Department
for Environment
Food & Rural Affairs

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Soil Nutrient Balances
England 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 England was a surplus of 91 kg/ha of managed agricultural land. This is an increase of 3 kg/ha (4%) compared to 2011 but a reduction of 17 kg/ha (-16%) 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 offtake (particularly for 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 England was a surplus of 6.3 kg/ha of managed agricultural land. This is an increase of 0.9 kg/ha (16%) compared to 2011. However, as with nitrogen, the long term trend is downward (with similar drivers). The total surplus has fallen from 9.1kg/ha in 2000, a reduction of 31%.

- The increase between 2011 and 2012 has been driven by a reduction in offtake (mainly via harvested crops).

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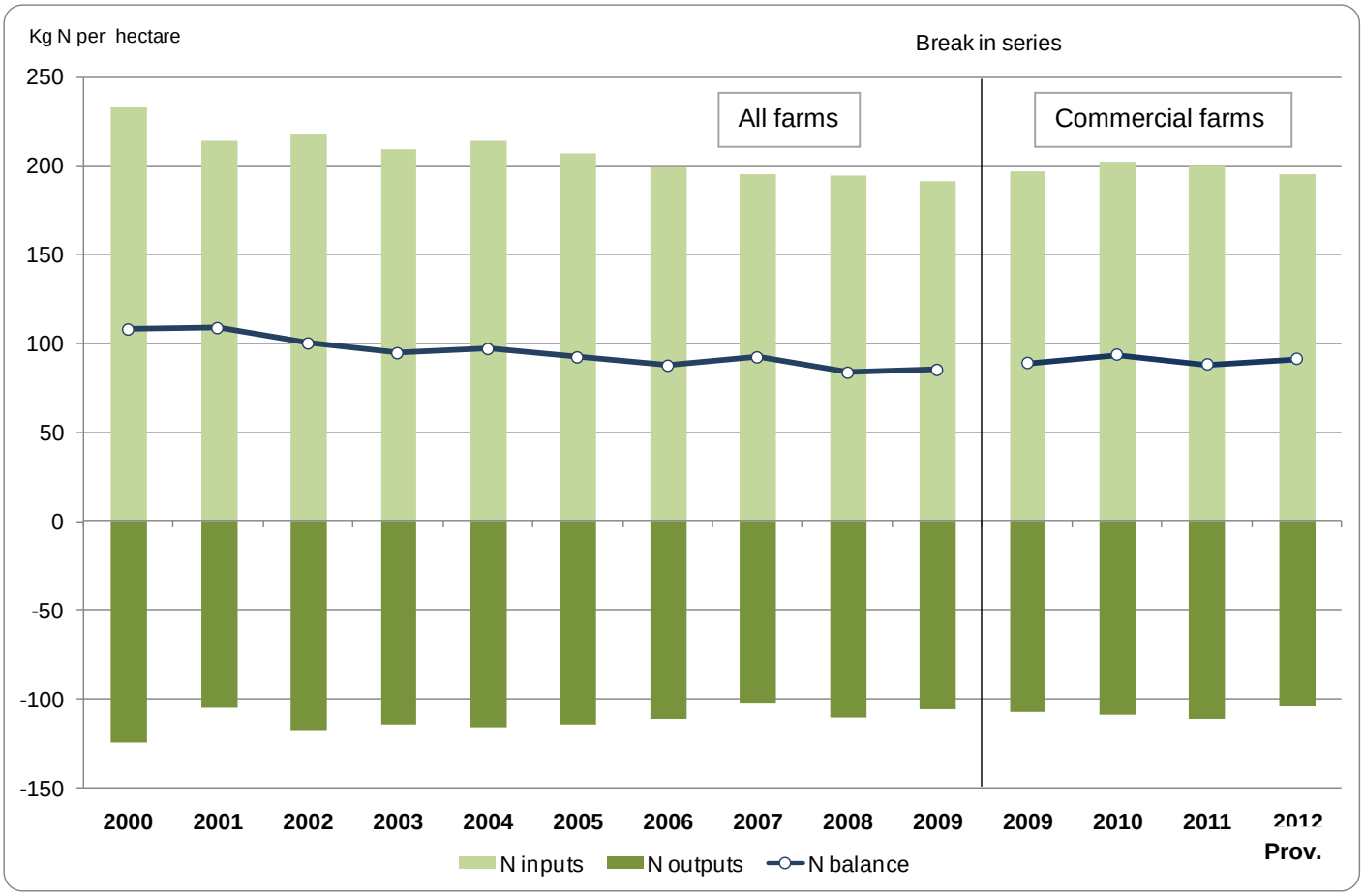
Detail

England Nitrogen Balance

Chart 1: Summary of Nitrogen balance for England, 2000 to 2012 (kg N per hectare)



For the period 2000 to 2012 the key points are:

- A 16% fall in the total surplus per hectare of managed agricultural land in England from 108 kg/ha in 2000 to 91 kg/ha in 2012.
- The main driver for the lower surplus has been a reduction in inputs of 38 kg/ha (from 233 kg/ha to 195 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 20 kg/ha (from 125 kg/ha to 104 kg/ha).
- The series break is due to changes[1] in farm survey data collection.

