Office for National Statistics

Statistical bulletin

UK natural capital: ecosystem accounts for freshwater, farmland and woodland

Natural capital accounts for freshwater, farmland and woodland have been developed with categories not previously included. Methodology is experimental and some services are not currently measured.

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1 . Main points

- Woodland removed more harmful pollution and carbon dioxide from the atmosphere than any other habitat, valued at £1.8 billion in 2015

- Between 2009 and 2015 the amount of time spent visiting woodlands in the UK was estimated to have increased from 245 million hours to 350 million hours.

- Conditions of freshwater habitats in recent years have generally deteriorated, whilst the condition of woodland has improved

- Farmland habitats are producing more energy from solar power, with 600 times more solar energy being produced in 2015 than in 2007.

2 . Things you need to know about this release

This bulletin contains ecosystem accounts for three of the eight broad habitats found in the UK. They form part of UK natural capital accounts being developed by the Department for Environment, Food and Rural Affairs (Defra) and Office for National Statistics (ONS). Farmland, freshwater and woodland ecosystem accounts were previously published in individual releases.

Estimates of the quantity and value of pollution removed from the atmosphere by vegetation have been heavily revised. This is as a result of methodological improvements carried out by the Centre for Ecology and Hydrology (CEH) for ONS. Full details and total UK estimates can be found in the report released with this bulletin.

All methods are continually improved upon as the UK natural capital accounts are developed, so remain in experimental status. Revisions to estimates in future releases are highly likely. The monetary accounts should be interpreted as the partial or minimum value of the habitat, as a number of ecosystem services are not currently measured.

Figures are given between the periods 2007 to 2015 where available. All monetary valuations are given in 2015 prices.

3 . Collaboration

This publication is produced in partnership with the Department for Environment, Food and Rural Affairs.

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We would also like to thank Rebecca Clark and colleagues at Natural England and Sheila Ward and colleagues at Forestry Commission for their valuable comments and review of this work.

4 . What are ecosystem accounts?

Each habitat can be thought of as an asset supplying a number of services that the economy and society benefit from. For example, food, water or clean air. The ecosystem accounts monitor the size and condition of these assets and also the quantity and value of the services supplied.

In this bulletin, freshwater, woodland and farmland ecosystem accounts are presented in four sections:

- the size of the area covered by each habitat (extent account)

- indicators of the quality of the ecosystem and ability to continue supplying services (condition account)

- quantity and value of services supplied by the ecosystem (physical and monetary ecosystem service flow accounts)

- value of the asset, which represents the stream of services expected to be provided over the lifetime of the asset (monetary asset account)

Ecosystems provide a diverse range of services and not all have been included in this bulletin, either due to data or methodological requirements. Services included and excluded are given in Table 1.

Table 1: UK environmental services included in this publication

	Included	Not included
Provisioning	· Agricultural production	· Wild animals
Products such as food, water, fibre and fuel	· Water · Fish · Timber · Hydro and solar power on farms · Navigation . Peat	· Wild plants · Abiotic services - oil, gas, coal & minerals · Other renewable energy sources
Regulating	· Carbon sequestration	· Waste water cleaning
Benefits such as water purification, climate regulation, noise and air pollution reduction and flood hazard reduction	· Air pollution removed by vegetation	· Mediation of smell, noise and Pollution removed by water · Flood, erosion and landslide protection, water flow control, temperature regulation · Lifecycle regulation · Water condition regulation
Cultural	· Recreation (day trips by UK residents)	· Scientific interactions
Non-material benefits, for example recreational enjoyment and aesthetic experience	· Education	· Heritage and aesthetic interactions · Symbolism of certain plants and animals · Value placed on nature simply existing · Overnight visits and visits by non-residents

Source: Office for National Statistics

5 . Ecosystem accounts for freshwater

What is freshwater?

Freshwater can be divided into wetlands and open waters. Floodplains were included in the initial accounts but have been removed for this release.

Wetlands are defined as areas of land covered by shallow water at or near the surface level including fens, marshes, swamps and bogs.

Open waters include standing and flowing waters. Standing waters consist of natural bodies such as lakes, meres and pools, as well as manmade features such as reservoirs, canals, ponds and gravel pits. Flowing waters include rivers and streams that flow into the sea or a lake.

These habitats are very different and they inevitably provide different services. Open waters are used for water abstraction, to generate hydropower and for fishing, while wetlands act as a natural flood defence and attract and support a range of wildlife.

What is the size of the area covered by freshwater?

UK natural capital land cover accounts show inland waters accounted for around 314,000 hectares in 2007 with open wetlands covering around 2,800,000 hectares. Together, the freshwater habitat covers around 12% of land in the UK.

How has the condition of freshwater ecosystems changed?

The capacity of the ecosystem to provide services depends on the area covered by an ecosystem and the management and condition of that ecosystem. Table 2 provides indicators for the condition of freshwaters in the UK.

Table 2: UK freshwater condition indicators, 2008 and 2012

Type	Indicator	Indicator signalling improvement or deterioration in condition between 2008 and 2015
Chemical	Ammonium Levels	Improvement
	Biomedical Oxygen Demand	Improvement
River Flow	Exceptionally high annual flow	No Trend
	Exceptionally low flow	Little/no change
Biodiversity	Water and Wetland Birds index	Deterioration
WFD status for rivers and canals	Percentage of rivers and canals in good or excellent condition	Little/no change
	Percentage of rivers and canals in poor or bad condition	Deterioration
WFD status for lakes	Percentage of lakes in good or excellent condition	Deterioration
	Percentage of lakes in poor or Bad Condition	Deterioration

Source: European Environment Agency, Joint Nature Conservation Committee, Natural Environment Research Council and Defra

The EU Water Framework Directive (WFD) assesses the condition of open waters with 30 indicators broken into three categories: biological (for example, fish, invertebrates, plants), chemical (for example, heavy metals, pesticides, nutrients) and condition (for example, presence of barriers to fish migration, modelled lake level data). The WFD excludes many smaller water bodies from its estimates so it is not a full representation of UK open waters.

Since 2008, the number of bodies classed as in poor or bad condition has increased, while the number classed as in excellent or good condition has decreased. In 2014, 69% of rivers and canals and 62% of lakes did not meet all the criteria to receive an excellent or good status. However, if measurement of only one of the 30 criteria falls short, that one result determines the overall assessment of the water's quality, which could mask progress in certain components of condition.

