Department
for Environment
Food & Rural Affairs

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Soil Nutrient Balances
UK Provisional Estimates for 2018

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 2018 show the nitrogen balance:

- to be a surplus of 92 kg/ha of managed agricultural land
- increased 1.3 kg/ha (+1%) compared to 2017
- decreased 19.3 kg/ha (-17%) compared to 2000

Phosphorus

Provisional estimates for 2018 show the phosphorus balance:

- to be a surplus of 6.8 kg/ha of managed agricultural land
- increased 0.6 kg/ha (+10%) compared to 2017
- decreased 3.2 kg/ha (-32%) compared to 2000

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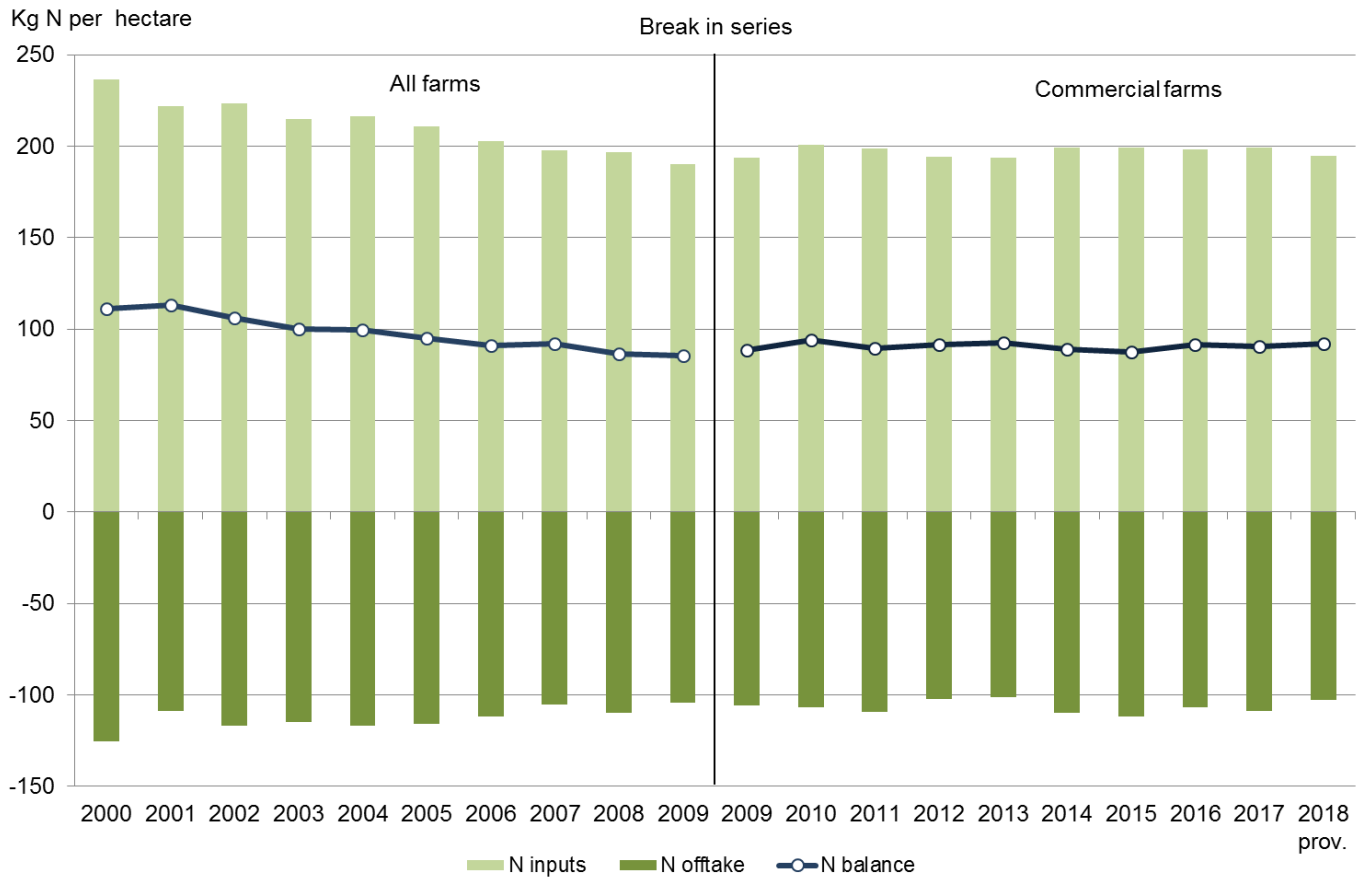
Detail

UK Nitrogen Balance

Chart 1: Summary of nitrogen balance for UK, 2000 to 2018 (kg N per hectare)



For the period 2017 to 2018 the key points are:

- Inputs (mainly from inorganic fertilisers and livestock manures) decreased by 2% over this time period, however this was more than offset by a 5% decrease in offtake (mainly via harvested crops) resulting in a 1.3kg/ha (1%) increase in the balance overall
- Whilst crop areas stayed largely similar, the lower yields and production for both cereals and oil crops was the main driving force behind the decrease in uptake by harvested crops