For the period 2011 to 2012 the key points are:

- The increase of 3.1 kg/ha has mainly been driven by a decrease in offtake from harvested crops (particularly cereals) and grazed pasture reflecting the poor weather conditions in 2012. This has more than offset a small reduction in inputs (from inorganic fertilisers).

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

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

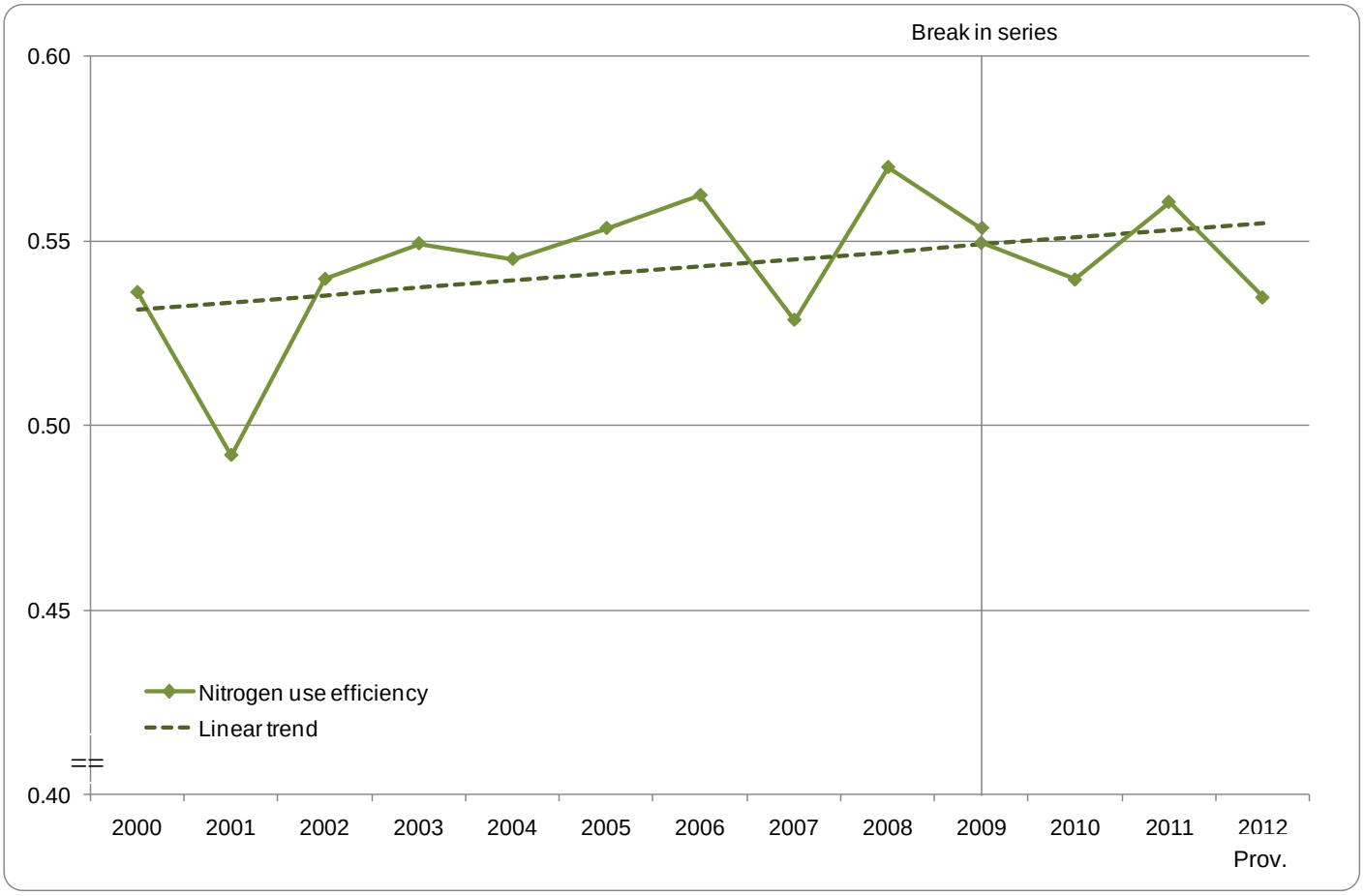
	kg N per hectare				
	2009	2010	2011	prov. 2012	% change 2011/12
Total Inputs	196.5	202.4	199.7	195.3	-2%
Total Offtake	107.9	109.2	111.9	104.4	-7%
BALANCE (Inputs minus Offtake)	**88.6**	**93.2**	**87.8**	**90.9**	**4%**