For example, average ammonium levels have fallen from a high of 88 micrograms of N-NH4 per litre of water in 2004 to 32 in 2012. Ammonium is very toxic to aquatic organisms (SEPA). High concentrations are often caused by organic pollution originating from domestic sewage (raw or treated), urban run-off, industrial effluents and farm wastes. Falling ammonium levels suggest progress towards the WFD chemical condition targets.

Figure 1: Ammonium levels in UK rivers, 2001 to 2012 (micrograms of N-NH4 per litre)

United Kingdom

Figure 1: Ammonium levels in UK rivers, 2001 to 2012 (micrograms of N-NH4 per litre)

United Kingdom

mg of N-NH5 per litre
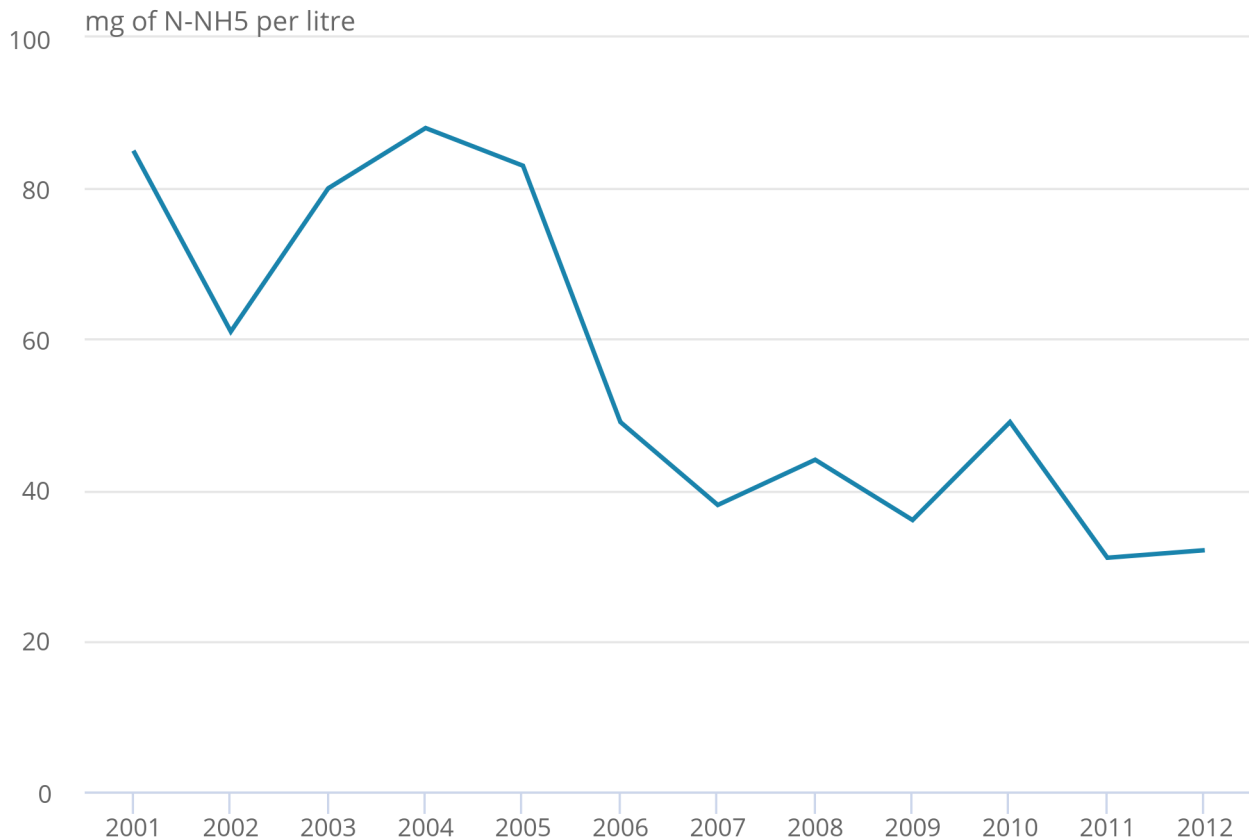

Source: European Environment Agency

Source: European Environment Agency

The water and wetland bird index suggests a decrease in the ability of wetland habitats to maintain biodiversity, although there is some resurgence in 2015. The recent decline between 2002 and 2014 can be attributed in some part to changes in land management, such as drainage of land, intensification of grassland management and conversion of floodplain grazing marshes to arable land (according to the Department of Environment, Food and Rural Affairs (Defra)). According to the Joint Nature Conservation Committee (JNCC), external factors, such as the condition of summer breeding grounds and migratory routes, also influence these estimates as the majority of water and wetland birds are migratory.