For the period 2000 to 2018 the key points are:

- A 17% fall in the total surplus per hectare from 111 kg/ha to 92 kg/ha.
- The main driver has been a 42kg/ha decrease in inputs (from 237 kg/ha to 195 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 22 kg/ha reduction in offtake (particularly forage) from 125 kg/ha to 103 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, 2000, 2017 and 2018 (kg N per hectare)

	2000	2017	prov. 2018	Change 2017-18	Change 2000-18
Total Inputs	236.6	199.3	**194.8**	-4.5	-41.8
Total Offtake	125.4	108.8	**103.0**	-5.8	-22.4
BALANCE (Inputs minus Offtake)	111.1	90.5	**91.8**	-1.3	-19.3

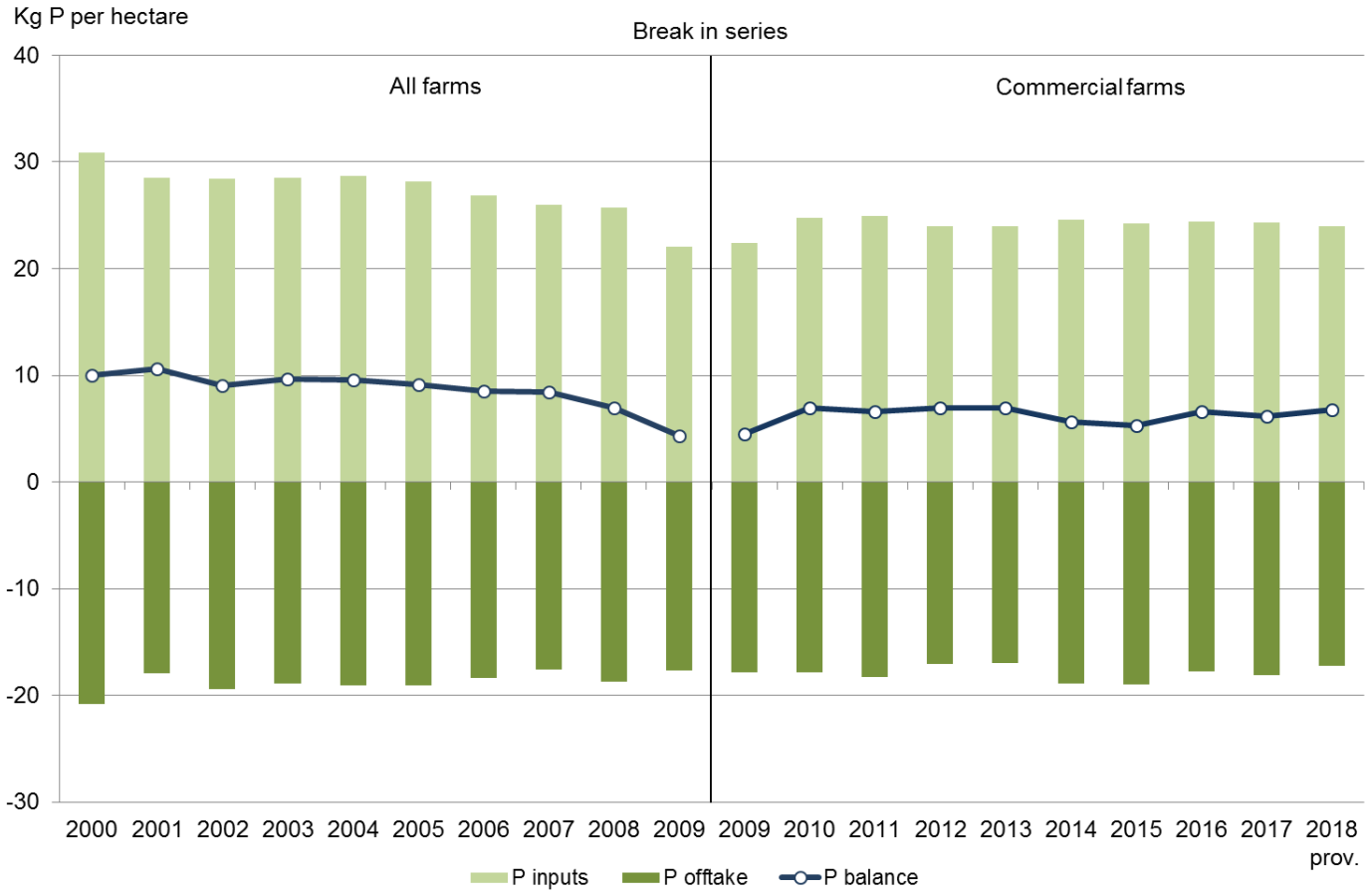
Table 2: Detailed nitrogen balance sheet results, 2000, 2017 and 2018 (thousand tonnes N)

