Department for Environment Food & Rural Affairs

Published 25th July 2013

Soil Nutrient Balances
UK Provisional Estimates for 2012

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.

Summary of key results

Nitrogen

- Provisional estimates for 2012 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 3 kg/ha compared to 2011 (3%), but a reduction of 19 kg/ha (-17%) compared to 2000, reflecting 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 2011 and 2012 has been mainly driven by a reduction in offtake, particularly via harvested crops and grazed pasture as a result of the poor weather in 2012. This has more than offset a reduction in inputs from inorganic (manufactured) nitrogen fertilisers.

Phosphorus

- Provisional estimates for 2012 show that the phosphorus balance for the United Kingdom was a surplus of 7.5 kg/ha of managed agricultural land. This is an increase of 0.9 kg/ha (14%) compared to 2011. As with nitrogen, the long term trend is downward (with similar drivers). The total surplus has fallen from 10 kg/ha in 2000, a reduction of 25%.

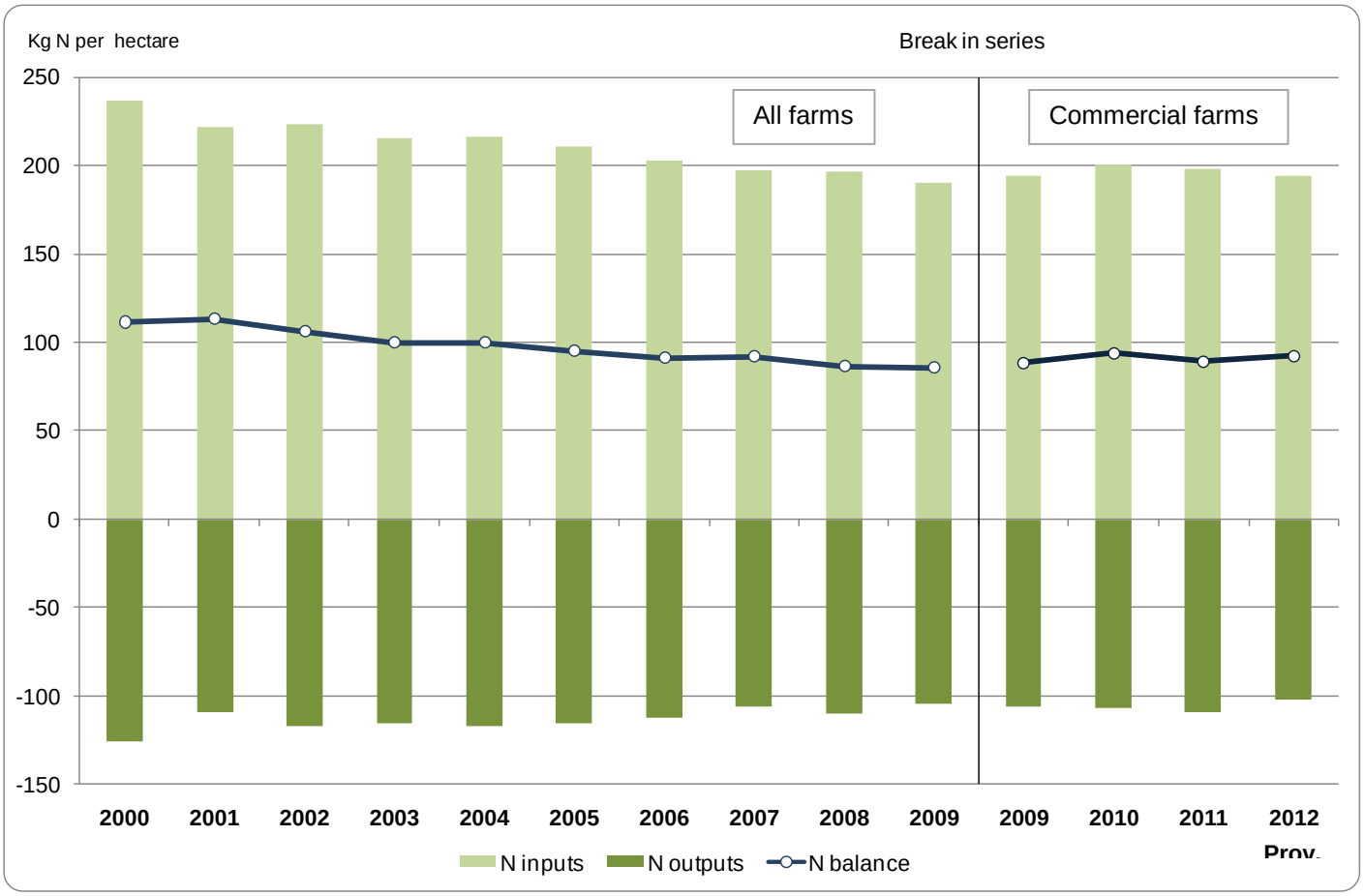
- The increase between 2011 and 2012 has also been driven by a reduction in offtake via harvested crops and grazed pasture.

