



# Department for Environment Food & Rural Affairs

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## Soil Nutrient Balances UK Provisional Estimates for 2016

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 is also used by Defra to monitor farming's environmental performance.

### Summary of key results

#### Nitrogen

- Provisional estimates for 2016 show that the nitrogen balance for the United Kingdom was a surplus of 91 kg/ha of managed agricultural land. This is an increase of 3.4 kg/ha (4%) compared to 2015, and a reduction of 20 kg/ha (-18%) compared to 2000, continuing the long-term downward trend.
- The increase between 2015 and 2016 has been driven by a decrease in overall offtake (mainly via harvested crops) while inputs remained virtually unchanged. The decrease in offtake reflects a reduction in overall production compared to the high levels seen in 2015.
- The main drivers for the overall reduction in the surplus since 2000 have been reductions in the application of inorganic (manufactured) fertilisers and manure production (due to lower livestock numbers), although this has been partially offset by a reduction in the nitrogen offtake (particularly forage) over the same period.

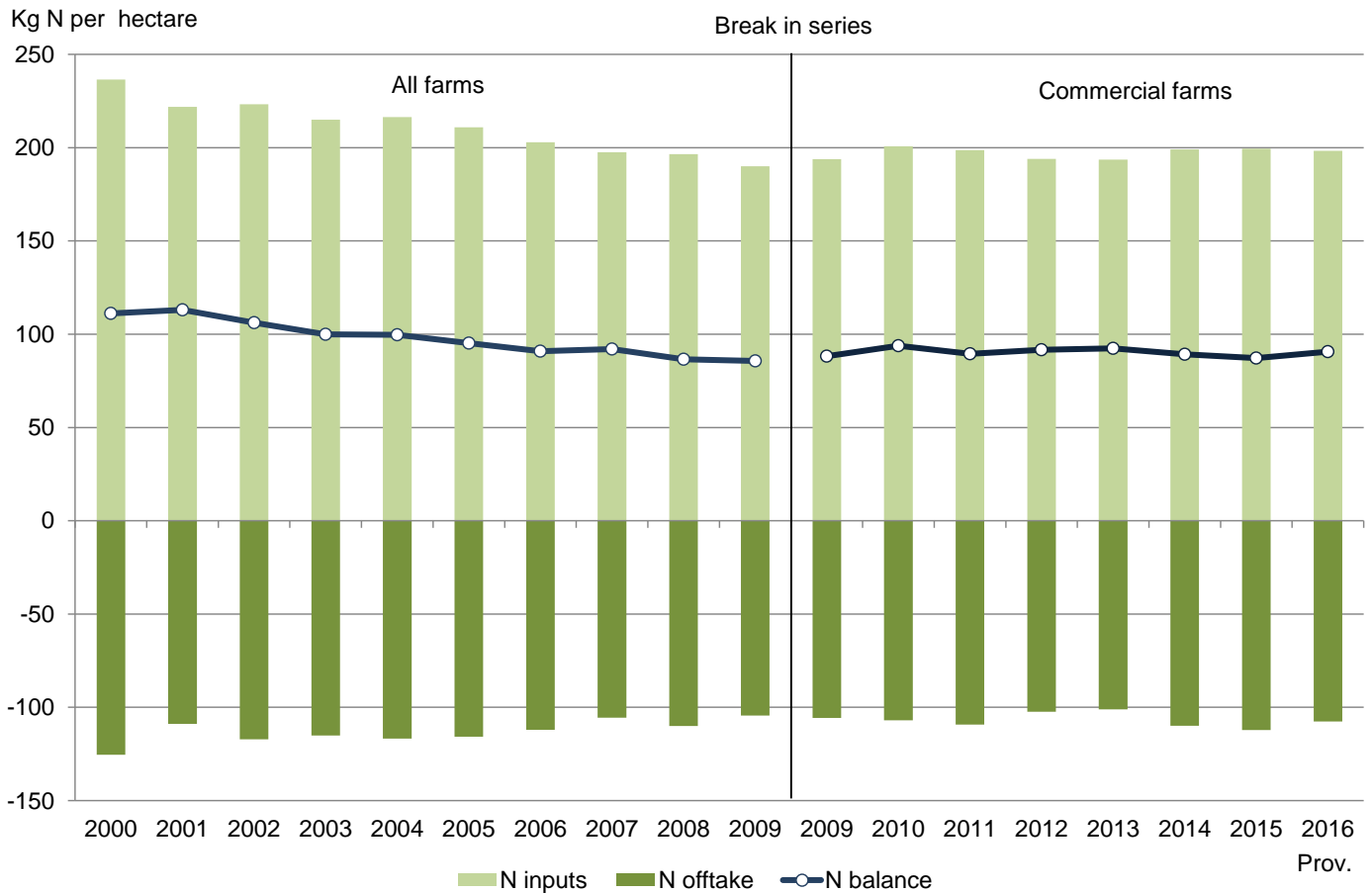
#### Phosphorus

- Provisional estimates for 2016 show that the phosphorus balance for the United Kingdom was a surplus of 6.6 kg/ha of managed agricultural land. This is an increase 1.4 kg/ha (26%) compared to 2015 and a reduction of 3.4 kg/ha (-34%) compared to 2000.
- The increase between 2015 and 2016 reflects a decrease in offtake while inputs increased slightly. In the longer term the trend is downward, again with similar drivers to nitrogen.

