Department for Environment Food & Rural Affairs

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Soil Nutrient Balances
UK Provisional Estimates for 2013

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 2013 show that the nitrogen balance for the United Kingdom was a surplus of 92 kg/ha of managed agricultural land. This is an increase of 0.8 kg/ha compared to 2012 (+1%), but a reduction of 19 kg/ha (-17%) compared to 2000, continuing the long term downward trend.
- 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.
- The increase between 2012 and 2013 has been mainly driven by a small reduction in offtake (via harvested crops and crop residues) while inputs remained virtually unchanged.

Phosphorus

- Provisional estimates for 2013 show that the phosphorus balance for the United Kingdom was a surplus of 7.2 kg/ha of managed agricultural land. This is an increase of 0.2 kg/ha (+3%) compared to 2012, but a reduction of 2.8 kg/ha[1] (-28%) compared to 2000. As with nitrogen, the long term trend is downward (with similar drivers).
- The increase between 2012 and 2013 has been mainly driven by an increase in inputs from inorganic (manufactured) fertiliser while outputs remained at a similar level to 2012.

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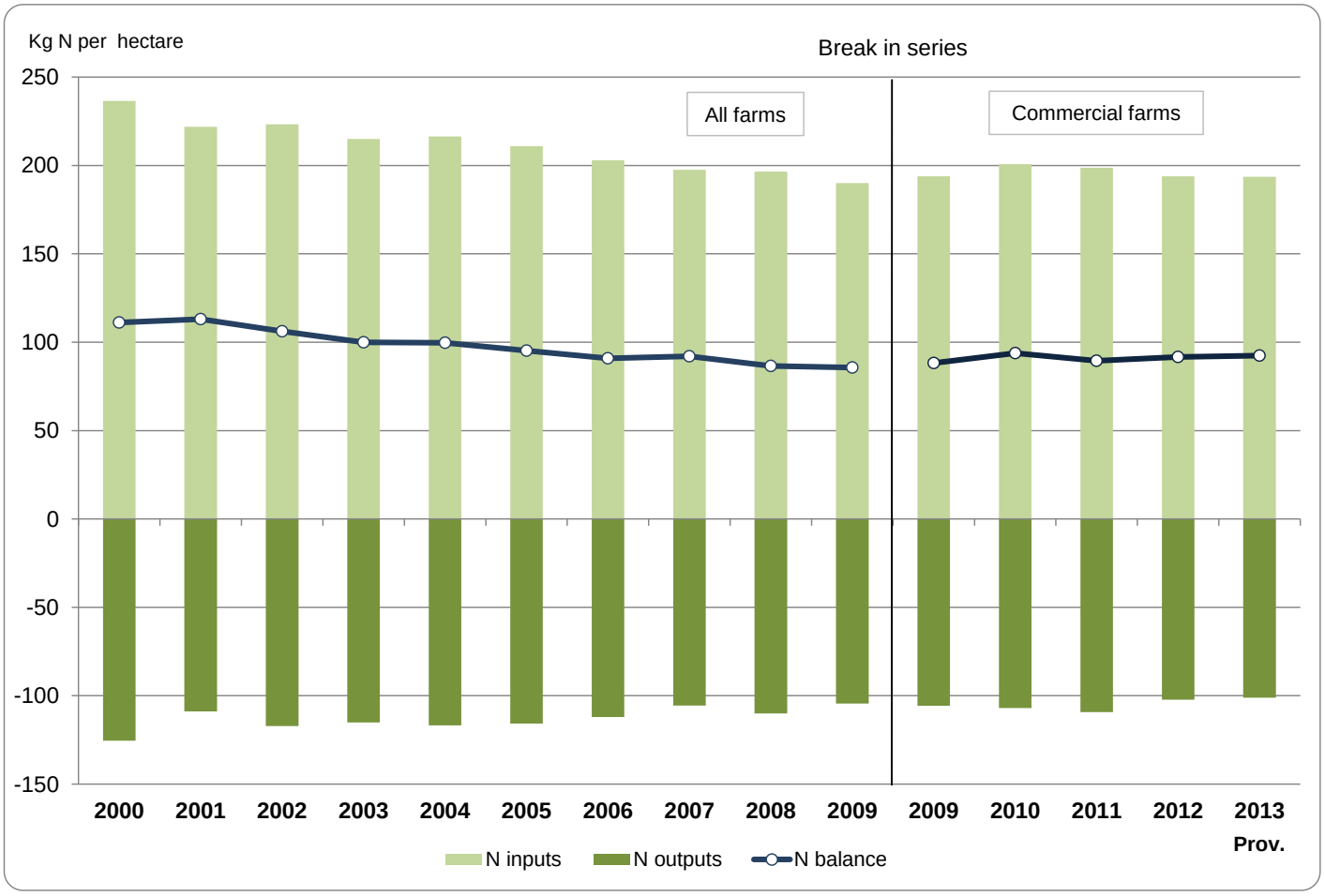
[1] **Correction 30 April 2015:** the original figure was incorrectly shown as 10kg/ha. This does not affect any other figures in the release.

