



Department for Environment Food & Rural Affairs

Published 27th July 2017

Soil Nutrient Balances England 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 England was a surplus of 85 kg/ha of managed agricultural land. This is a 4.0 kg/ha increase (5%) compared to 2015 and a 23 kg/ha reduction (-21%) 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 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.

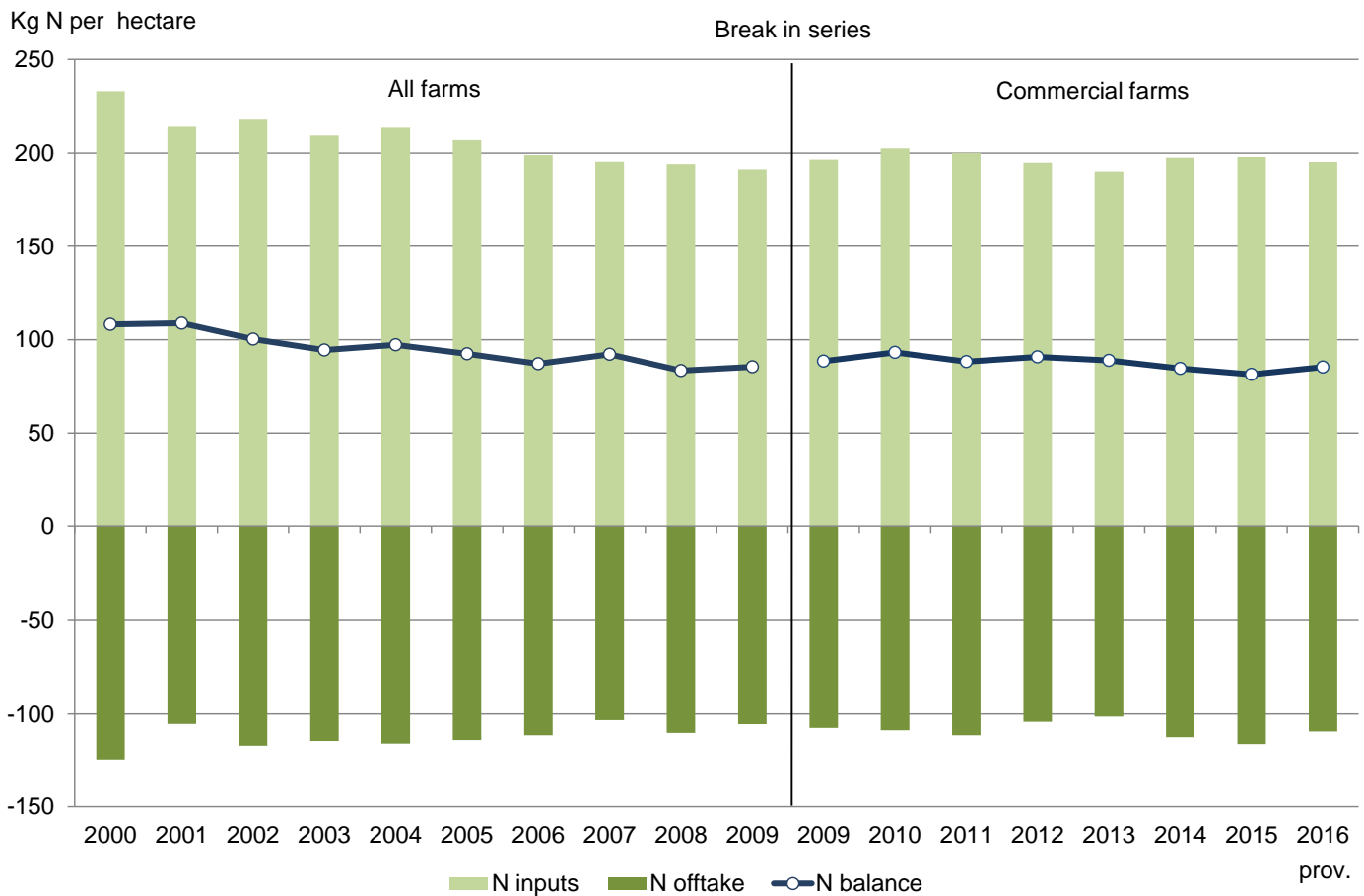
Phosphorus

- Provisional estimates for 2016 show that the phosphorus balance for England was a surplus of 4.7 kg/ha of managed agricultural land. This is an increase of 1.4 kg/ha (42%) compared to 2015 and a 4.3 kg/ha reduction (-48%) compared to 2000.
- As with nitrogen, the increase between 2015 and 2016 reflects a decrease in offtake while inputs remained virtually unchanged. 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 2016 (kg N per hectare)



For the period 2015 to 2016 the key points are:

- The 4.0 kg/ha (5%) increase has been driven by a 6% decrease in offtake (mainly via harvested crops) while inputs remained little changed compared to the previous year.
- 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:

- 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 2016.
- The main driver for the lower surplus has been a 38 kg/ha reduction in inputs (from 233 kg/ha to 195 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 15 kg/ha reduction (from 125 kg/ha to 110 kg/ha) in the nitrogen offtake (particularly forage).
- The series break is due to changes¹ in farm survey data collection.