Figure 2: Water and wetlands birds Index, 1975 to 2015
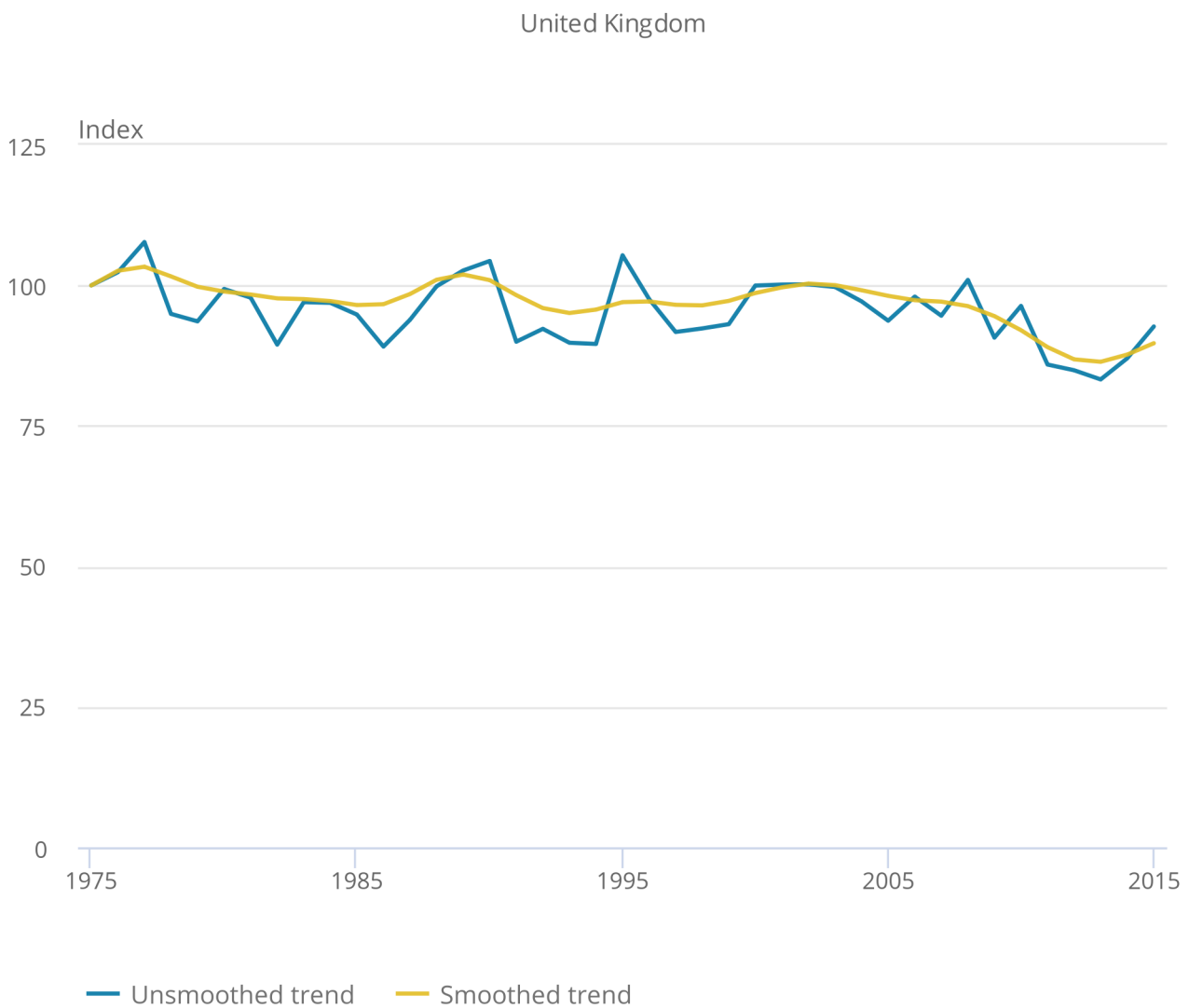
United Kingdom

Source: Department for Environment, Food and Rural Affairs, British Trust for Ornithology, Royal So

Source: Department for Environment, Food and Rural Affairs, British Trust for Ornithology, Royal Society for the Protection of Birds, Joint Nature Conservation Committee

What is the quantity and value of freshwater ecosystem services?

This section assesses the contribution of the services freshwater provides to the economy and society, capturing the flow of services in physical and monetary units. Table 3 provides the annual physical flow of services provided by freshwater ecosystems and Table 4 presents their monetary value.

To note, air pollution removal estimates only include pollution removed by vegetation and not by water bodies. Water bodies also sink pollution, so for the freshwater habitat this will be a substantial underestimate. Falling levels of pollution removed reflect reduced pollution emissions, rather then degrading condition of the habitat. This is discussed more later in the woodland ecosystem accounts.

Table 3 is partial; there are many other services provided by freshwaters not currently being captured (see Table 1). Further work will be undertaken to include these other services.

Table 3: UK freshwater non-monetary ecosystem services account, 2007 to 2015

Type of Service	Ecosystem Service	2007	2008	2009	2010	2011	2012	2013	2014	2015
Provisioning services	Water abstraction (million m^3)	5,061.6	4,967.1	4,741.9	4,931.5	4,742.3	4,790.0	4,808.5	4,708.8	-
	Peat extracted (thousand tonnes)	666.4	572.3	667.9	756.0	621.2	427.7	944.3	589.6	-
	Hydropower (Gwh)		4,209.1	4,279.1	2,693.6	4,577.9	4,168.1	3,596.4	4,605.8	4,889.0
	Fish capture (tonnes)	2,517.0	2,529.0	2,562.0	2,473.0	2,325.0	2,084.0	2,268.0	2,032.0	2,045.0
	Navigation (licensed boats)		36,941.0	36,261.0	35,872.0	35,643.0	35,445.0	35,304.0	35,013.0	34,170.0
Regulating services	Pollution removal (thousand tonnes)	54.6	54.0	53.3	52.7	52.0	52.2	52.4	52.6	52.8
Cultural services	Time spent at habitat (million hours)		-	275.5	240.7	283.7	305.0	385.7	302.4	296.3
	Educational visits		55,833.0	56,916.0	67,083.0	69,524.0	57,703.0	65,720.0	59,773.0	-

Source: British Geological Survey, Food and Agriculture Organization of the United Nations, Canal River Trust, Defra, Centre for Ecology and Hydrology, Ricardo, Natural England, Wildfowl & Wetland Trust

Table 4: UK freshwater annual monetary value by service, 2007 to 2015

										£ million
Type of Service	Ecosystem Service	2007	2008	2009	2010	2011	2012	2013	2014	2015
Provisioning services	Water abstraction	1,001	1,213	643.7	575.4	917.7	1,223.8	1,289	1,019	-
	Peat extraction	2.3	1.4	2.6	1.4	2.9	3.4	8.4	5.4	-
	Fish capture	1.4	1.3	1.4	1.8	1.3	1.2	1.0	-	-
Regulating services	Pollution removed	25.0	23.9	22.8	21.6	20.5	19.3	18.1	16.9	15.7
Cultural services	Time spent at habitat			530.1	410.9	493.1	456.2	456.3	321.8	303.0

Source: Office for National Statistics

Water for public consumption valued at £1 billion in 2015

Freshwaters supply water for drinking, agricultural and industrial production purposes and more. Water abstraction estimates include only water in the public water supply and not private water supplies. This service is provided solely by open waters.

Public water supply prices are regulated by designated bodies in the UK. Their price caps affect the ability of water companies to change their prices. This price cap therefore effects the water companies output, which we use for our valuations.

