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Soil Nutrient Balances England 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 England was a surplus of 89 kg/ha of managed agricultural land. This is a decrease of 2 kg/ha (-2%) compared to 2012 and a reduction of 19 kg/ha (-18%) 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 offtake (particularly for forage) over the same period.
- The decrease between 2012 and 2013 has been driven by small reductions to inputs from inorganic (manufactured) nitrogen fertilisers, partially offset by reductions in offtake (particularly harvested crops and crop residue).

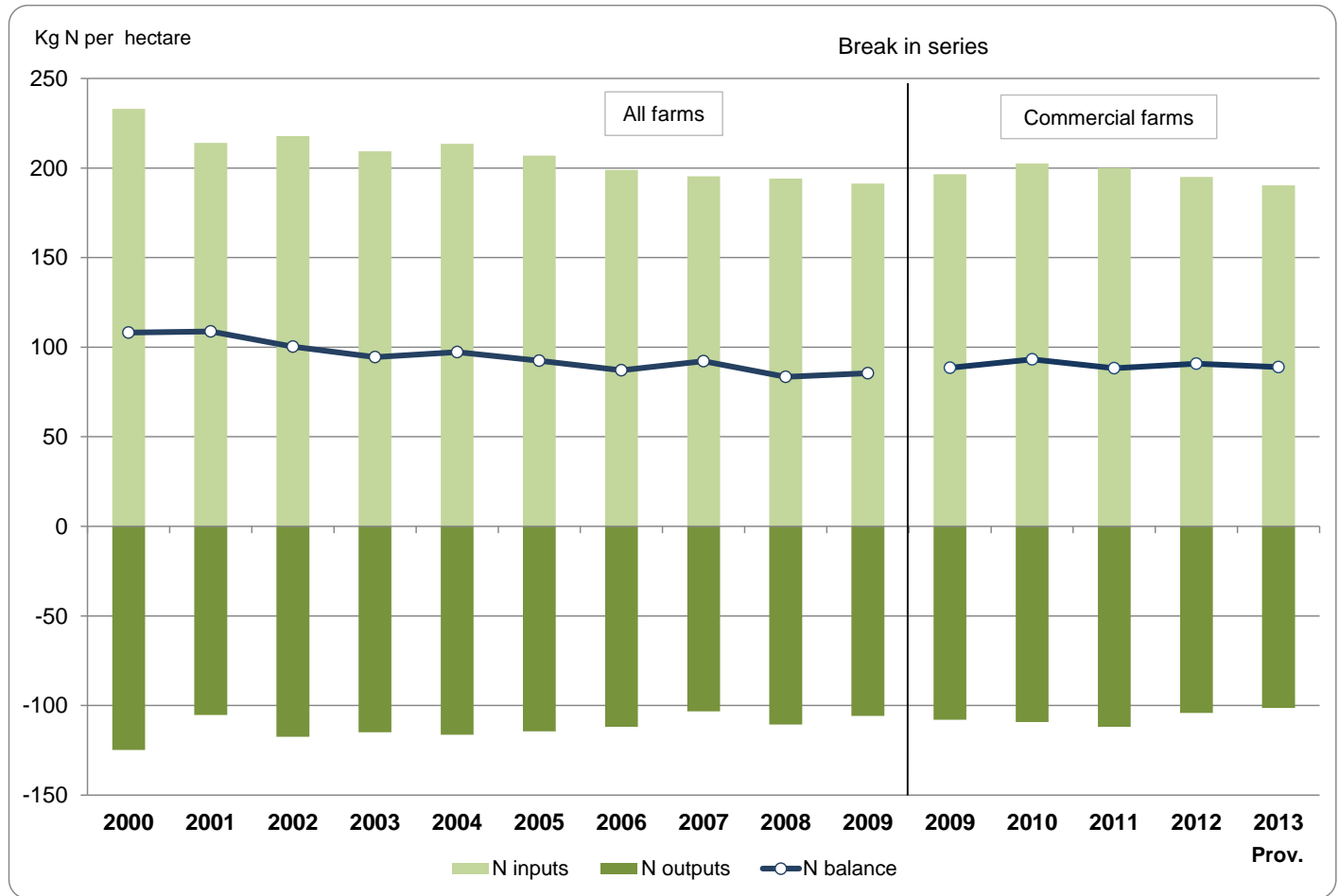
Phosphorus

- Provisional estimates for 2013 show that the phosphorus balance for England was a surplus of 5.8 kg/ha of managed agricultural land. This is an increase of 0.2 kg/ha (+3%) compared to 2012 and a reduction of 9.1kg/ha (-36%) compared to 2000. As with nitrogen, the long term trend is downward (with similar drivers).
- The increase between 2012 and 2013 has been driven by a small increase in inputs (mainly via livestock manure) while outputs remained virtually unchanged on 2012.

