Department for Environment Food & Rural Affairs

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Soil Nutrient Balances
England Provisional Estimates for 2015

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 2015 show that the nitrogen balance for England was a surplus of 82 kg/ha of managed agricultural land. This is a 3 kg/ha decrease (-4%) compared to 2014 and a 27 kg/ha reduction (-25%) compared to 2000, continuing the long term downward trend.
- The reduction between 2014 and 2015 has been driven by a small increase in offtake (mainly via harvested crops) while overall, inputs remained virtually unchanged.
- 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 2015 show that the phosphorus balance for England was a surplus of 3 kg/ha of managed agricultural land. This is a decrease of less than 1 kg/ha (-10%) compared to 2014 and a 6 kg/ha reduction (-63%) compared to 2000.
- The small reduction between 2014 and 2015 reflects the minimal change in both inputs and offtake between the two years. In the longer term the trend is downward, again with similar drivers to nitrogen.

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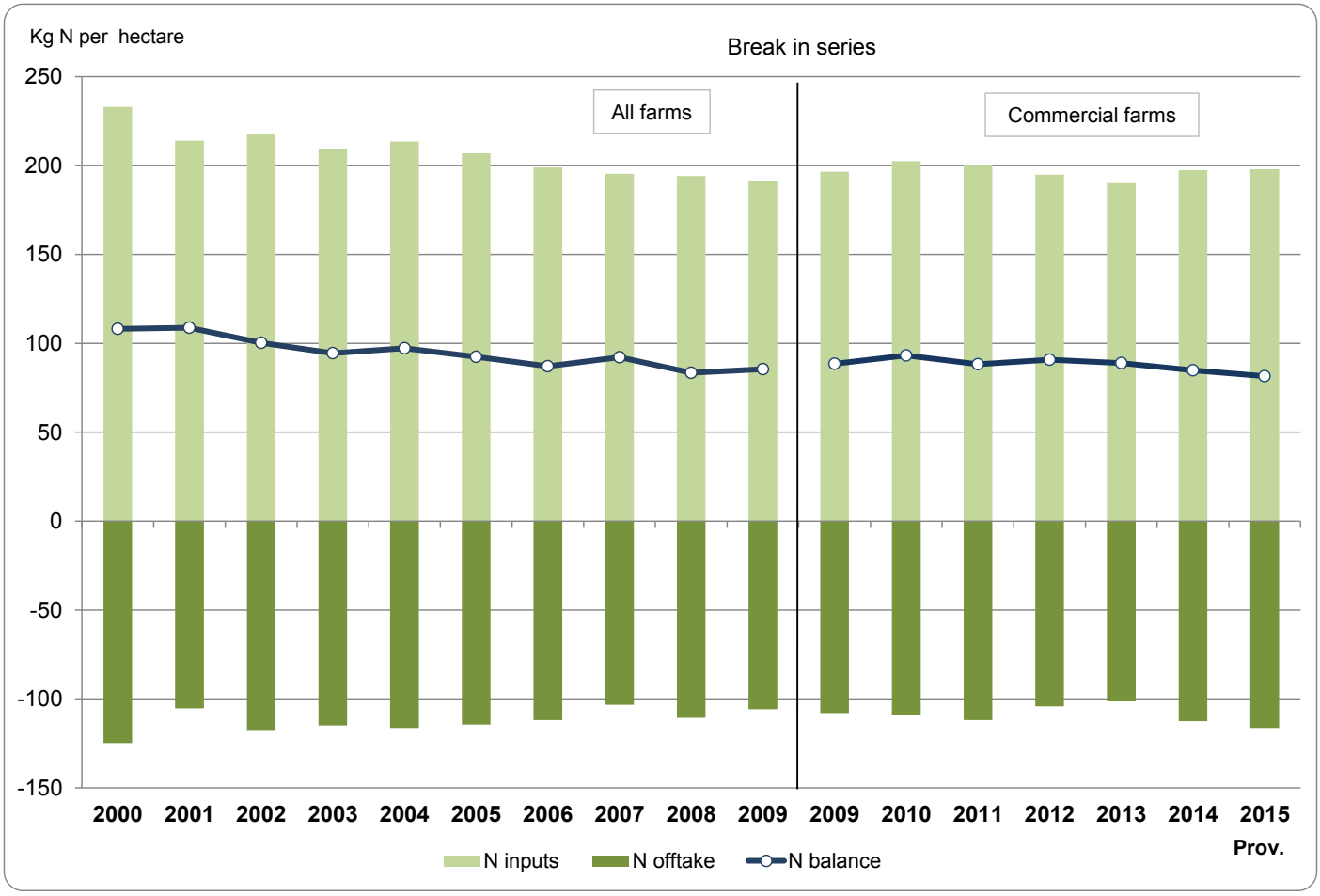
Detail

England Nitrogen Balance

Chart 1: Summary of Nitrogen balance for England, 2000 to 2015 (kg N per hectare)