Peat extraction remains variable despite policy to phase out by 2030

Wetlands supply many services, one of them being peat extraction. Peat is used in horticulture for its unique characteristics that make it an ideal growing medium. However, its extraction degrades the ecosystem effecting the ability to provide other ecosystem services into the future. Furthermore, peat is estimated to store at least 3 billion tonnes of carbon in the UK, almost four times as much as in UK forests. When peat is extracted, some of this carbon is released into the atmosphere causing wider-reaching environmental effects.

While there is an ambition set out in the Natural Environment White Paper to end the use of peat in horticulture in England by 2030, peat extraction has remained variable over recent years.

Mainly recreational fishing in UK inland waters

According to the Food and Agriculture Organisation (FAO), there is little commercial exploitation of inland waters other than eel fisheries and limited salmonoid fisheries. Commercial salmonoid catches have declined throughout the UK as fishing rights are increasingly bought out by recreational fishermen. However, there has also been a decline in angling in the UK, especially in the last 4 years, with salmon and trout licences and fishing days decreasing (Environment Agency).

Recreational trips increase while expenditure decreases

Freshwaters also provide cultural services. People visit freshwater bodies for a number of activities providing numerous non-material benefits to people's physical and mental health. Although wetlands provide many opportunities for leisure activities, these results focus near open waters only due to data limitations.

Despite an increase in visitor numbers, the annual value of recreation on or by freshwaters has fallen. This value comprises of travel costs (fuel or public transport), parking and admission fees, which are used as a proxy to determine the willingness to pay for a visit. This signals that the average cost of a visit is falling.

What is the asset value of freshwater?

The asset account includes projections of all the ecosystem services. They are projected for their expected life with a discount applied to each further year. Services such as recreation and water abstraction are seen as renewable, so the asset life is set at 100 years. Services such as peat extraction are non-renewable, as they can only continue for as long as there is peat available to extract.

For more information on monetary flow and asset accounts, please refer to the Principles of Natural Capital Accounting publication.

Table 5: UK freshwater asset values by service, 2014 to 2015

Service	2014 to 2015 (£million)
Fish capture	29.4
Water abstraction	28,904.10
Peat extraction	25.7
Pollution removed	453.0
Recreation	10,052.6
Total	39,464.8

Source: Office for National Statistics

6 . Ecosystem accounts for woodland

What are woodlands?

Woodlands in the UK are tree-covered areas, which include plantation forests (usually intensive areas of trees), more natural forested areas and lower density or smaller stands of trees.

What is the size of the area covered by woodland?

Land used for forestry has increased steadily from 3.04 million hectares in 2007 to 3.16 million hectares in 2015. The increase has largely been in privately-owned broadleaved (hardwood) woodland.

Forestry Commission statistics have been used, rather than Office for National Statistics (ONS) Land Cover accounts, because Forestry Commission statistics provide annual estimates specifically for woodland. Currently, only woodland used for forestry over 0.5 hectares in size is included. Smaller woodland and individual trees are not; this is expected to be around 20% of trees in Britain. Areas recently felled but expected to be replanted and open space within woodland are included.

How has the condition of woodland ecosystems changed?

Table 6: UK woodland ecosystem condition account, 2008 and 2012

Type	Indicator	Indicator signalling improvement or deterioration in condition between 2008 and 2015
Timber	Coniferous (softwood) stock available	Improvement
	Broadleaved (hardwood) stock available	Improvement
	Tonnes of carbon stored by forests	Improvement
Biodiversity	Specialist Woodland bird index	Little/no change
Certified Woodland	Area of FSC certified woodland	Improvement
Space for people	Percentage of population with access to 20 hectares	Improvement

Source: Forestry Commission, Defra, Woodland Trust

Improvements are seen in most condition indicators, both since 2008 and 2012. The current stock and age of trees determine the future supply of timber. Timber stock is estimated to have increased by 10% between 2007 and 2015. Carbon contained in forests also increased over the same period, by 7%. This indicator includes carbon contained in trees, deadwood, forest litter and soils.

Woodland certified under the Forest Stewardship Council (FSC) scheme also increased modestly over the decade. To be FSC certified, woodland managers are required to meet certain standards to ensure the forest is being managed in a way that preserves the natural ecosystem. Increased FSC certified woodland is a good indicator of sustainable management and condition.

Accessible woodland is an indicator of the ability to supply recreational services to the population. The percentage of the population with access to 20 hectares of woodland within 4 kilometres of their home also increased, indicating improved accessibility.

The woodland bird index was the only indicator to not show an improvement. There was no clear trend in the accounting period, but estimates of bird numbers are low when compared with levels recorded in the last part of the 20th century.