Detail

England Nitrogen Balance

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



For the period 2000 to 2013 the key points are:

- An 18% fall in the total surplus per hectare of managed agricultural land in England from 108 kg/ha in 2000 to 89 kg/ha in 2013.
- The main driver for the lower surplus has been a reduction in inputs of 43 kg/ha (from 233 kg/ha to 190 kg/ha) largely due to reductions in inorganic fertiliser applications and manure production (reflecting lower numbers of livestock). This has been partially offset by a reduction in the nitrogen offtake (particularly forage) of 23 kg/ha (from 125 kg/ha to 101 kg/ha).
- The series break is due to changes¹ in farm survey data collection.

For the period 2012 to 2013 the key points are:

- The decrease of 2 kg/ha has mainly been driven by a decrease in inputs from inorganic (manufactured) fertiliser. At the same time offtake also saw a small reduction (from harvested crops and crop residue).

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

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

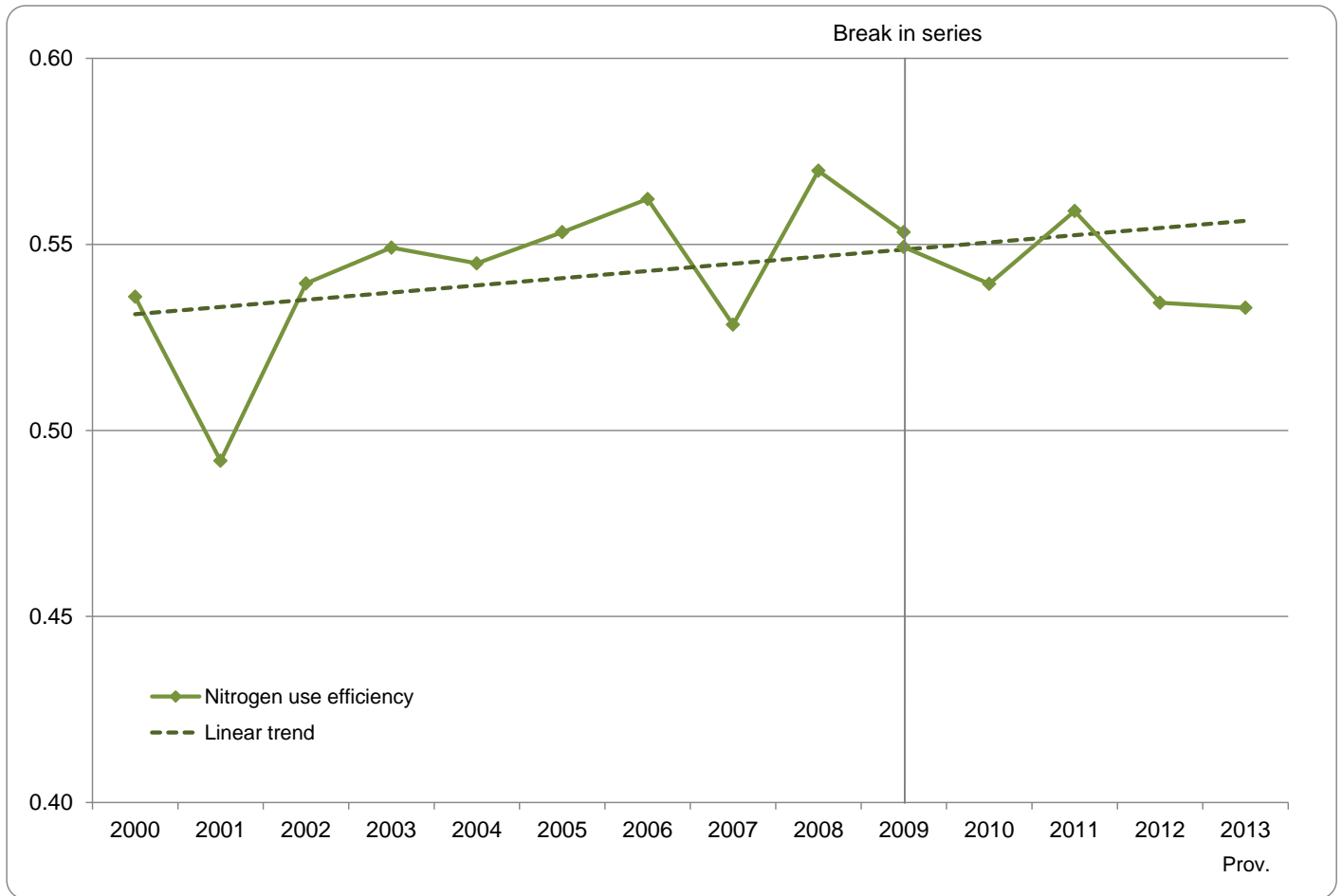
	Kg N per hectare				
	2010	2011	2012	prov. 2013	% change 2012/13
Total Inputs	202.4	200.1	195.0	190.3	-2%
Total Offtake	109.2	111.8	104.2	101.4	-3%
BALANCE (Inputs minus Offtake)	93.2	88.3	90.8	88.9	-2%

