Department for Environment Food & Rural Affairs

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Soil Nutrient Balances
UK 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 the United Kingdom was a surplus of 87 kg/ha of managed agricultural land. This is a decrease of 2 kg/ha (- 2%) compared to 2014, and a reduction of 24 kg/ha (-21%) compared to 2000, continuing the long-term downward trend.
- The reduction between 2014 and 2015 has been mainly driven by a small increase in overall offtake (mainly via harvested crops) while inputs remained virtually unchanged.
- 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 2015 show that the phosphorus balance for the United Kingdom was a surplus of 5 kg/ha of managed agricultural land. This is a decrease of less than 1 kg/ha (-7%) compared to 2014 and a reduction of 5 kg/ha (-47%) 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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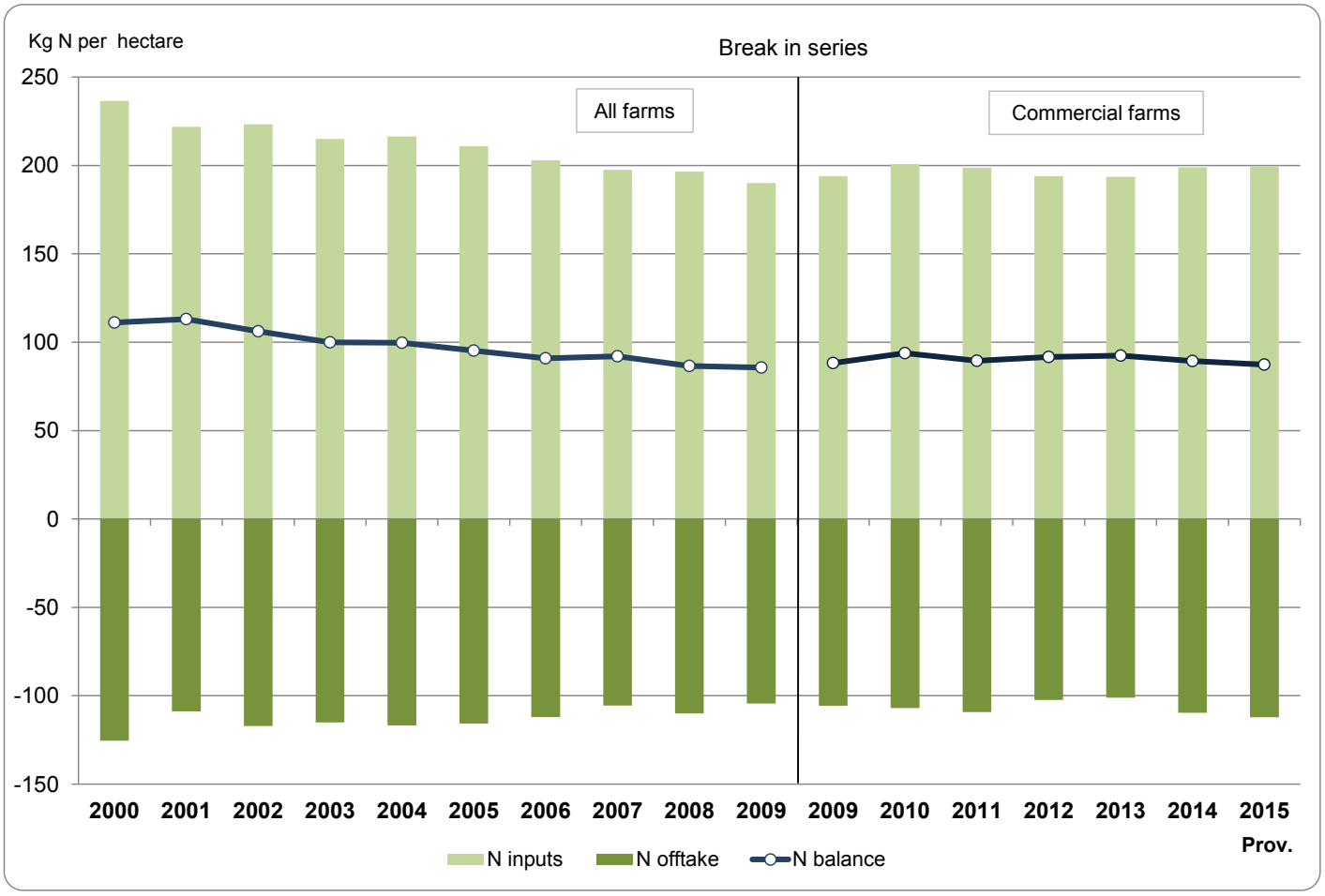
Detail

UK Nitrogen Balance

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



For the period 2014 to 2015 the key points are:

- The 2 kg/ha reduction (-2%) in the total surplus has mainly been driven by a small increase in offtake (mainly via harvested crops) while inputs (mainly from inorganic manufactured fertilisers and livestock manures) changed little over the same period.
- The largest percent change in both the inputs (via biological fixation) and offtake (via harvest 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 21% fall in the total surplus per hectare of managed agricultural land from 111 kg/ha to 87 kg/ha.
- The main driver has been a 37 kg/ha decrease in inputs (from 237 kg/ha to 199 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 a 13 kg/ha reduction in offtake (particularly forage) from 125 kg/ha to 112 kg/ha.
- The series break is due to changes[1] in farm survey data collection in England.