## Detail

### UK Nitrogen Balance

Chart 1: Summary of nitrogen balance for UK, 2000 to 2016 (kg N per hectare)



For the period 2015 to 2016 the key points are:

- The 3.4 kg/ha increase (4%) in the total surplus has largely been driven by a reduction in offtake (mainly via harvested crops) of 4% while inputs (mainly from inorganic manufactured fertilisers and livestock manures) changed little over the same period.
- The fall in harvested crops is particularly pronounced for oil crops reflecting an 11% fall in the planted area of oilseed rape compared to 2015, and reduced yields due to poor weather conditions in key parts of the growing season along with high disease and pest pressure.
- The changes seen in 2015 and 2016 to inputs via biological fixation and offtake via harvested pulses and beans are likely to have been influenced by Common Agricultural Policy greening measures.

For the period 2000 to 2016 the key points are:

- An 18% fall in the total surplus per hectare of managed agricultural land from 111 kg/ha to 91 kg/ha.
- The main driver has been a 38 kg/ha decrease in inputs (from 237 kg/ha to 198 kg/ha) due to decreases in the application of inorganic (manufactured) fertilisers and manure production (the result of lower livestock numbers). This has been partially offset by an 18 kg/ha reduction in offtake (particularly forage) from 125 kg/ha to 108 kg/ha.
- The series break is due to changes<sup>1</sup> in farm survey data collection in England.

<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 UK, 2013 to 2016 (kg N per hectare)

	2013	2014	2015	prov. 2016	% change 2015/16
Total Inputs	193.5	199.1	199.4	198.3	-1%
Total Offtake	101.1	109.9	112.2	107.6	-4%
<b>BALANCE (Inputs minus Offtake)</b>	<b>92.4</b>	<b>89.2</b>	<b>87.2</b>	<b>90.7</b>	<b>4%</b>