Detail

UK Nitrogen Balance

Chart 1: Summary of nitrogen balance for UK, 2000 to 2013 (kg N per hectare)



For the period 2000 to 2013 the key points are:

- A 17% fall in the total surplus per hectare of managed agricultural land from 111 kg/ha to 92 kg/ha.
- The main driver has been a decrease in inputs of 43 kg/ha (from 237 kg/ha to 194 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 24 kg/ha (from 125 kg/ha to 101 kg/ha).
- The series break is due to changes[2] in farm survey data collection in England.

For the period 2012 to 2013 the key points are:

- The increase in the total surplus of 0.8 kg/ha (1%) has mainly been driven by a reduction in offtake (via harvested crops and crop residues). There was virtually no change in inputs between 2012 and 2013.

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

Table 1: Nitrogen balance for UK, 2010 to 2013 (kg N per hectare)

	Kg N per hectare				
	2010	2011	2012	prov. 2013	% change 2012/13
Total Inputs	200.7	198.7	193.8	193.6	0%
Total Outputs	106.9	109.2	102.2	101.1	-1%
BALANCE (Inputs minus Outputs)	**93.8**	**89.5**	**91.6**	**92.4**	**1%**

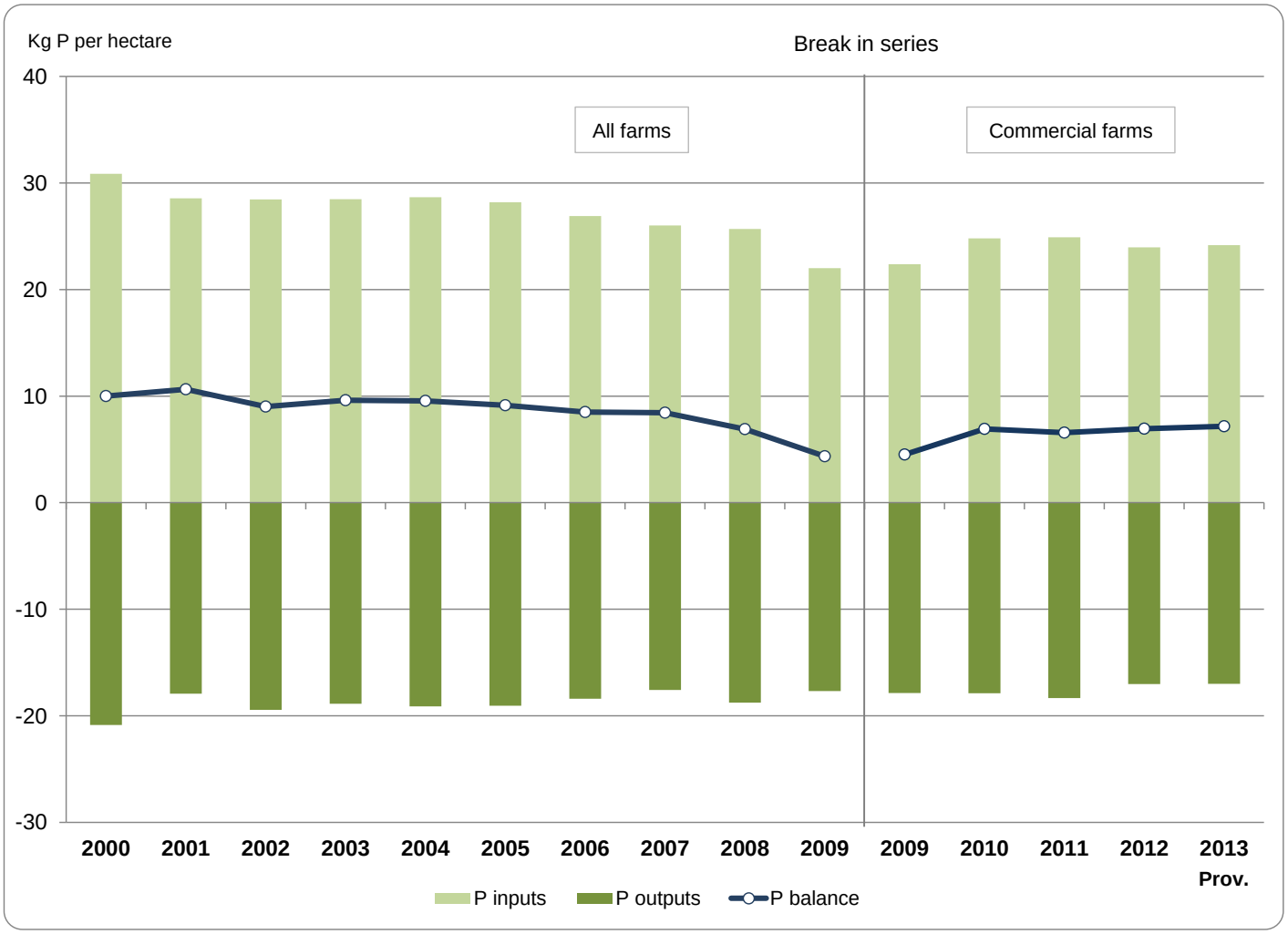
Table 2: Detailed nitrogen balance sheet results, 2010 to 2013 (thousand tonnes N)

	Thousand tonnes of N				