Figure 3: Woodland bird index, 1990 to 2015
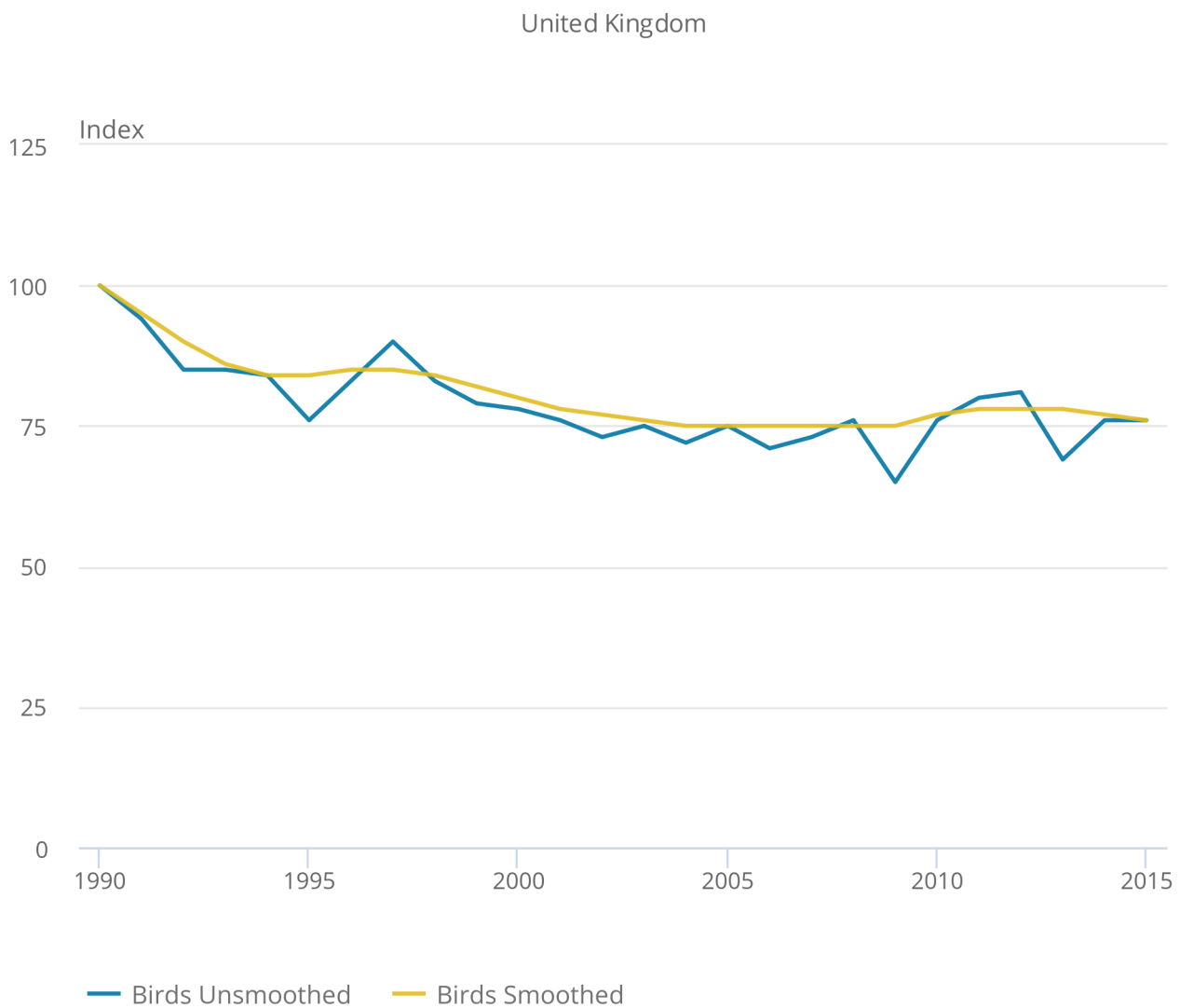
United Kingdom

Source: Department for Environment, Food and Rural Affairs, British Trust for Ornithology, Royal So

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What is the quantity and value of woodland ecosystem services?

This section assesses the contribution of some of the services woodland provides to the economy and society, capturing the annual flow of services in physical units in Table 7 and the monetary value in Table 8.

Table 7: UK woodland annual physical flow by service, 2007 to 2015

Type of service	Service	2007	2008	2009	2010	2011	2012	2013	2014	2015
Provisioning services	Total timber removals (million cubic metres overbark standing)	11.2	10.5	10.9	11.9	12.9	12.9	14.0	14.6	13.7
Regulating services	Carbon sequestration (million tonnes carbon dioxide equivalent)	17.8	17.9	17.9	18.0	17.9	17.6	17.6	17.3	17.0
	Pollution removed (thousand tonnes)	350.2	343.925	337.65	331.375	325.1	322.7	320.3	317.9	315.5
Cultural services	Time spent at habitat (million hours)			244.8		172.0	256.7	290.1	365.8	352.2	351.2

Source: Forestry Commission, United Nations framework convention on Climate Change, Centre for Ecology and Hydrology, Ricardo, Natural England

Table 8: UK woodland annual monetary value by service, 2007 to 2015

£ million

Type of service	Service	2007	2008	2009	2010	2011	2012	2013	2014	2015
Provisioning services	Total timber removals	156.5	105.4	112.4	172.8	189.8	175.8	219.3	266.8	227.5
Regulating services	Carbon sequestration	955.5	980.4	1,002.2	1,025.8	1,022.2	1,022.5	1,041.5	1,043.3	1,045.7
	Pollution removal (thousand tonnes)	1313.2	1251.2	1189.3	1127.4	1065.5	990.8	916.2	841.6	767.0
Cultural services	Time spent at habitat			490.9	349.3	388.8	397.2	509.7	339.1	290.8

Source: Office for National Statistics

## Woodland removed 292,000 tonnes of air pollution in 2015

The value of woodland vegetation removing harmful pollution was estimated to be £767 million in 2015. This value is based on the avoided health costs associated with respiratory and cardiovascular illnesses, and subsequent years of life gained and deaths avoided.

In 2007, 292,000 pollution particles were removed from the atmosphere and this was valued at £1.3 billion. The decline is largely due to less pollution being emitted into the atmosphere for vegetation to remove (see Figure 4), rather than a reflection of changing condition of woodland. A report that explains the estimates in full is published with this release.