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

	Thousand tonnes of N				
	2009	2010	2011	prov. 2012	% change 2011/12
TOTAL INPUTS	**1564**	**1610**	**1591**	**1571**	**-1%**
Fertilisers	**769**	**808**	**818**	**808**	**-1%**
Inorganic fertilisers	717	756	766	756	-1%
Total organic fertilisers	53	52	52	52	0%
Manures	**555**	**572**	**561**	**558**	**-1%**
Livestock Manure Production	572	584	574	571	-1%
Cattle	372	378	369	365	-1%
Pigs	42	41	41	42	2%
Sheep and goats	74	75	76	78	3%
Poultry	79	85	83	80	-3%
Other livestock	5	5	5	5	-1%
Withdrawals	-17	-13	-13	-13	0%
Other inputs	**240**	**230**	**212**	**205**	**-3%**
Atmospheric Deposition	115	112	108	109	1%
Biological fixation	116	110	96	87	-10%
Seeds and Planting Material	9	9	9	9	10%
TOTAL OFFTAKE	**859**	**868**	**892**	**840**	**-6%**
Total Harvested Crops	**460**	**463**	**485**	**446**	**-8%**
Cereals	338	341	353	328	-7%
Oil crops	56	65	80	74	-7%
Pulses and Beans	31	26	17	14	-15%
Industrial Crops	14	11	14	12	-14%
Other Crops	20	20	20	16	-20%
Total Forage	**390**	**395**	**396**	**384**	**-3%**
Harvested Fodder Crops	25	25	25	25	-2%
Pasture	365	370	371	359	-3%
Crop residues	**9**	**10**	**10**	**10**	**2%**
BALANCE (Inputs minus Offtake)	**705**	**742**	**700**	**731**	**4%**
Managed area (Th. Ha) (a)	**7,961**	**7,953**	**7,967**	**8,043**	**1%**

(a) excludes rough grazing

Chart 2: Nitrogen use efficiency, 2000 to 2012



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. A value of 1 would indicate that the application of nutrients precisely matches the crop requirements.

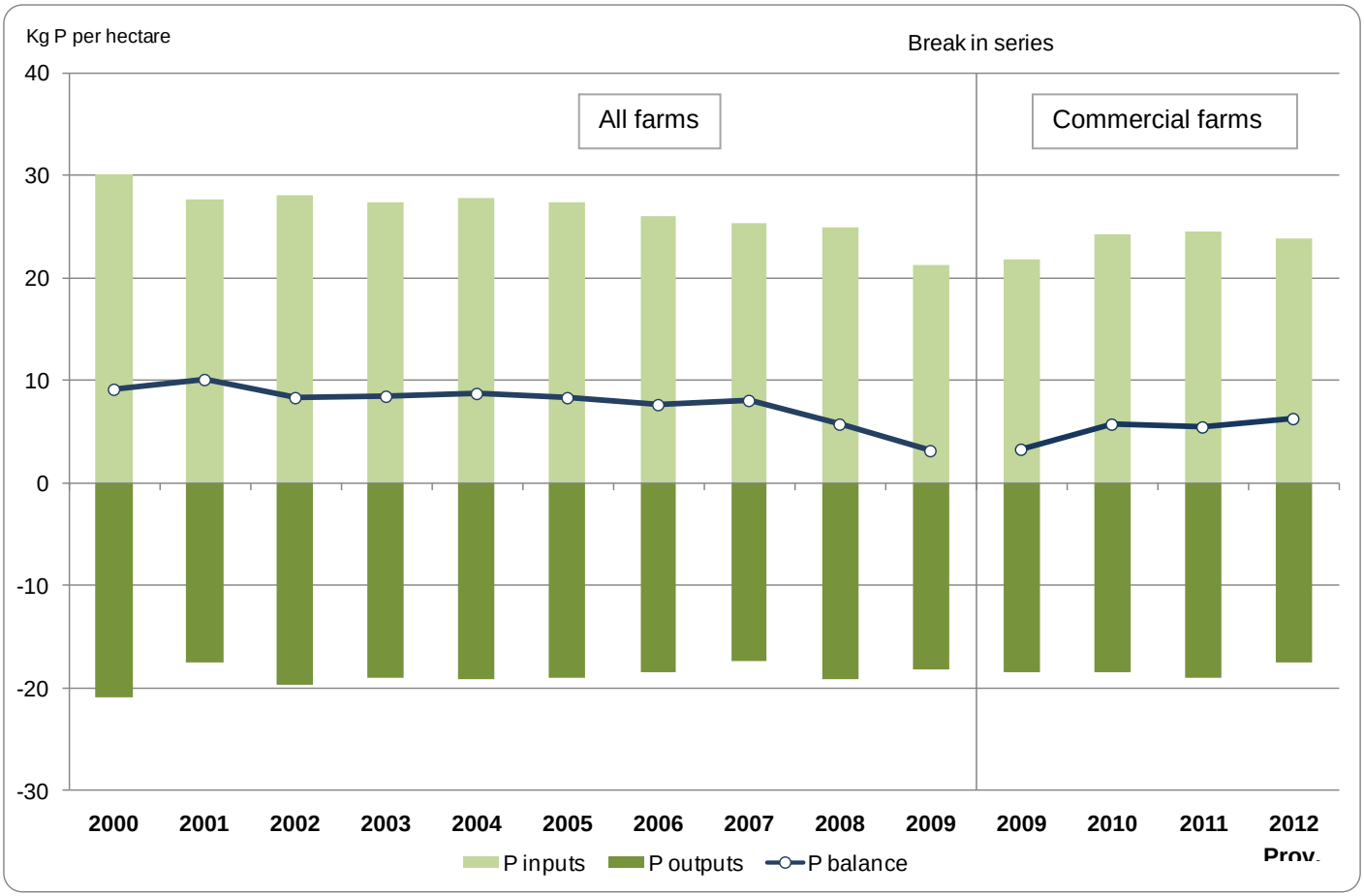
The chart shows an overall steady improvement in nitrogen use efficiency between 2000 and 2012.