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 2012 (kg N per hectare)



For the period 2000 to 2012 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 42 kg/ha (from 237 kg/ha to 194 kg/ha) due to decreases in the application of inorganic fertilisers and manure production (the result of lower livestock numbers). This has been partially offset by a reduction in offtake (particularly forage) of 23 kg/ha (from 125 kg/ha to 102 kg/ha).
- The series break is due to changes[1] in farm survey data collection in England.

For the period 2011 to 2012 the key points are:

- The increase in the total surplus of 2.9 kg/ha (3%) has mainly been driven by a reduction in offtake, particularly from harvested crops and grazed pasture, following the poor weather in 2012. This has more than offset a small reduction in inputs (from inorganic fertilisers).

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

Table 1: Nitrogen balance for UK, 2009 to 2012 (kg N per hectare)

	kg N per hectare				
	2009	2010	2011	prov. 2012	% change 2011/12
Total Inputs	193.9	200.7	198.2	194.3	-2%
Total Outputs	105.6	106.9	109.2	102.4	-6%
BALANCE (Inputs minus Outputs)	**88.3**	**93.8**	**89.0**	**92.0**	**3%**

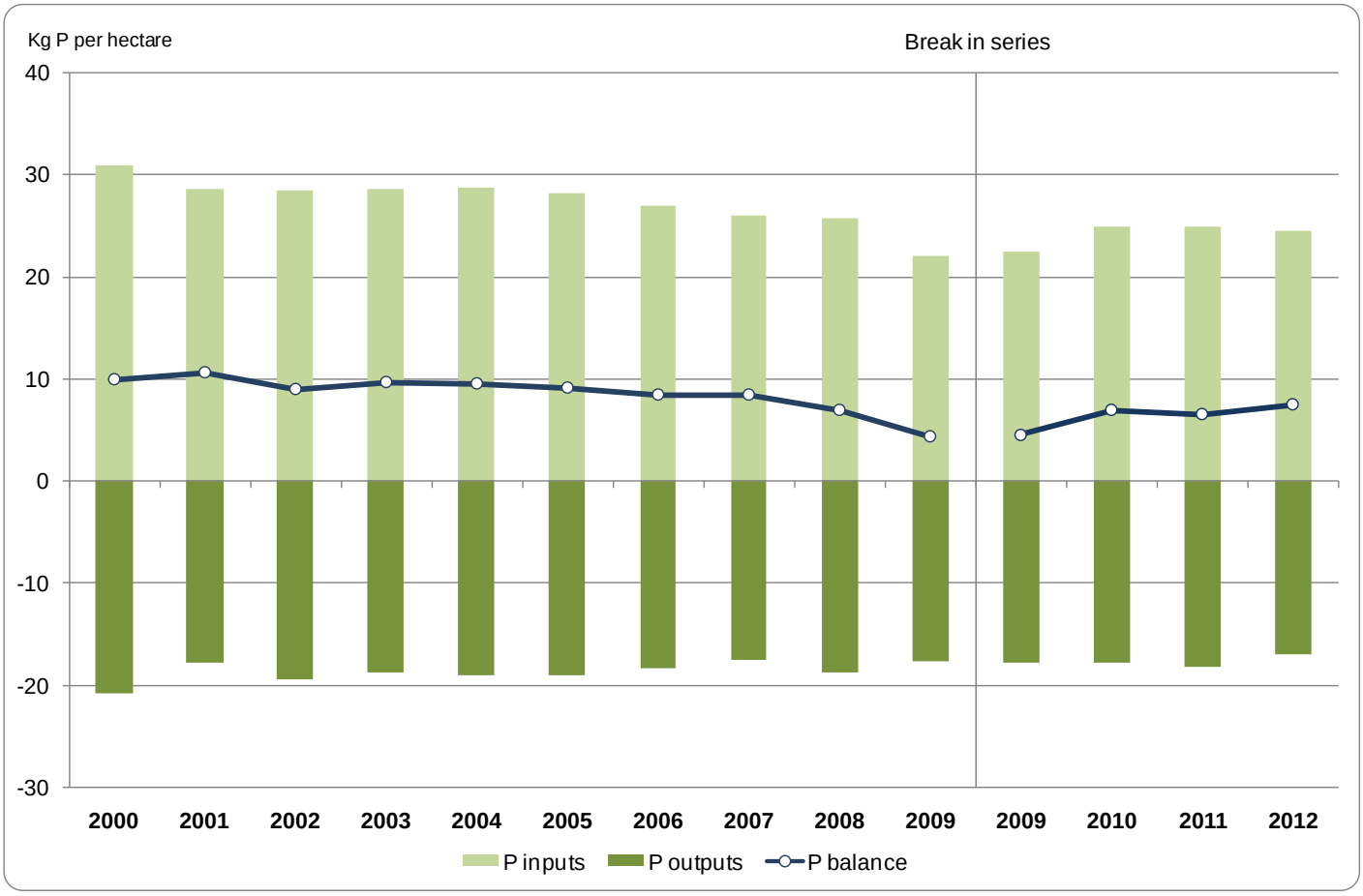
Table 2: Detailed nitrogen balance sheet results, 2009 to 2012 (Th. tonnes N)