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

Table 1: Nitrogen balance for England, 2013 to 2016 (kg N per hectare)

	2013	2014	2015	prov. 2016	% change 2015/16
Total Inputs	190.2	197.5	197.9	195.3	-1%
Total Offtake	101.4	112.9	116.5	109.9	-6%
BALANCE (Inputs minus Offtake)	88.8	84.6	81.4	85.4	5%

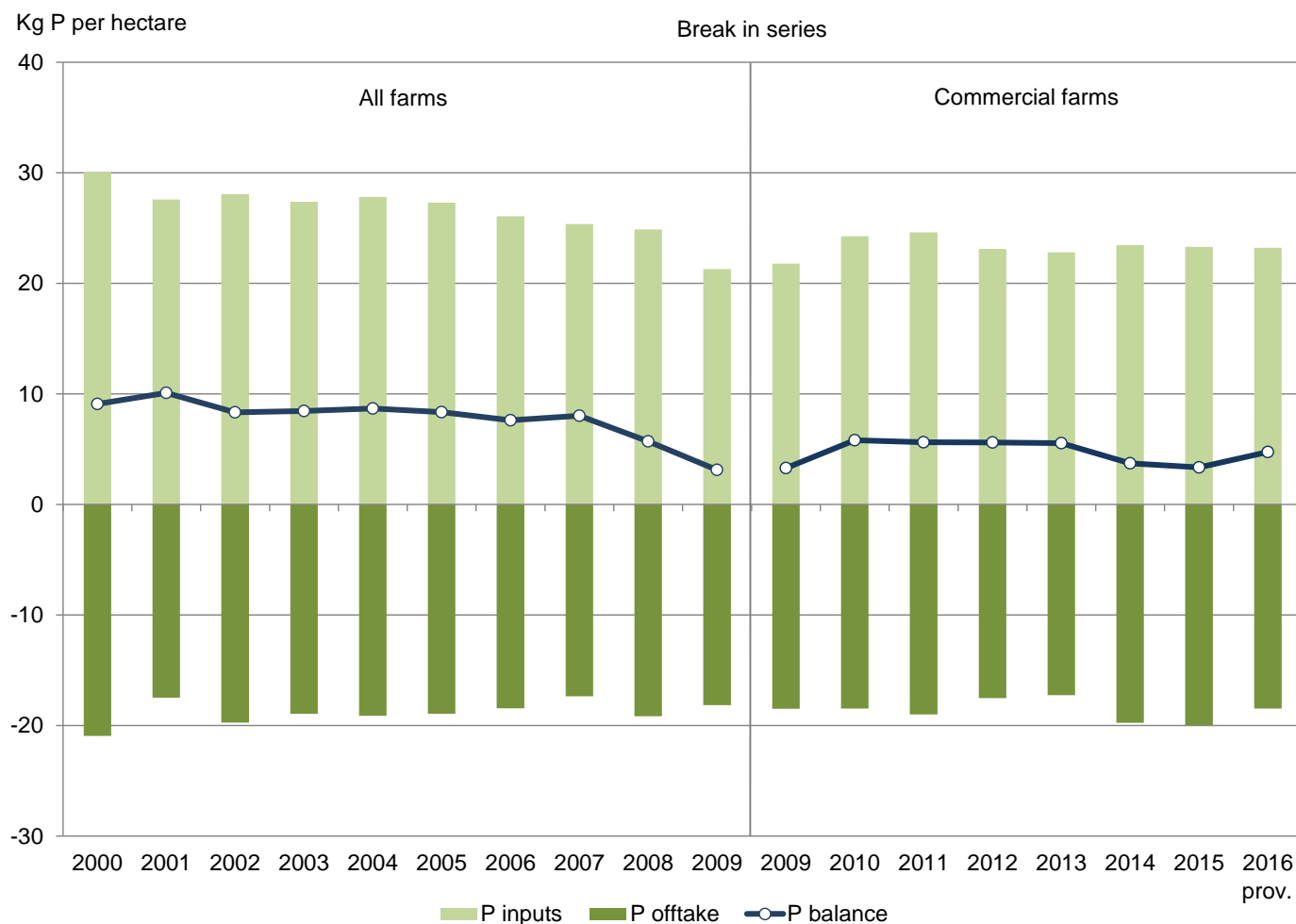
Table 2: Detailed nitrogen balance sheet results, 2013 to 2016 (thousand tonnes of N)