Figure 4: Indexed emissions of air pollution, 2007 to 2015

United Kingdom

Figure 4: Indexed emissions of air pollution, 2007 to 2015
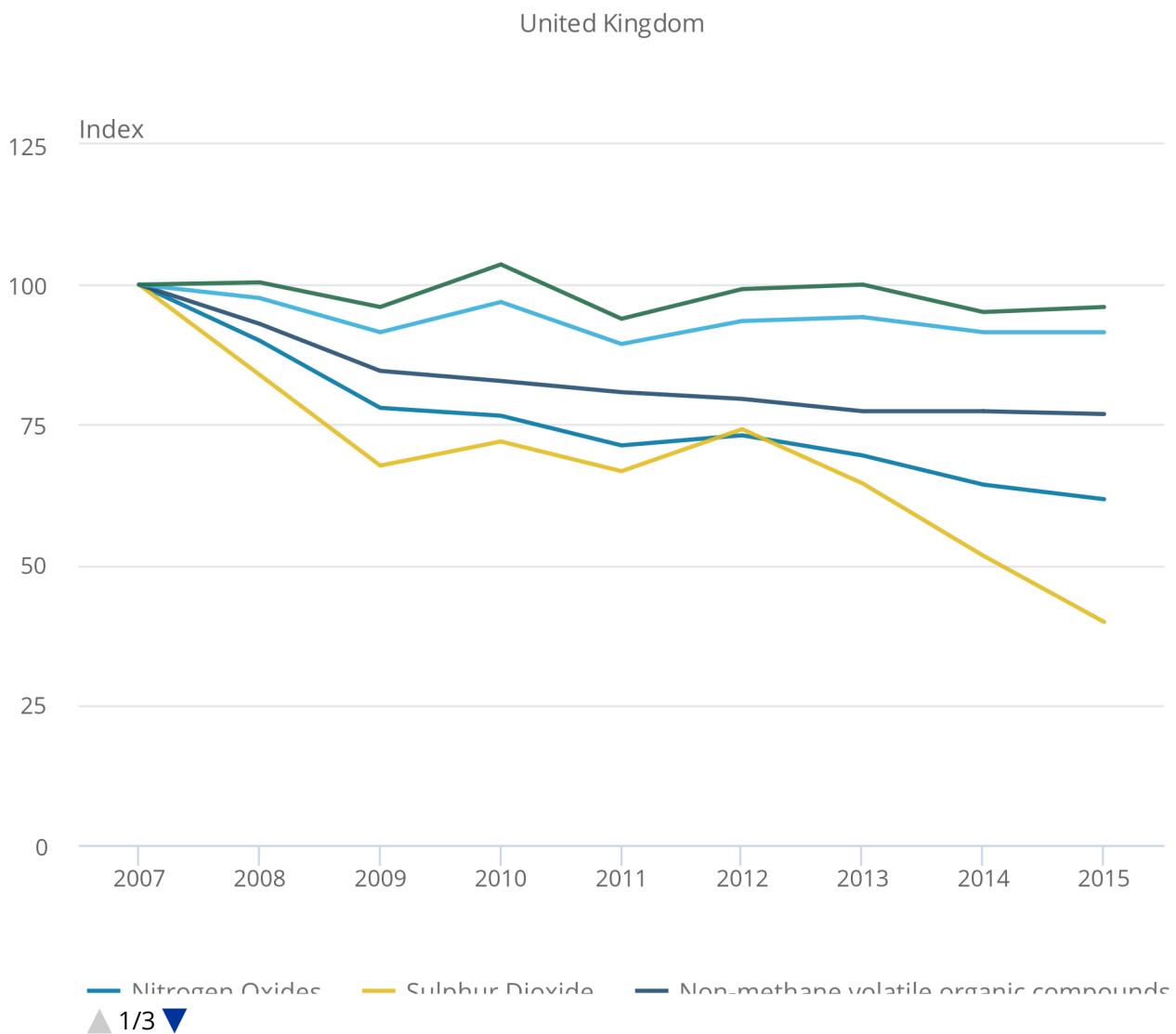
United Kingdom

Source: Department for Environment, Food and Rural Affairs

Value of timber provision increased by £70 million since 2007

Timber in the UK is generally sustainably sourced, so is in essence renewable. The amount of timber removed from woodlands has increased from 11.2 million cubic metres in 2007 to 13.7 million cubic metres in 2015. The value of timber provision also increased, from £157 million in 2007 to £227 million in 2015.

Visits to woodlands increase while expenditure decreases

Between 2009 and 2015, the amount of time spent on visits made to woodlands in the UK was estimated to have increased from 244 million to 351 million. To value these trips, the amount spent travelling and entering woodlands is used as a proxy for a person's willingness to pay for the trip. The value has decreased over this period as less has been spent on travel and admission fees, despite increased visits.

Price of carbon causes increase in value of woodlands

The amounts of carbon sequestered by UK woodland was broadly unchanged throughout the period, however, the non-trade carbon price, set by the Department for Business, Energy and Industrial Strategy (BEIS), increased over the period (see Table 9). Due to this, the value of the carbon removed from the atmosphere, known as sequestered, rose from £956 million in 2007 to over £1 billion in 2015.

Table 9: UK non-trade carbon price, 2008 to 2015

Year	Carbon Price (£ per tonne)
2008	55
2009	56
2010	57
2011	57
2012	58
2013	59
2014	60
2015	61

Source: Department for Business Energy and Industrial Strategy

What is the asset value of woodlands?

This section presents the asset account for woodland. Please see Table 5 for a description of what an asset account shows and how it is calculated.

Table 10: UK woodland ecosystem asset values (2015 prices), 2015

Service	2015 (£million)
Biomass for timber	6,582.9
Carbon sequestration	42,857.3
Pollution removal	24,951.3
Time spent at habitat	13,193.2
Total	87,584.7

Source: Office for National Statistics

7 . Ecosystem accounts for farmland

What is farmland?

Farmland accounts presented in this section encompass cropped and grass fields that cover much of the UK's lowlands, along with the networks of hedges and ditches. Included are:

- arable and horticultural – land used to grow vegetables, fruit, mushrooms and flowers; this includes uncropped arable land

- improved grassland – grasslands altered for agricultural use both temporary and permanent

- rough grazing – land used for low-intensity grazing of livestock

Small woodlands can also be found in farmland, however, these are included within woodland ecosystem accounts.

What is the size of the area covered by farmland?

The June Survey of Agriculture and Horticulture (June Survey) records 17.6 million hectares of land in the UK as farmland. Since 2007, this has declined slightly (by 2.6%). Less land being used for rough grazing contributed the most to this fall (8.0%), but land used for arable and horticultural purposes also fell during this period (3.0%).

The June Survey has been used, rather than Office for National Statistics (ONS) land cover accounts because the June Survey provides a greater level of detail and annual estimates.

What is the condition of farmland ecosystems?

Table 11: UK farmland ecosystem condition account, 2008 and 2012

Type	Indicator	Indicator signalling improvement or deterioration in condition between 2008 and 2015
Chemical	Nitrogen soil balance	Improvement
	Phosphorus soil balance	Improvement
Biodiversity	Farmland bird index	Deterioration
Protected areas	Hectares of Protected Areas	Improvement
Organic Farming	Number of organic farms	Deterioration

Source: British Trust for Ornithology, Royal Society for Protection of Birds, Joint Nature Conservation Committee, Defra

Changes in land management can indicate improving or worsening treatment of the land, reflecting its condition and capacity to produce ecosystem services. Designated protected areas are often protected for biodiversity and geological diversity. But, protecting the land also enhances the provision of recreation and other cultural services by maintaining valued landscapes. Similarly, to grow certified organic food certain management practices aimed at protecting the soil need to be met.