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

Table 1: Nitrogen balance for UK, 2012 to 2015 (kg N per hectare)

	Kg N per hectare				
	2012	2013	2014	prov. 2015	% change 2014/15
Total Inputs	193.9	193.5	199.0	199.4	0%
Total Outputs	102.3	101.1	109.6	112.1	2%
BALANCE (Inputs minus Outputs)	**91.6**	**92.4**	**89.4**	**87.3**	**-2%**

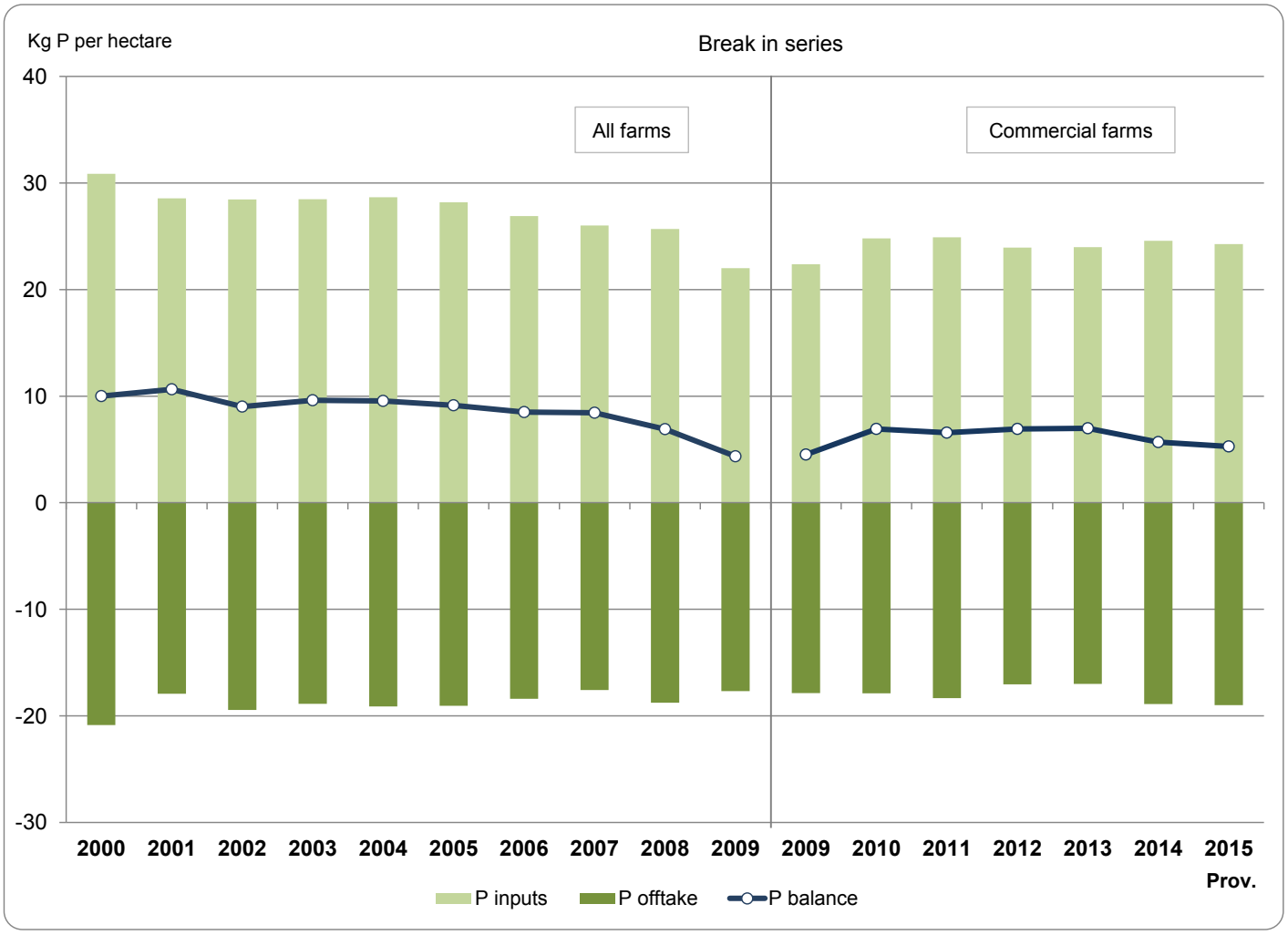
Table 2: Detailed nitrogen balance sheet results, 2012 to 2015 (thousand tonnes N)

