Department
for Environment
Food & Rural Affairs

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Soil Nutrient Balances
UK 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 as a Defra 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 the United Kingdom was a surplus of 90 kg/ha of managed agricultural land. This is a decrease of 3 kg/ha (- 3%) compared to 2013, and a reduction of 21 kg/ha (-19%) compared to 2000, continuing the long-term downward trend.
- The reduction between 2013 and 2014 has been mainly driven by an increase in offtake (via harvested crops and crop residues) which more than offset an increase in inputs (mainly from inorganic manufactured fertilisers) over the same period.
- 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

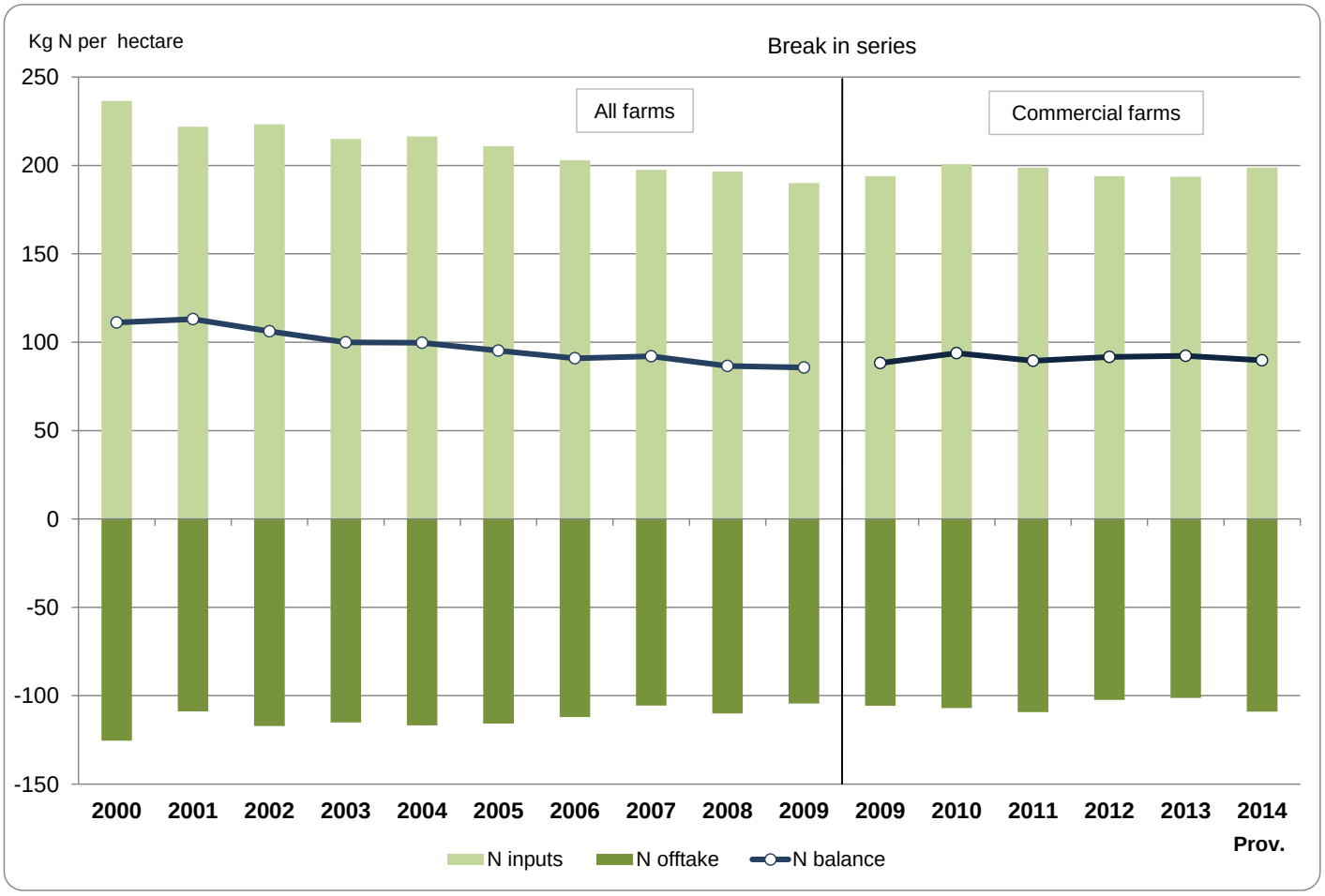
- Provisional estimates for 2014 show that the phosphorus balance for the United Kingdom was a surplus of 6 kg/ha of managed agricultural land. This is a decrease of 1 kg/ha (-17%) compared to 2013 and a reduction of 4 kg/ha (-42%) compared to 2000.
- As with nitrogen, the reduction between 2013 and 2014 has been mainly driven by an increase in offtake while inputs increased by a much smaller margin in comparison. In the longer term the trend is downward, again with similar drivers to nitrogen.