	2000	2017	prov. 2018	Change 2017-18	Change 2000-18
TOTAL INPUTS	2,805	2,446	**2,391**	-56	-415
Fertilisers	1,301	1,100	**1,092**	-8	-209
Inorganic fertilisers	1,268	1,041	**1,033**	-8	-235
Total organic fertilisers	33	59	**59**	0	+26
Manures	1,180	1,024	**1,016**	-9	-164
Livestock Manure Production	1,196	1,041	**1,033**	-9	-164
Cattle	773	673	**665**	-8	-108
Pigs	73	55	**55**	-1	-19
Sheep and goats	227	187	**184**	-4	-44
Poultry	116	120	**123**	+3	+8
Other livestock	7	6	**6**	0	-1
Withdrawals	-17	-17	**-17**	0	0
Other inputs	325	322	**283**	-39	-42
Atmospheric Deposition	172	156	**128**	-28	-44
Biological fixation	142	155	**144**	-11	+2
Seeds and Planting Material	10	10	**10**	0	0
TOTAL OFFTAKE	1,487	1,336	**1,264**	-72	-223
Total Harvested Crops	561	579	**528**	-51	-33
Cereals	453	434	**408**	-26	-45
Oil crops	36	67	**64**	-3	+28
Pulses and Beans	29	38	**21**	-17	-8
Industrial Crops	15	15	**13**	-2	-2
Other Crops	27	25	**22**	-3	-4
Total Forage	915	744	**724**	-20	-191
Harvested Fodder Crops	23	38	**42**	+4	+19
Pasture	892	706	**682**	-24	-210
Crop residues	12	12	**12**	0	0
BALANCE (Inputs minus Offtake)	1,318	1,111	**1,127**	+16	-191
Managed area (thousand ha) (a)	11,858	12,276	**12,272**	-4	+414

(a) excludes rough grazing

UK Phosphorus Balance

Chart 2: Summary of Phosphorus balance for UK, 2000 to 2018 (kg P per hectare)



For the period 2017 to 2018 the key points are:

- Following a similar trend as nitrogen, the 1% decrease in inputs was more than offset by a 5% decrease in offtake resulting in a 0.6kg/ha (10%) increase in the balance overall

For the period 2000 to 2018 the key points are:

- A fall in the total surplus per hectare from 10 kg/ha in 2000 to 6.8 kg/ha in 2017 (-32%).
- 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 production.
- After remaining level from 2002 to 2007 there was a sharp fall in the surplus between 2007 and 2009. This was a result of increased offtake from harvested crops in 2008 and a sharp reduction in fertiliser applications in 2009. 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.

[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, 2000, 2017 and 2018 (kg P per hectare)

	2000	2017	**prov. 2018**	Change 2017-18	Change 2000-18
Total Inputs	30.9	24.3	**24.0**	-0.3	-6.9
Total Offtake	20.8	18.1	**17.2**	-0.9	-3.6
BALANCE (Inputs minus Offtake)	10.0	6.2	**6.8**	+0.6	-3.2

Table 4: Detailed phosphorus balance sheet results for 2000, 2017 and 2018 (thousand tonnes P)

	2000	2017	**prov. 2018**	Change 2017-18	Change 2000-18
TOTAL INPUTS	366	298	**294**	-4	-72
Fertilisers	158	116	**113**	-3	-45
Inorganic fertilisers	138	85	**82**	-3	-56
Total organic fertilisers	20	31	**31**	0	+11
Manures	201	176	**175**	-1	-26
Livestock Manure Production	201	176	**175**	-1	-26
Cattle	121	105	**104**	-1	-17
Pigs	15	11	**11**	0	-4
Sheep and goats	35	29	**28**	-1	-7
Poultry	28	28	**29**	+1	+1
Other livestock	3	2	**2**	0	0
Withdrawals	-	-	-	-	-
Other inputs	7	7	**7**	0	0
Atmospheric Deposition	5	5	**5**	0	0
Seeds and Planting Material	2	2	**2**	0	0
TOTAL OFFTAKE	247	223	**211**	-12	-36
Total Harvested Crops	100	103	**95**	-8	-4
Cereals	82	78	**74**	-5	-8
Oil crops	7	14	**13**	-1	+6
Pulses and Beans	3	4	**2**	-2	-1
Industrial Crops	3	3	**3**	0	-1
Other Crops	4	4	**4**	-1	-1
Total Forage	145	117	**114**	-3	-32
Harvested Fodder Crops	4	7	**8**	+1	+4
Pasture	141	110	**106**	-4	-35
Crop residues	2	2	**2**	0	0
BALANCE (Inputs minus Offtake)	119	76	**83**	+7	-36
Managed area (thousand ha) (a)	11,858	12,276	**12,272**	-4	+414

(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 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. The balance per hectare is based on the area of managed agricultural land. This is based on the approximation that this is the only land to which significant levels of fertilisers and manures are applied.

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.

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[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.
[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
http://webarchive.nationalarchives.gov.uk/20130222210445/http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-environ-obs-research-soilnutrientbalance-1108-update.pdf