	2010	2011	2012	prov. 2013	% change 2012/13
TOTAL INPUTS	**2,398**	**2,383**	**2,338**	**2,346**	**0%**
Fertilisers	**1,079**	**1,090**	**1,060**	**1,055**	0%
Inorganic fertilisers	1,016	1,022	1,000	995	0%
Total organic fertilisers	63	68	60	60	0%
Manures	**999**	**989**	**986**	**990**	**0%**
Livestock Manure Production	1,015	1,004	1,002	1,008	1%
Cattle	681	670	666	661	-1%
Pigs	51	51	51	55	6%
Sheep and goats	167	168	172	177	3%
Poultry	108	108	106	108	2%
Other livestock	8	8	8	7	-6%
Withdrawals	-16	-16	-16	-17	9%
Other inputs	**320**	**304**	**292**	**300**	3%
Atmospheric Deposition	164	162	158	159	1%
Biological fixation	146	132	123	130	6%
Seeds and Planting Material	10	10	11	11	-1%
TOTAL OUTPUT	**1,278**	**1,310**	**1,233**	**1,226**	**-1%**
Total Harvested Crops	**529**	**557**	**502**	**495**	**-1%**
Cereals	396	412	376	373	**-1%**
Oil crops	70	85	78	66	-15%
Pulses and Beans	27	19	14	18	23%
Industrial Crops	11	14	12	14	16%
Other Crops	26	27	21	24	17%
Total Forage	**737**	**742**	**720**	**721**	**0%**
Harvested Fodder Crops	32	32	31	39	24%
Pasture	705	709	688	683	-1%
Crop residues	**11**	**11**	**11**	**9**	-19%
BALANCE (Inputs minus Offtake)	**1,121**	**1,073**	**1,105**	**1,120**	**1%**
Managed area (thousand ha) (a)	**11,951**	**11,992**	**12,064**	**12,121**	**0%**