	Thousand tonnes of N				
	2009	2010	2011	prov. 2012	% change 2011/12
TOTAL INPUTS	**2,318**	**2,398**	**2,377**	**2,344**	**-1%**
Fertilisers	**1,012**	**1,079**	**1,085**	**1,063**	-2%
Inorganic fertilisers	948	1,016	1,022	1,000	-2%
Total organic fertilisers	64	63	63	63	0%
Manures	**980**	**999**	**989**	**986**	0%
Livestock Manure Production	1000	1,015	1,004	1,002	0%
Cattle	674	681	670	666	-1%
Pigs	51	51	51	51	1%
Sheep and goats	166	167	168	172	2%
Poultry	102	108	108	106	-2%
Other livestock	7	8	8	8	0%
Withdrawals	-20	-16	-16	-16	0%
Other inputs	**327**	**320**	**304**	**296**	-3%
Atmospheric Deposition	165	164	162	162	0%
Biological fixation	152	146	132	123	-7%
Seeds and Planting Material	10	10	10	11	9%
TOTAL OUTPUT	**1,263**	**1,278**	**1,310**	**1,235**	**-6%**
Total Harvested Crops	**523**	**529**	**557**	**503**	-10%
Cereals	391	396	412	376	-9%
Oil crops	59	70	85	78	-8%
Pulses and Beans	32	27	19	15	-22%
Industrial Crops	14	11	14	12	-14%
Other Crops	26	26	26	21	-20%
Total Forage	**730**	**737**	**742**	**721**	-3%
Harvested Fodder Crops	32	32	32	31	-3%
Pasture	698	705	710	689	-3%
Crop residues	**10**	**11**	**11**	**11**	1%
BALANCE (Inputs minus Offtake)	**1,055**	**1,121**	**1,068**	**1,110**	**4%**
Managed area (Th. Ha) (a)	**11,957**	**11,951**	**11,992**	**12,064**	**1%**

(a) excludes rough grazing

UK Phosphorus Balance

Chart 2: Summary of Phosphorus balance for UK, 2000 to 2012 (kg P per hectare)



For the period 2000 to 2012 the key points are:

- A fall in the total surplus per hectare of managed agricultural land from 10.0 kg/ha in 2000 to 7.5 kg/ha in 2012 (-25%).
- 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 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[2] in farm survey data collection in England.

For the period 2011 to 2012 the key points are:

- There has been an increase of 0.9 kg/ha (14%) in the surplus compared to 2011.
- This increase has been driven by decreases in offtake, particularly from harvested crops and forage, which reflect the poor weather conditions in 2012. There was a small reduction in inputs.

[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, 2009 to 2012 (kg P per hectare)

	kg P per hectare				
	2009	2010	2011	prov. 2012	% change 2011/12
Total Inputs	22.4	24.8	24.9	24.5	-1%
Total Outputs	17.9	17.9	18.3	17.0	-7%
BALANCE (Inputs minus Outputs)	**4.5**	**6.9**	**6.5**	**7.5**	**14%**

Table 4: Detailed phosphorus balance sheet results for 2009 to 2012 (Th. tonnes P)

	Thousand tonnes of P				
	2009	2010	2011	prov. 2012	% change 2011/12
TOTAL INPUTS	**268**	**296**	**298**	**296**	**-1%**
Fertilisers	**93**	**119**	**122**	**120**	**-2%**
Inorganic fertilisers	56	80	84	82	-2%
Total organic fertilisers	36	38	38	38	0%
Manures	**168**	**171**	**169**	**168**	**0%**
Livestock Manure Production	168	171	169	168	0%
Cattle	105	106	104	104	-1%
Pigs	10	10	10	10	1%
Sheep and goats	26	26	26	27	2%
Poultry	24	26	26	25	-2%
Other livestock	3	3	3	3	1%
Withdrawals	0	0	0	0	-
Other inputs	**7**	**7**	**7**	**7**	**2%**
Atmospheric Deposition	5	5	5	5	0%
Seeds and Planting Material	2	2	2	2	9%
TOTAL OUTPUT	**214**	**214**	**220**	**206**	**-6%**
Total Harvested Crops	**97**	**95**	**100**	**90**	**-10%**
Cereals	74	71	73	66	-9%
Oil crops	12	14	17	16	-8%
Pulses and Beans	4	3	2	2	-22%
Industrial Crops	3	2	3	3	-14%
Other Crops	4	4	4	3	-20%
Total Forage	**115**	**117**	**118**	**114**	**-4%**
Harvested Fodder Crops	6	6	6	6	-2%
Pasture	109	111	112	108	-4%
Crop residues	**2**	**2**	**2**	**2**	**1%**
BALANCE (Inputs minus Offtake)	**54**	**83**	**78**	**90**	**15%**
Managed area (Th. Ha) (a)	**11,957**	**11,951**	**11,992**	**12,064**	**1%**

(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.

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[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