <b>BALANCE (Inputs minus Offtake)</b> | <b>45</b>            | <b>45</b>    | <b>47</b>    | <b>31</b>    | <b>-31%</b>      |
| <b>Managed area (thousand ha) (a)</b> | <b>7,967</b>         | <b>8,043</b> | <b>8,147</b> | <b>8,088</b> | <b>-1%</b>       |

(a) excludes rough grazing

## Background and methodology

A methodology for calculating soil nutrient balances has been developed by OECD<sup>3</sup> and adopted by Eurostat<sup>4</sup>. Soil nutrient balances provide a method for estimating the nutrient loadings of nitrogen and phosphorus to managed agricultural soils. Whilst a shortage of nutrients can limit the productivity of agricultural soils, a surplus of these nutrients poses a serious environmental risk. Losses of nutrients to the environment can impact on air quality (ammonia emissions), water quality (nitrate and phosphate levels in rivers) and climate change (nitrous oxide emissions). A soil nutrient balance estimate, expressed as a loading of nitrogen or phosphorus per hectare of managed agricultural land can be used as an indicator of the environmental risks. It provides a high level measure which can be used to monitor long term trends and to make meaningful comparisons between countries.

The approach estimates the full range of nutrient inputs and removals to soils from all sources. The input sources are: manures, mineral fertilisers, atmospheric deposition and biological fixation. The removals sources are: crop production and fodder production for livestock, including grazing. The nutrient input or removal from each source is either estimated directly (atmospheric deposition) or calculated by applying a coefficient (e.g. for the amount of nitrogen that a dairy cow produces each year) to the corresponding physical data characteristic (e.g. number of dairy cows). The relevant coefficients are derived from research and the physical data is taken from a wide range of data sources many of which are already published as official statistics.

Although based on an internationally recognised methodology, the nutrient balance estimates are subject to a level of uncertainty or error margins. The physical data on which the estimates are based is subject to uncertainty because it is generally collected using a sample survey with associated sampling error margins. Similarly, the coefficients are derived from sound research but are subject to uncertainty and are, out of necessity, based on average rates (e.g. average amount of nitrogen taken up by the growth of a tonne of wheat). There can be a considerable amount of variation within these averages with no cost-effective method of taking this variation into account.

Fertilisers and animal feeds (a main source of agricultural nutrients) represent significant input costs to farming and therefore efficient use of these inputs can make a significant contribution to the profitability of farm businesses whilst at the same time reducing the environmental impacts.

The estimates presented here utilise the June Survey data for England for commercial holdings<sup>5</sup> for 2009 onwards. A consistent time series can be found in the accompanying excel worksheets.

Managed agricultural land has been defined as the utilised agricultural area (UAA) excluding common land and sole right rough grazing.

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<sup>3</sup> Organisation for Economic Cooperation and Development

<sup>4</sup> Eurostat is the Statistical body of the European Commission

<sup>5</sup> See [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/182206/defra-stats-foodfarm-landuselivestock-june-junemethodology-20120126.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182206/defra-stats-foodfarm-landuselivestock-june-junemethodology-20120126.pdf) for further information.

## Developing the methodology

The estimates within this release are based on a programme of work to develop and improve the methodology and data sources. This work includes two funded projects<sup>6,7</sup> and follow-up work carried out within Defra. Details of the two projects are available at <https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/series/agri-environment-analysis>.

The follow-up work is presented in a separate paper<sup>8</sup> that gives an overview of the methods utilised to compile the data series within this release. The paper also gives details of where they differ to the proposals within the ADAS project and provides a commentary on the resultant balances and components.

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<sup>6</sup> TAPAS Funded Project – UK Soil Nutrient Balances, May 2009

<sup>7</sup> UK Nutrient Balances Methodology Review, ADAS, April 2011

<sup>8</sup> Observatory Report: Soil Nutrient Balances 2010 Update, April 2011