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

	Thousand tonnes of N				
	2010	2011	2012	prov. 2013	% change 2012/13
TOTAL INPUTS	1,610	1,594	1,568	1,551	-1%
Fertilisers	808	821	804	771	-4%
Inorganic fertilisers	756	766	756	723	-4%
Total organic fertilisers	52	55	48	48	0%
Manures	572	561	558	563	1%
Livestock Manure Production	584	574	571	577	1%
Cattle	378	369	365	364	0%
Pigs	41	41	42	45	8%
Sheep and goats	75	76	78	81	3%
Poultry	85	83	80	82	2%
Other livestock	5	5	5	5	-9%
Withdrawals	-13	-13	-13	-14	10%
Other inputs	230	212	207	216	5%
Atmospheric Deposition	112	108	111	112	1%
Biological fixation	110	96	87	95	10%
Seeds and Planting Material	9	8	9	9	-5%
TOTAL OFFTAKE	868	891	838	826	-1%
Total Harvested Crops	463	486	445	432	-3%
Cereals	341	353	328	320	-3%
Oil crops	65	80	74	62	-16%
Pulses and Beans	26	17	13	17	26%
Industrial Crops	11	14	12	14	16%
Other Crops	20	21	16	19	17%
Total Forage	395	395	383	386	1%
Harvested Fodder Crops	25	25	25	31	25%
Pasture	370	370	358	355	-1%
Crop residues	10	10	10	8	-19%
BALANCE (Inputs minus Offtake)	742	703	730	724	-1%
Managed area (thousand ha) (a)	7,953	7967	8043	8147	1%