Enquiries on this publication to Alison Wray, Department for Environment, Food and Rural Affairs, Foss House, Kings Pool, 1-2 Peasholme Green, York YO1 7PX, tel: 01904 456405, email: Observatory@defra.gsi.gov.uk.

Detail

UK Nitrogen Balance

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



For the period 2013 to 2014 the key points are:

- The reduction in the total surplus of 3 kg/ha (-3%) has mainly been driven by an increase in offtake (via harvested crops and crop residues). 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 19% fall in the total surplus per hectare of managed agricultural land from 111 kg/ha to 90 kg/ha.
- The main driver has been a decrease in inputs of 38 kg/ha (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 reduction in offtake (particularly forage) of 16 kg/ha (from 125 kg/ha to 109 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, 2011 to 2014 (kg N per hectare)

	Kg N per hectare				
	2011	2012	2013	prov. 2014	% change 2013/14
Total Inputs	198.7	193.9	193.5	198.8	3%
Total Outputs	109.2	102.3	101.2	109.0	8%
BALANCE (Inputs minus Outputs)	**89.5**	**91.6**	**92.3**	**89.8**	**-3%**

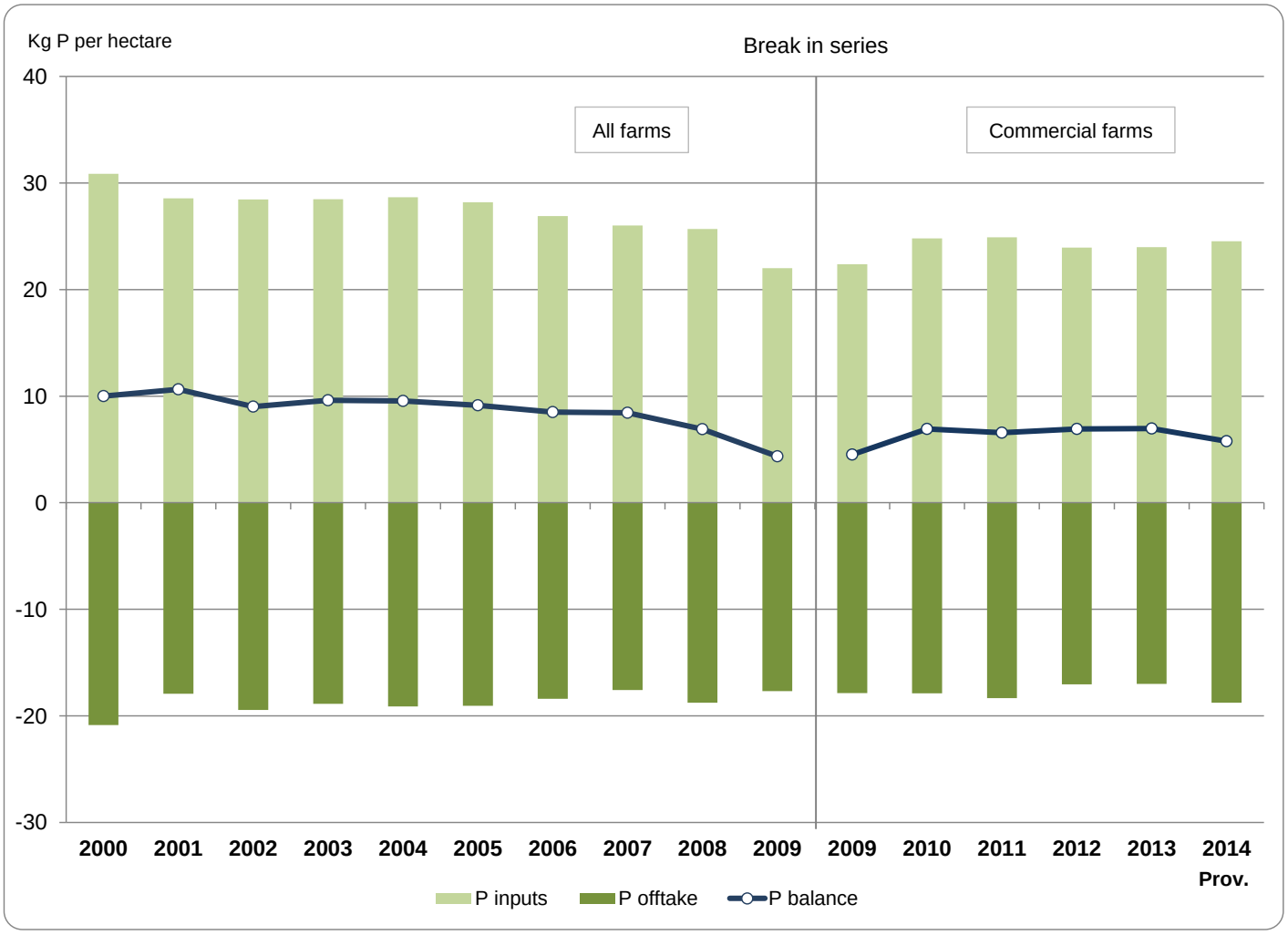
Table 2: Detailed nitrogen balance sheet results, 2011 to 2014 (thousand tonnes N)