Since 2008, more farmlands are now classed as protected areas, although there has been no change in this indicator since 2012. However, the area of land used for organic farming decreased between 2007 and 2015, suggesting a worsening in the treatment of land.

Birds numbers can also reflect the condition of a habitat and have significant cultural importance. The population of farmland birds has fallen since 2007, as shown by the farmland bird index. Birds are susceptible to changes in crop type, pesticides and field sizes, although their numbers can also be affected by external factors such as the weather or migration routes.

Nitrogen and phosphorus soil balances fell between 2007 and 2015, notably in phosphorus (38%). Generally, this is seen as an improvement in condition, although a shortage of nutrients can limit the productivity of agricultural soils.

What is the quantity and value of farmland ecosystem services?

Table 12: UK farmland Annual physical flow by service, 2007 to 2015

Type of Service	Service	2007	2008	2009	2010	2011	2012	2013	2014	2015
Provisioning services	Arable crops (million tonnes)	33.6	40.1	38.5	35.9	39.2	34.1	36.7	42.3	39.1
	Horticultural crops (million tonnes)	2.9	3.0	3.1	3.2	3.1	2.9	3.0	3.2	3.4
	Grazed biomass (million tonnes)	13.6	15.1	12.5	12.3	10.4	11.0	5.4	3.5	3.0
	Arable feedstock (million tonnes)	49.7	46.8	47.9	50.6	52.0	51.6	58.0	62.8	63.6
	Water abstraction (million cubic metres)	85.0	71.0	101.0	129.0	144.0	76.0	126.0	117.0	119.0
	Solar energy (GWh)	9.6	11.6	13.7	18.8	95.0	494.1	965.9	2580.6	5647.9
Regulatory services	Pollution removed (thousand tonnes)	823.8	809.2	794.6	780.1	765.5	770.6	775.8	781.0	786.2
Cultural services	Time spent at habitat (million hours)			149.3	155.8	172.3	191.5	166.4	155.2	131.4
	Educational visits (thousand visits)	65.0	90.0	94.3	112.0	147.1	147.1	248.1	310.0	230.1

Source: Natural England, Ricardo, Centre for Ecology and Hydrology

Table 13: UK farmland annual monetary value by service, 2007 to 2015

£ million

Type of Service	Service	2007	2008	2009	2010	2011	2012	2013	2014	2015
Provisioning Services	Crops and grazed biomass	235.0	1,555.1	0.0	1,300.3	1,079.2	1,160.5	1,763.1	1,330.1	
	Water abstraction	5.3	3.4	2.2	2.9	5.1	6.4	6.7	5.7	3.8
Regulating Services	Pollution removed (thousand tonnes)	342.2	313.8	285.4	256.9	228.5	215.4	202.3	189.1	176.0
Cultural Services	Time spent at habitat			405.2	327.3	275.6	232.4	211.8	312.3	197.8
	Education visits	0.7	0.9	1	1.2	1.5	1.5	2.1	2.3	1.8

Source: Office for National Statistics

Crop production has increased

Both the volume of arable crops produced in the UK (cereals, oilseed and potatoes) and horticulture crops (vegetables, fruit and plants) have increased. UK wheat yield in particular has been increasing in recent years and peaked in 2015 at 9 tonnes per hectare, the highest it has been in the past 25 years.

Arable feedstocks (grasses cut and harvested for hay, silage from grass, and silage from other arable crops) have also increased. Only grazed biomass fell during this period. Grazed biomass is essentially any biomass that goes into livestock that was not specifically grown for this purpose, for example, grass that is grazed on. It is derived from the gap between estimated annual feed intake for livestock and the supply of fodder crops.

Farmland continues to provide an environment for waste recycling

Farmland provides an area on which animal manures and slurry can be spread, which would otherwise need to be disposed of by alternative means. There has been an overall positive trend in this service over the period. However, if spread or stored in the wrong way this waste can negatively impact on other habitats, particularly freshwater.

Quantity of electricity from solar farms continues to rise

The UK is required to meet an EU renewable energy target to source 15% of its energy from renewables by 2020. The flow of renewable solar energy from farmland has increased enormously over this accounting period helping towards this target. In 2015, the government reduced support for solar farms, where solar arrays are ground mounted on either agricultural of brownfield land; this could have an impact on future results.

Farmland removed 786 tonnes of pollution from the atmosphere

The value of farmland vegetation removing harmful air pollution was estimated to be £176 million in 2015. This value is based on the avoided health costs associated with respiratory and cardiovascular illnesses, and subsequent years of life gained and deaths avoided. Figure 6 displays the four pollutants included in the valuation.

Physically, farmland habitats remove the most pollution as they remove a substantial amount of ozone (O3). However, fine particular matter (PM2.5) is associated with the highest damage to health and as woodlands remove more PM10 than any other habitat, the ecosystem service that woodlands provide is valued at far higher.

Since 2007, the amount of pollution being removed has declined; this reflects less pollution being emitted into the atmosphere rather than changing condition of farmland. A report that explains the estimates in full is published with this release.

Figure 5: Value of vegetation removing air pollution, by pollutant and habitat, 2015

United Kingdom

Figure 5: Value of vegetation removing air pollution, by pollutant and habitat, 2015