	2012	2013	2014	prov. 2015	% change 2014/15
TOTAL INPUTS	**2,340**	**2,346**	**2,410**	**2,422**	**1%**
Fertilisers	**1,060**	**1,056**	**1,119**	**1,108**	**-1%**
Inorganic fertilisers	1,000	999	1,060	1,049	-1%
Total organic fertilisers	60	57	59	59	0%
Manures	**988**	**990**	**1,000**	**1,002**	**0%**
Livestock Manure Production	1,003	1,008	1,017	1,019	0%
Cattle	667	661	664	669	1%
Pigs	51	55	54	54	-1%
Sheep and goats	172	177	180	178	-1%
Poultry	106	108	111	111	0%
Other livestock	8	7	7	7	-7%
Withdrawals	-16	-17	-17	-17	0%
Other inputs	**292**	**299**	**291**	**313**	**7%**
Atmospheric Deposition	158	157	152	153	1%
Biological fixation	123	130	128	149	16%
Seeds and Planting Material	11	12	11	11	-3%
TOTAL OFFTAKE	**1,234**	**1,226**	**1,327**	**1,362**	**3%**
Total Harvested Crops	**502**	**496**	**570**	**600**	**5%**
Cereals	376	373	433	452	4%
Oil crops	78	66	75	77	3%
Pulses and Beans	14	18	21	35	66%
Industrial Crops	12	14	16	11	-33%
Other Crops	21	25	25	25	-1%
Total Forage	**721**	**721**	**742**	**750**	**1%**
Harvested Fodder Crops	31	39	36	36	1%
Pasture	690	682	706	713	1%
Crop residues	**11**	**9**	**15**	**13**	**-17%**
BALANCE (Inputs minus Offtake)	**1,105**	**1,120**	**1,082**	**1,060**	**-2%**
Managed area (thousand ha) (a)	**12,064**	**12,121**	**12,111**	**12,147**	**0%**

(a) excludes rough grazing

UK Phosphorus Balance

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



For the period 2014 to 2015 the key points are:

- There has been a reduction of less than 1 kg/ha (-7%) in the surplus compared to 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:

- A fall in the total surplus per hectare of managed agricultural land from 10 kg/ha in 2000 to 5 kg/ha in 2015 (-47%).
- The main driver has been a reduction in inputs (from 31 to 24 kg/ha) reflecting reduced fertiliser application rates and manure production (due to declining livestock populations). Total offtake has fallen from 21 to 19 kg/ha, largely due to reduced forage production.
- After a period of stability from 2002 to 2007 there was a sharp fall in the surplus between 2007 and 2009. The annual surplus then returned to levels more consistent with the longer term trend before falling again in 2014.
- The series break is due to changes[2] in farm survey data collection in England.

[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 UK, 2012 to 2015 (kg P per hectare)

	2012	2013	2014	prov. 2015	% change 2014/15
Total Inputs	23.9	24.0	24.6	24.3	-1%
Total Outputs	17.0	17.0	18.9	19.0	1%
BALANCE (Inputs minus Outputs)	**6.9**	**7.0**	**5.7**	**5.3**	**-7%**

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

	2012	2013	2014	prov. 2015	% change 2014/15
TOTAL INPUTS	**289**	**291**	**298**	**295**	**-1%**
Fertilisers	**113**	**114**	**119**	**116**	**-2%**
Inorganic fertilisers	82	85	88	86	-3%
Total organic fertilisers	31	29	31	31	0%
Manures	**169**	**170**	**172**	**172**	**0%**
Livestock Manure Production	169	170	172	172	0%
Cattle	104	103	104	104	1%
Pigs	10	11	11	11	-1%
Sheep and goats	27	27	28	27	-2%
Poultry	25	26	26	26	0%
Other livestock	3	3	3	3	-7%
Withdrawals					-
Other inputs	**7**	**7**	**7**	**7**	**-1%**
Atmospheric Deposition	5	5	5	5	0%
Seeds and Planting Material	2	2	2	2	-3%
TOTAL OFFTAKE	**206**	**206**	**229**	**231**	**1%**
Total Harvested Crops	**90**	**91**	**108**	**110**	**2%**
Cereals	66	68	83	84	1%
Oil crops	16	13	15	16	3%
Pulses and Beans	2	2	2	4	66%
Industrial Crops	3	3	3	2	-33%
Other Crops	3	4	6	4	-34%
Total Forage	**114**	**114**	**118**	**118**	**1%**
Harvested Fodder Crops	6	7	7	7	1%
Pasture	108	106	111	112	0%
Crop residues	**2**	**2**	**3**	**2**	**-17%**
BALANCE (Inputs minus Offtake)	**83**	**85**	**69**	**64**	**-7%**
Managed area (thousand ha) (a)	**12,064**	**12,121**	**12,111**	**12,147**	**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 use the June Survey data for England for commercial holdings[5] 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.

[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