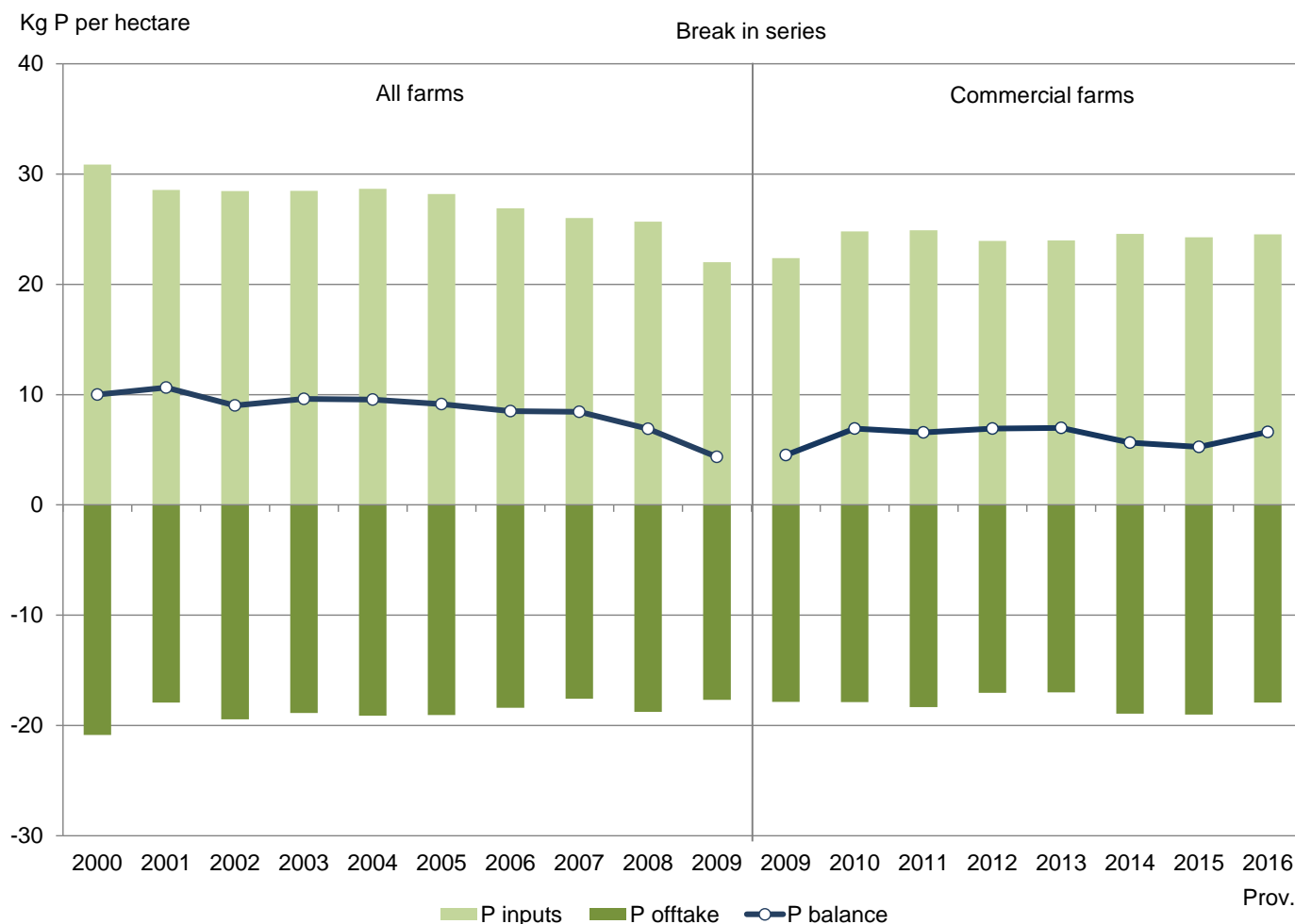
Table 2: Detailed nitrogen balance sheet results, 2013 to 2016 (thousand tonnes N)

	2013	2014	2015	prov. 2016	% change 2015/16
<b>TOTAL INPUTS</b>	<b>2,346</b>	<b>2,411</b>	<b>2,423</b>	<b>2,419</b>	<b>0%</b>
Fertilisers	1,056	1,119	1,108	1,085	-2%
Inorganic fertilisers	999	1,060	1,049	1,026	-2%
Total organic fertilisers	57	59	59	59	0%
Manures	990	1,000	1,002	1,015	1%
Livestock Manure Production	1,008	1,017	1,019	1,033	1%
Cattle	661	664	669	674	1%
Pigs	55	54	54	54	2%
Sheep and goats	177	180	178	183	3%
Poultry	108	111	114	111	-3%
Other livestock	7	7	7	7	-5%
Withdrawals	-17	-17	-17	-17	0%
Other inputs	299	292	313	319	2%
Atmospheric Deposition	157	153	153	155	1%
Biological fixation	130	128	149	153	3%
Seeds and Planting Material	12	11	11	11	0%
<b>TOTAL OFFTAKE</b>	<b>1,226</b>	<b>1,331</b>	<b>1,363</b>	<b>1,313</b>	<b>-4%</b>
Total Harvested Crops	496	573	603	539	-11%
Cereals	373	433	452	417	-8%
Oil crops	66	75	77	55	-29%
Pulses and Beans	18	24	38	34	-11%
Industrial Crops	14	16	11	10	-9%
Other Crops	25	25	25	23	-8%
Total Forage	721	742	747	761	2%
Harvested Fodder Crops	39	36	36	38	3%
Pasture	682	706	711	724	2%
Crop residues	9	15	13	13	-1%
<b>BALANCE (Inputs minus Offtake)</b>	<b>1,120</b>	<b>1,080</b>	<b>1,060</b>	<b>1,106</b>	<b>4%</b>
Managed area (thousand ha) (a)	12,121	12,111	12,147	12,201	0%