	Thousand tonnes of N				
	2011	2012	2013	prov. 2014	% change 2013/14
TOTAL INPUTS	**2,383**	**2,340**	**2,346**	**2,407**	**3%**
Fertilisers	**1,090**	**1,060**	**1,056**	**1,119**	**6%**
Inorganic fertilisers	1,022	1,000	999	1,060	6%
Total organic fertilisers	68	60	57	59	3%
Manures	**989**	**988**	**990**	**1,000**	**1%**
Livestock Manure Production	1,004	1,003	1,008	1,017	1%
Cattle	670	667	661	664	0%
Pigs	51	51	55	54	0%
Sheep and goats	168	172	177	180	2%
Poultry	108	106	108	111	3%
Other livestock	8	8	7	7	3%
Withdrawals	-16	-16	-17	-17	0%
Other inputs	**304**	**292**	**299**	**288**	**-4%**
Atmospheric Deposition	162	158	157	149	-5%
Biological fixation	132	123	130	128	-2%
Seeds and Planting Material	10	11	11	11	-5%
TOTAL OFFTAKE	**1,310**	**1,234**	**1,227**	**1,320**	**8%**
Total Harvested Crops	**557**	**502**	**496**	**507**	**15%**
Cereals	412	376	373	433	16%
Oil crops	85	78	66	75	14%
Pulses and Beans	19	14	18	21	19%
Industrial Crops	14	12	14	16	10%
Other Crops	27	21	25	25	1%
Total Forage	**742**	**721**	**722**	**735**	**2%**
Harvested Fodder Crops	32	31	39	36	-7%
Pasture	709	690	683	699	2%
Crop residues	**11**	**11**	**9**	15	69%
BALANCE (Inputs minus Offtake)	**1,073**	**1,105**	**1,119**	**1,087**	**-3%**
Managed area (thousand ha) (a)	**11,992**	**12,064**	**12,121**	**12,111**	**0%**

(a) excludes rough grazing

UK Phosphorus Balance

Chart 2: Summary of Phosphorus balance for UK, 2000 to 2014 (kg P per hectare)



For the period 2013 to 2014 the key points are:

- There has been a reduction of 1 kg/ha (-17%) in the surplus compared to 2013. As with nitrogen, this is the result of a larger increase in offtake relative to that seen in the inputs (with similar drivers).

For the period 2000 to 2014 the key points are:

- A fall in the total surplus per hectare of managed agricultural land from 10 kg/ha in 2000 to 6 kg/ha in 2014 (-42%).
- 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 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, although the annual surplus has since returned to levels more consistent with the longer term trend.
- 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.

T**able 3: Phosphorus balance for UK, 2011 to 2014 (kg P per hectare)**

	Kg P per hectare				
	2011	2012	2013	prov. 2014	% change 2013/14
Total Inputs	24.9	23.9	24.0	24.5	2%
Total Outputs	18.3	17.0	17.0	18.8	10%
BALANCE (Inputs minus Outputs)	**6.6**	**6.9**	**7.0**	**5.8**	**-17%**

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

	Thousand tonnes of P				
	2011	2012	2013	2014	% change 2013/14
TOTAL INPUTS	**299**	**289**	**291**	**297**	**2%**
Fertilisers	**122**	**113**	**114**	**118**	**4%**
Inorganic fertilisers	84	82	85	88	4%
Total organic fertilisers	39	31	29	31	5%
Manures	**169**	**169**	**170**	**172**	**1%**
Livestock Manure Production	169	169	170	172	1%
Cattle	104	104	103	104	1%
Pigs	10	10	11	11	0%
Sheep and goats	26	27	27	28	2%
Poultry	26	25	26	26	3%
Other livestock	3	3	3	3	3%
Withdrawals					-
Other inputs	**7**	**7**	**7**	**7**	**-2%**
Atmospheric Deposition	5	5	5	5	-1%
Seeds and Planting Material	2	2	2	2	-4%
TOTAL OFFTAKE	**220**	**206**	**206**	**227**	**10%**
Total Harvested Crops	**100**	**90**	**91**	**108**	**19%**
Cereals	73	66	68	83	22%
Oil crops	17	16	13	15	14%
Pulses and Beans	2	2	2	2	19%
Industrial Crops	3	3	3	3	10%
Other Crops	4	3	4	6	51%
Total Forage	**118**	**114**	**114**	**116**	**2%**
Harvested Fodder Crops	6	6	7	7	-7%
Pasture	112	108	106	110	3%
Crop residues	**2**	**2**	**2**	**3**	**69%**
BALANCE (Inputs minus Offtake)	**79**	**83**	**84**	**70**	**-17%**
Managed area (thousand ha) (a)	**11,992**	**12,064**	**12,121**	**12,111**	**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