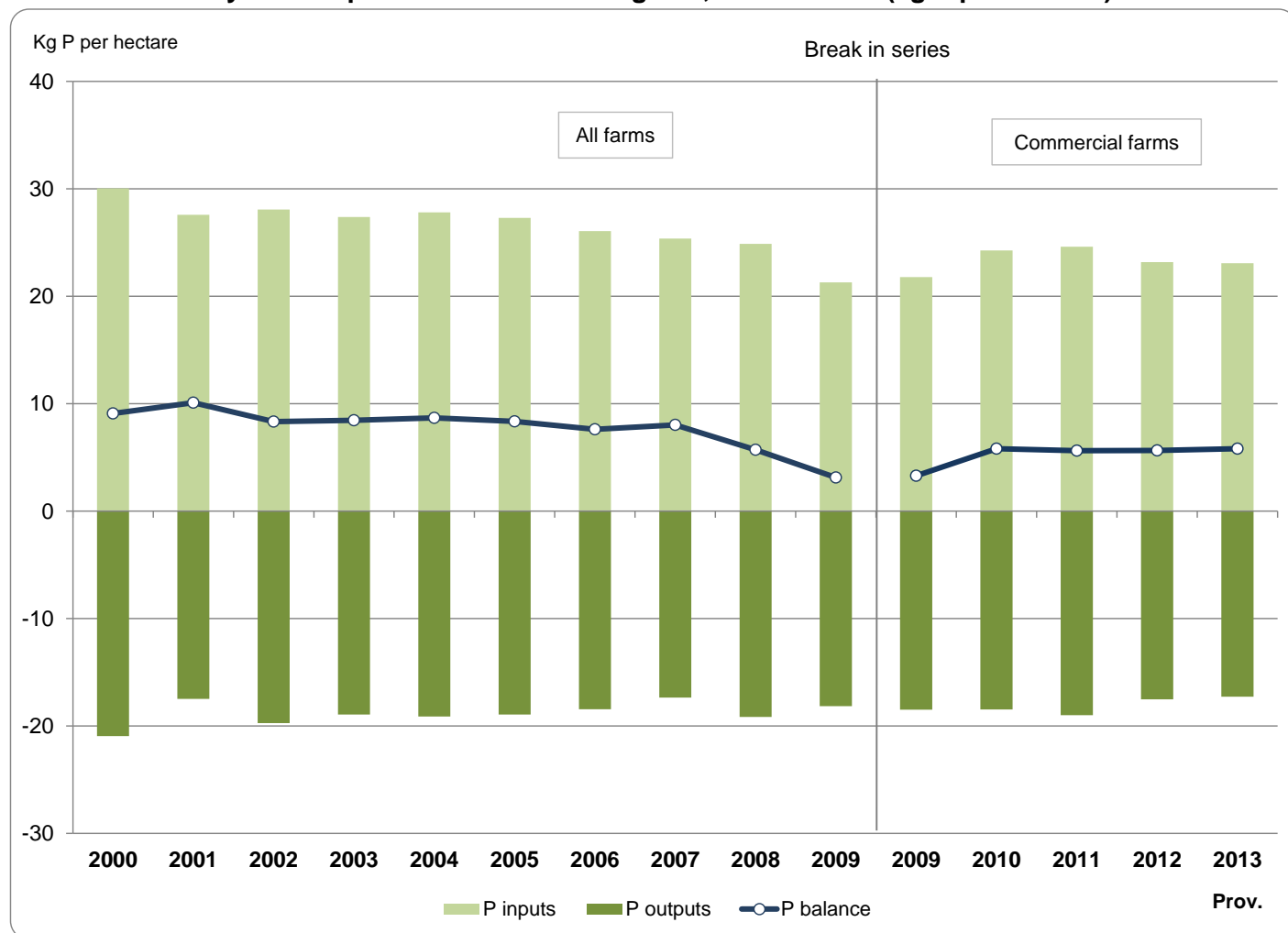
(a) excludes rough grazing

Chart 2: Nitrogen use efficiency, 2000 to 2013



Nitrogen use efficiency provides an indication of the efficiency with which the nutrients applied are taken up by the crops and forage. It is calculated as the ratio of inputs to offtake (whereas the balance is inputs minus offtake). A value of 1 would indicate that the application of nutrients precisely matches the crop requirements.

Chart 3: Summary of Phosphorus balance for England, 2000 to 2013 (kg P per hectare)



For the period 2000 to 2013 the key points are:

- Provisional estimates for 2013 show an fall in the total surplus per hectare of managed agricultural land in England from 9.1 kg/ha in 2000 to 5.8 kg/ha in 2013, a reduction of 36%.
- The main driver for the lower surplus has been the reduction in inputs (from 30 to 23 kg/ha), due mainly to reduced fertiliser applications and manure production (as a result of declining livestock populations). The level of offtake has also reduced although to a lesser extent (from 21 to 17 kg/ha).
- The reductions in the surplus between 2007 and 2009 were due to increased offtake from harvested crops in 2008 and a sharp reduction in fertiliser applications in 2009.
- The series break is due to changes² in farm survey data collection.

For the period 2010 to 2013 the key points are:

- There has been an increase in the surplus of 0.2 kg/ha (3%) compared with 2012. This increase has been driven by a small increase in inputs (mainly from manure production) while outputs have remained virtually unchanged.
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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 England, 2010 to 2013 (kg P per hectare)

	Kg P per hectare				
	2010	2011	2012	prov. 2013	% change 2012/13
Total Inputs	24.3	24.6	23.2	23.1	0%
Total Offtake	18.5	19.0	17.5	17.3	-1%
BALANCE (Inputs minus Offtake)	5.8	5.6	5.6	5.8	3%

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

	Thousand tonnes of P				
	2010	2011	2012	prov. 2013	% change 2012/13
TOTAL INPUTS	193	196	186	188	1%
Fertilisers	87	92	83	84	1%
Inorganic fertilisers	55	59	57	57	1%
Total organic fertilisers	32	33	26	26	0%
Manures	101	99	99	100	1%
Livestock Manure Production	101	99	99	100	1%
Cattle	59	58	57	57	0%
Pigs	8	8	8	9	7%
Sheep and goats	12	12	12	12	3%
Poultry	20	20	19	19	2%
Other livestock	2	2	2	2	0%
Withdrawals					-
Other inputs	4	4	5	5	-1%
Atmospheric Deposition	3	3	3	3	2%
Seeds and Planting Material	2	2	2	2	-5%
TOTAL OFFTAKE	147	151	141	141	0%
Total Harvested Crops	82	86	78	78	0%
Cereals	60	61	56	57	2%
Oil crops	13	16	15	13	-16%
Pulses and Beans	3	2	2	2	26%
Industrial Crops	2	3	3	3	16%
Other Crops	3	3	3	3	16%
Total Forage	63	64	61	61	1%
Harvested Fodder Crops	5	5	5	6	25%
Pasture	59	59	56	56	-1%
Crop residues	2	2	2	1	-19%
BALANCE (Inputs minus Offtake)	46	45	45	47	4%
Managed area (thousand ha) (a)	7,953	7967	8043	8147	1%

(a) excludes rough grazing

Background and methodology

A methodology for calculating soil nutrient balances has been developed by OECD³ and adopted by Eurostat⁴. 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 holdings⁵ for 2009 onwards. 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 paper⁸ 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