(a) excludes rough grazing

## UK Phosphorus Balance

Chart 2: Summary of Phosphorus balance for UK, 2000 to 2016 (kg P per hectare)



For the period 2015 to 2016 the key points are:

- There has been an increase of 1.4 kg/ha (26%) in the surplus compared to 2015. This has been driven by a 6% decrease in offtake while inputs increased by 1%. As with nitrogen, the decrease in offtake reflects a reduction in harvested crops, particularly oil crops.

For the period 2000 to 2016 the key points are:

- A fall in the total surplus per hectare of managed agricultural land from 10 kg/ha in 2000 to 6.6 kg/ha in 2016 (-34%).
- The main driver has been a reduction in inputs (from 31 to 25 kg/ha) reflecting reduced fertiliser application rates and manure production (due to declining livestock populations). Total offtake has fallen from 21 to 18 kg/ha, largely due to reduced forage production.
- After remaining level from 2002 to 2007 there was a sharp fall in the surplus between 2007 and 2009 although the surplus has since returned to levels more consistent with the longer term trend.
- The series break is due to changes<sup>2</sup> in farm survey data collection in England.

<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 UK, 2013 to 2016 (kg P per hectare)

	2013	2014	2015	prov. 2016	% change 2015/16
Total Inputs	24.0	24.6	24.3	24.5	1%
Total Offtake	17.0	18.9	19.0	17.9	-6%
<b>BALANCE (Inputs minus Offtake)</b>	<b>7.0</b>	<b>5.6</b>	<b>5.3</b>	<b>6.6</b>	<b>26%</b>

Table 4: Detailed phosphorus balance sheet results for 2013 to 2016 (thousand tonnes P)

	2013	2014	2015	prov. 2016	% change 2015/16
<b>TOTAL INPUTS</b>	<b>291</b>	<b>298</b>	<b>295</b>	<b>299</b>	<b>2%</b>
Fertilisers	114	119	116	118	2%
Inorganic fertilisers	85	88	86	88	3%
Total organic fertilisers	29	31	31	31	0%
Manures	170	172	172	174	1%
Livestock Manure Production	170	172	172	174	1%
Cattle	103	104	104	105	1%
Pigs	11	11	11	11	2%
Sheep and goats	27	28	27	28	3%
Poultry	26	26	26	27	3%
Other livestock	3	3	3	2	-5%
Withdrawals					-
Other inputs	7	7	7	7	1%
Atmospheric Deposition	5	5	5	5	1%
Seeds and Planting Material	2	2	2	2	0%
<b>TOTAL OFFTAKE</b>	<b>206</b>	<b>229</b>	<b>231</b>	<b>219</b>	<b>-5%</b>
Total Harvested Crops	91	109	111	96	-13%
Cereals	68	83	84	75	-11%
Oil crops	13	15	16	11	-29%
Pulses and Beans	2	3	4	4	-11%
Industrial Crops	3	3	2	2	-9%
Other Crops	4	7	4	4	-6%
Total Forage	114	118	118	121	2%
Harvested Fodder Crops	7	7	7	7	3%
Pasture	106	111	111	114	2%
Crop residues	2	3	2	2	-1%
<b>BALANCE (Inputs minus Offtake)</b>	<b>85</b>	<b>68</b>	<b>64</b>	<b>81</b>	<b>26%</b>
Managed area (thousand ha) (a)	12,121	12,111	12,147	12,201	0%

(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 use the June Survey data for England for commercial holdings<sup>5</sup> for 2009 onwards and for all farms for preceding years. 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

<http://webarchive.nationalarchives.gov.uk/20130222210445/http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-enviro-obs-research-soilnutrientbalance-1108-update.pdf>