	2013	2014	2015	prov. 2016	% change 2015/16
TOTAL INPUTS	1,550	1,597	1,593	1588	0%
Fertilisers	770	824	804	786	-2%
Inorganic fertilisers	725	777	757	739	-2%
Total organic fertilisers	45	47	46	47	0%
Manures	563	567	564	571	1%
Livestock Manure Production	577	581	578	584	1%
Cattle	364	366	367	368	0%
Pigs	45	45	44	44	1%
Sheep and goats	81	81	79	81	3%
Poultry	82	84	84	86	2%
Other livestock	5	5	5	4	-4%
Withdrawals	-14	-14	-14	-14	0%
Other inputs	216	206	225	231	3%
Atmospheric Deposition	112	105	105	106	1%
Biological fixation	95	92	112	117	4%
Seeds and Planting Material	9	9	8	9	0%
TOTAL OFFTAKE	826	913	938	894	-5%
Total Harvested Crops	433	504	533	475	-11%
Cereals	320	375	394	363	-8%
Oil crops	62	70	72	51	-29%
Pulses and Beans	17	23	37	33	-10%
Industrial Crops	14	16	11	10	-9%
Other Crops	20	20	19	18	-6%
Total Forage	385	395	394	407	3%
Harvested Fodder Crops	31	29	30	31	5%
Pasture	354	366	364	376	3%
Crop residues	8	14	12	12	-1%
BALANCE (Inputs minus Offtake)	724	684	655	694	6%
Managed area (thousand ha) (a)	8,147	8,088	8,049	8,128	1%

(a) excludes rough grazing

England Phosphorus Balance

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



For the period 2015 to 2016 the key points are:

- There has been an increase in the surplus of 1.4 kg/ha (42%) compared with 2015. This has been driven by a 7% decrease in offtake while inputs remained little changed. 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:

- Provisional estimates for 2016 show a fall in the total surplus per hectare of managed agricultural land in England from 9.1 kg/ha in 2000 to 4.7 kg/ha in 2016, a 48% reduction.
- 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 18 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 changes² in farm survey data collection.

² See 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, 2013 to 2016 (kg P per hectare)

	2013	2014	2015	prov. 2016	% change 2015/16
Total Inputs	22.8	23.5	23.3	23.2	0%
Total Offtake	17.3	19.8	20.0	18.5	-7%
BALANCE (Inputs minus Offtake)	5.5	3.7	3.3	4.7	42%

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

	2013	2014	2015	prov. 2016	% change 2015/16
TOTAL INPUTS	186	190	188	189	1%
Fertilisers	82	84	83	83	0%
Inorganic fertilisers	57	59	58	57	0%
Total organic fertilisers	24	26	26	26	0%
Manures	100	101	100	101	1%
Livestock Manure Production	100	101	100	101	1%
Cattle	57	58	58	58	0%
Pigs	9	9	9	9	1%
Sheep and goats	12	13	12	13	5%
Poultry	19	20	20	21	2%
Other livestock	2	2	2	2	-4%
Withdrawals					-
Other inputs	5	5	5	5	1%
Atmospheric Deposition	3	3	3	3	1%
Seeds and Planting Material	2	2	2	2	0%
TOTAL OFFTAKE	141	160	161	150	-7%
Total Harvested Crops	78	94	96	83	-14%
Cereals	57	71	72	64	-11%
Oil crops	13	14	15	10	-29%
Pulses and Beans	2	3	4	4	-10%
Industrial Crops	3	3	2	2	-9%
Other Crops	3	3	3	3	-3%
Total Forage	61	63	63	65	4%
Harvested Fodder Crops	6	5	5	6	5%
Pasture	56	58	57	60	4%
Crop residues	1	2	2	2	-1%
BALANCE (Inputs minus Offtake)	44	30	27	39	43%
Managed area (thousand ha) (a)	8,147	8,088	8,049	8,128	1%

(a) excludes rough grazing

Background and methodology

A methodology for calculating soil nutrient balances has been developed by OECD³ and adopted by Eurostat⁴. 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 holdings⁵ 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.

³ Organisation for Economic Cooperation and Development

⁴ Eurostat is the Statistical body of the European Commission

⁵ See 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^{6,7} 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 paper⁸ 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.

⁶ TAPAS Funded Project – UK Soil Nutrient Balances, May 2009

⁷ UK Nutrient Balances Methodology Review, ADAS, April 2011

⁸ 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-environ-obs-research-soilnutrientbalance-1108-update.pdf>