(a) excludes rough grazing

UK Phosphorus Balance

Chart 2: Summary of Phosphorus balance for UK, 2000 to 2013 (kg P per hectare)



For the period 2000 to 2013 the key points are:

- A fall in the total surplus per hectare of managed agricultural land from 10.0 kg/ha in 2000 to 7.2 kg/ha in 2013 (-28%).
- 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 17 kg/ha, largely due to reduced forage.
- After a period of stability 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[3] in farm survey data collection in England.

For the period 2012 to 2013 the key points are:

- There has been an increase of 0.2 kg/ha (3%) in the surplus compared to 2012. This has been driven by an increase in inputs, largely inorganic (manufactured) fertiliser while offtake remained virtually unchanged compared to 2012.

[3] 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, 2010 to 2013 (kg P per hectare)

	Kg P per hectare				
	2010	2011	2012	prov. 2013	% change 2012/13
Total Inputs	24.8	24.9	24.0	24.2	1%
Total Outputs	17.9	18.3	17.0	17.0	0%
BALANCE (Inputs minus Outputs)	**6.9**	**6.6**	**6.9**	**7.2**	**3%**

Table 4: Detailed phosphorus balance sheet results for 2010 to 2013 (thousand tonnes P)

	Thousand tonnes of P				
	2010	2011	2012	prov. 2013	% change 2012/13
TOTAL INPUTS	**296**	**299**	**289**	**293**	**1%**
Fertilisers	**119**	**122**	**114**	**116**	**2%**
Inorganic fertilisers	80	84	82	85	3%
Total organic fertilisers	38	39	32	31	0%
Manures	**171**	**169**	**168**	**170**	**1%**
Livestock Manure Production	171	169	168	170	1%
Cattle	106	104	104	103	-1%
Pigs	10	10	10	11	6%
Sheep and goats	26	26	27	27	3%
Poultry	26	26	25	26	2%
Other livestock	3	3	3	3	-7%
Withdrawals					-
Other inputs	**7**	**7**	**7**	**7**	**0%**
Atmospheric Deposition	5	5	5	5	1%
Seeds and Planting Material	2	2	2	2	-2%
TOTAL OUTPUT	**214**	**220**	**205**	**206**	**0%**
Total Harvested Crops	**95**	**100**	**90**	**91**	**1%**
Cereals	71	73	66	68	3%
Oil crops	14	17	16	13	-16%
Pulses and Beans	3	2	2	2	23%
Industrial Crops	2	3	3	3	16%
Other Crops	4	4	3	4	16%
Total Forage	**117**	**118**	**113**	**114**	**0%**
Harvested Fodder Crops	6	6	6	7	24%
Pasture	111	112	108	106	-1%
Crop residues	**2**	**2**	**2**	**2**	**-19%**
BALANCE (Inputs minus Offtake)	**83**	**79**	**84**	**87**	**4%**
Managed area (thousand ha) (a)	**11,951**	**11,992**	**12,064**	**12,121**	**0%**

(a) excludes rough grazing

Background and methodology

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

The main agricultural sources of nutrients are fertilisers and animal feeds. These 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[6] 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.

[4] Organisation for Economic Cooperation and Development

[5] Eurostat is the Statistical body of the European Commission

[6] 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[7,8] 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[9] 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.

[7] TAPAS Funded Project – UK Soil Nutrient Balances, May 2009

[8] UK Nutrient Balances Methodology Review, ADAS, April 2011

[9] Observatory Report: Soil Nutrient Balances 2010 Update, April 2011