Declines in 2001, 2007 and 2012 are a reflection of relatively poor cereal harvests due to wet weather at planting (2001) or at harvest (2007 and 2012), leading to a relatively low offtake compared to the inputs applied.

The decline in 2010 is due largely to the greater increase in inputs (mainly inorganic fertilisers) compared to offtake.

England Phosphorus Balance

Chart 3: Summary of Phosphorus balance for England, 2000 to 2012 (kg P per hectare)



For the period 2000 to 2012 the key points are:

- Provisional estimates for 2012 show a fall in the total surplus per hectare of managed agricultural land in England from 9.1 kg/ha in 2000 to 6.3 kg/ha in 2012, a reduction of 31%.
- The main driver for the lower surplus has been the reduction in inputs (from 30 to 24 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 18 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 changes[2] in farm survey data collection.

For the period 2010 to 2012 the key points are:

- There has been an increase in the surplus of 0.9 kg/ha (16%) compared with 2011.
- This increase has been driven by a reduction in offtake (particularly from harvested crops) which has more than offset 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 England, 2009 to 2012 (kg P per hectare)

	kg P per hectare				
	2009	2010	2011	prov. 2012	% change 2011/12
Total Inputs	21.8	24.3	24.4	23.8	-2%
Total Offtake	18.5	18.5	19.0	17.6	-8%
BALANCE (Inputs minus Offtake)	**3.3**	**5.8**	**5.4**	**6.3**	**16%**

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

	Thousand tonnes of P				
	2009	2010	2011	prov. 2012	% change 2011/12
TOTAL INPUTS	**173**	**193**	**195**	**192**	**-1%**
Fertilisers	**70**	**87**	**91**	**89**	**-3%**
Inorganic fertilisers	38	55	59	57	-4%
Total organic fertilisers	32	32	32	32	0%
Manures	**99**	**101**	**99**	**99**	**-1%**
Livestock Manure Production	99	101	99	99	-1%
Cattle	58	59	58	57	-1%
Pigs	8	8	8	8	1%
Sheep and goats	12	12	12	12	3%
Poultry	19	20	20	19	-3%
Other livestock	2	2	2	2	-1%
Withdrawals	0	0	0	0	-
Other inputs	**5**	**4**	**4**	**5**	**4%**
Atmospheric Deposition	3	3	3	3	1%
Seeds and Planting Material	2	2	2	2	11%
TOTAL OFFTAKE	**147**	**147**	**151**	**141**	**-7%**
Total Harvested Crops	**83**	**82**	**86**	**78**	**-9%**
Cereals	62	60	61	56	-8%
Oil crops	11	13	16	15	-7%
Pulses and Beans	4	3	2	2	-15%
Industrial Crops	3	2	3	3	-14%
Other Crops	3	3	3	3	-20%
Total Forage	**62**	**63**	**64**	**61**	**-4%**
Harvested Fodder Crops	5	5	5	5	-2%
Pasture	58	59	59	57	-4%
Crop residues	**2**	**2**	**2**	**2**	2%
BALANCE (Inputs minus Offtake)	**26**	**46**	**43**	**51**	**17%**
Managed area (Th. Ha) (a)	**7,961**	**7,953**	**7,967**	**8,043**	**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. 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