For the period 2014 to 2015 the key points are:

- The 3 kg/ha reduction (-4%) has been driven by a small increase in offtake (mainly via harvested crops) while inputs (mainly from inorganic manufactured fertilisers and livestock manures) remained little changed, or saw decreases compared to the previous year.
- The largest percent change in both 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 2015 the key points are:

- A 25% fall in the total surplus per hectare of managed agricultural land in England from 108 kg/ha in 2000 to 82 kg/ha in 2015.
- The main driver for the lower surplus has been a 35 kg/ha reduction in inputs (from 233 kg/ha to 198 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 9 kg/ha reduction (from 125 kg/ha to 116 kg/ha) in the nitrogen offtake (particularly forage).
- The series break is due to changes[1] 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, 2012 to 2015 (kg N per hectare)

	2012	2013	2014	prov. 2015	% change 2014/15
Total Inputs	194.9	190.2	197.4	197.9	0%
Total Offtake	104.1	101.4	112.6	116.4	3%
BALANCE (Inputs minus Offtake)	**90.8**	**88.8**	**84.9**	**81.6**	**-4%**

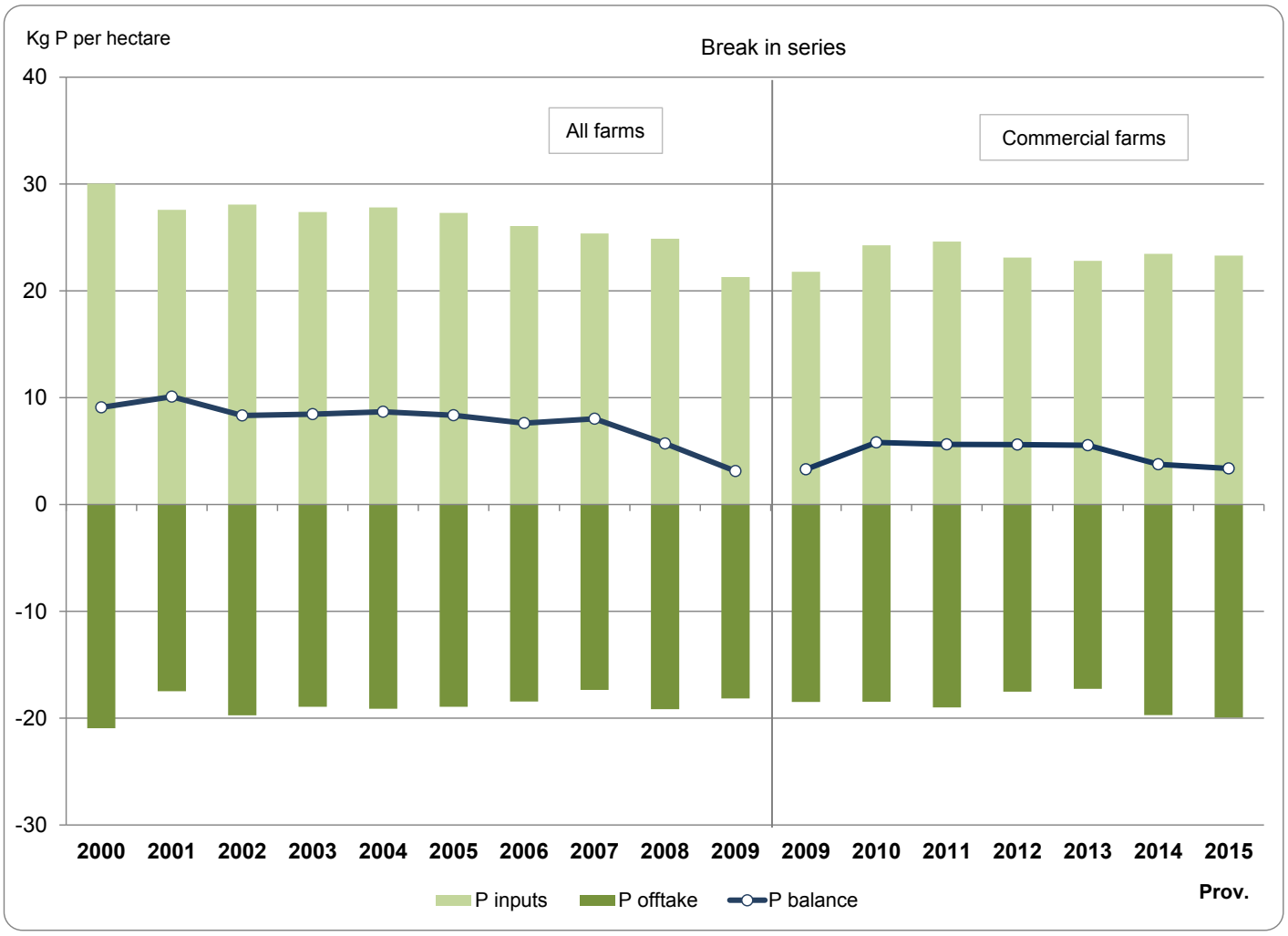
Table 2: Detailed nitrogen balance sheet results, 2012 to 2015 (thousand tonnes of N)

	2012	2013	2014	prov. 2015	% change 2014/15
TOTAL INPUTS	**1,568**	**1,550**	**1,597**	**1,593**	**0%**
Fertilisers	**803**	**770**	**824**	**804**	**-2%**
Inorganic fertilisers	756	725	777	757	-3%
Total organic fertilisers	47	45	47	46	0%
Manures	**558**	**563**	**567**	**564**	**-1%**
Livestock Manure Production	571	577	581	578	-1%
Cattle	365	364	366	367	0%
Pigs	42	45	45	44	-3%
Sheep and goats	78	81	81	79	-3%
Poultry	80	82	84	84	0%
Other livestock	5	5	5	0	-10%
Withdrawals	-13	-14	-14	-14	0%
Other inputs	**207**	**216**	**206**	**225**	**9%**
Atmospheric Deposition	111	112	105	105	0%
Biological fixation	87	95	92	112	21%
Seeds and Planting Material	9	9	9	8	-2%
TOTAL OFFTAKE	**838**	**826**	**910**	**937**	**3%**
Total Harvested Crops	**445**	**433**	**501**	**529**	**6%**
Cereals	328	320	375	394	5%
Oil crops	74	62	70	72	3%
Pulses and Beans	13	17	20	33	67%
Industrial Crops	12	14	16	11	-33%
Other Crops	16	20	20	19	-4%
Total Forage	**382**	**385**	**395**	**396**	**0%**
Harvested Fodder Crops	25	31	29	30	2%
Pasture	358	354	366	366	0%
Crop residues	**10**	**8**	**14**	**12**	**-18%**
BALANCE (Inputs minus Offtake)	**730**	**724**	**686**	**656**	**-4%**
Managed area (thousand ha) (a)	**8,043**	**8,147**	**8,088**	**8,049**	**0%**

(a) excludes rough grazing

England Phosphorus Balance

Chart 2: Summary of Phosphorus balance for England, 2000 to 2015 (kg P per hectare)



For the period 2014 to 2015 the key points are:

- There has been a reduction in the surplus of less than 1 kg/ha (-10%) compared with 2014. This reflects the minimal change in both inputs and offtake between the two years.

For the period 2000 to 2015 the key points are:

- Provisional estimates for 2015 show a fall in the total surplus per hectare of managed agricultural land in England from 9 kg/ha in 2000 to 3 kg/ha in 2015, a 63% 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 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[2] 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, 2012 to 2015 (kg P per hectare)

	2012	2013	2014	prov. 2015	% change 2014/15
Total Inputs	23.1	22.8	23.5	23.3	-1%
Total Offtake	17.5	17.3	19.7	19.9	1%
BALANCE (Inputs minus Offtake)	**5.6**	**5.5**	**3.8**	**3.4**	**-10%**

Table 4: Detailed phosphorus balance sheet results, 2012 to 2015 (thousand tonnes P)

	2012	2013	2014	prov. 2015	% change 2014/15
TOTAL INPUTS	**186**	**186**	**190**	**188**	**-1%**
Fertilisers	**83**	**82**	**84**	**83**	**-2%**
Inorganic fertilisers	57	57	59	58	-2%
Total organic fertilisers	26	24	26	26	0%
Manures	**99**	**100**	**101**	**100**	**-1%**
Livestock Manure Production	99	100	101	100	-1%
Cattle	57	57	58	58	0%
Pigs	8	9	9	9	-3%
Sheep and goats	12	12	13	12	-4%
Poultry	19	19	20	20	0%
Other livestock	2	2	2	2	-10%
Withdrawals					-
Other inputs	**5**	**5**	**5**	**4**	**-1%**
Atmospheric Deposition	3	3	3	3	-1%
Seeds and Planting Material	2	2	2	2	-2%
TOTAL OFFTAKE	**141**	**141**	**159**	**160**	**1%**
Total Harvested Crops	**78**	**78**	**94**	**95**	**2%**
Cereals	56	57	71	72	2%
Oil crops	15	13	14	15	3%
Pulses and Beans	2	2	2	4	67%
Industrial Crops	3	3	3	2	-33%
Other Crops	3	3	3	3	-5%
Total Forage	**61**	**61**	**63**	**63**	**-1%**
Harvested Fodder Crops	5	6	5	5	2%
Pasture	56	56	58	57	-1%
Crop residues	**2**	**1**	2	2	-18%
BALANCE (Inputs minus Offtake)	**45**	**44**	**30**	**27**	**-11%**
Managed area (thousand ha) (a)	**8,043**	**8,147**	**8,088**	**8,049**	**0%**

(a) excludes rough grazing

Background and methodology

A methodology for calculating soil nutrient balances has been developed by OECD[3] and adopted by Eurostat[4]. 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[5] 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 paper[8] 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