United Kingdom
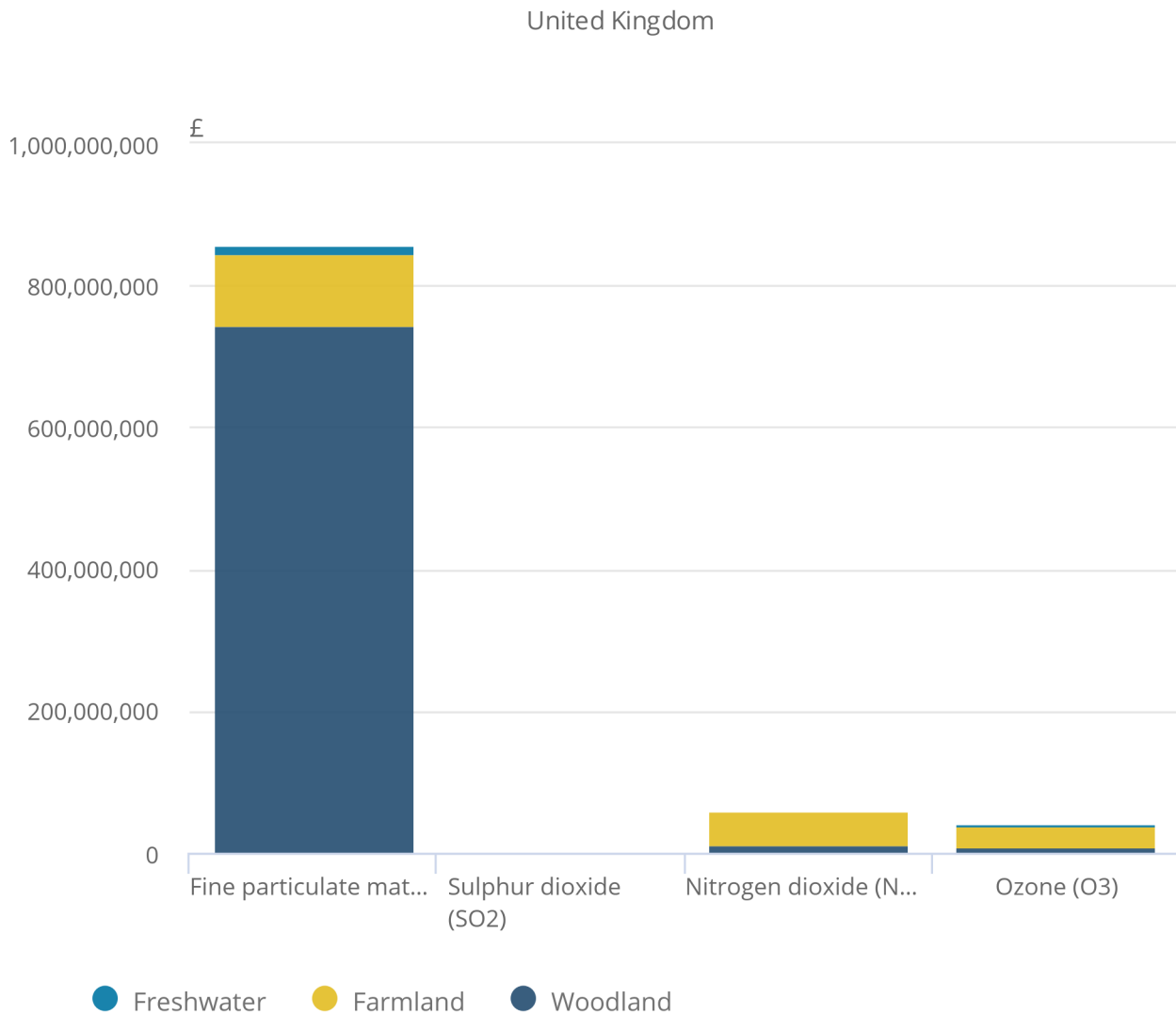
Source: Centre for Ecology and Hydrology

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Amount of time spent on farmland has fallen steadily since 2012

The amount of time spent on farmland rose steadily between 2009 and 2013 and then declined. Despite this, the overall value of these services has fallen as costs of travel and admission fees, used as a proxy for someone's willingness to pay to visit, have fallen over this period.

Increasing number of educational trips made to farmland

Farmland provides an opportunity for children and others to visit and learn about the natural and farming environment. We have measured this by taking data from the Education Access Programme run by Natural England, which facilitates school visits to farmland. Uptake of this programme increased over this accounting period.

What is the asset value of farmland?

This section presents the asset account for farmland. Please see Table 5 for a description of what an asset account shows and how it is calculated.

Table 14: UK farmland asset values by service, 2014 to 2015

Service	2014 to 2015 (£million)
Water Abstraction	160.9
Recreation	6,560.5
Education	54.3
Biomass Provisioning	38,157.2
Pollution removal	5,690.5
Total	50,623.4

Source: Office for National Statistics

8 . Quality and methodology

An explanation of the valuation methods can be found in the [Principles of Natural Capital Accounting](#) publication. In this methodology any assumptions that deviate from the standard methodology or previous accounts will be explained.

Air pollution removal estimates

Air quality regulation estimates have been supplied in consultation with the Centre for Ecology and Hydrology (CEH).The method and estimates are heavily revised from those published previously. A report published alongside this bulletin contains details of the changes, full methodology and new estimates for all habitats and the UK as a whole.

Biomass from timber

Data on the volume of removals from UK forests are sourced from the Forestry Commission. The value of the removals is based upon the Forestry Commission Coniferous Standing Sales Price Index.

Educational visits

The amount of educational trips to farmland areas was estimated using the Educational Access Programme, while the number of educational visits to freshwater was estimated using Wildfowl and Wetland Trust data. Both are relevant only to school trips.

The monetary value of educational visits to farmland is calculated using teachers wages as a proxy for trip costs. The number of school groups visiting farmlands through the Educational Access Programme is multiplied by the wages of two teachers. The National Union of Teachers (NUT) suggest a minimum of two teachers per school trip. The average teacher hourly wage is taken from the Annual Survey of Hours and Earnings (ASHE). The average amount of hours spent on school trips is estimated to be 4 hours. This is the midpoint between the lowest amount of hours to qualify to be included in the Educational Access Programme and a normal school day.

Carbon sequestration

The methodology underpinning the estimates combines data on the physical changes in the land use, land use change and forestry (LULUCF) sector within the UK greenhouse gas inventory, with information on the non-traded price of carbon. The land use refers to those classified as "cropland" for farmland and "forest land" for woodland.

Fish extraction

Physical data for the weight of fish captured from inland waters is from the Food and Agriculture Organisation (FAO). Aquaculture is not included within the estimates.

The residual value approach is used to value the ecosystem services from freshwater to fish capture. Ratio of fishing from inland freshwater to all types of fishing is applied to resource rent as only monetary data is available for the whole of fishing and aquaculture. This assumes that the unit costs and revenue from inland fishing are the same as for the whole of marine, freshwater fishing and aquaculture.

Peat extraction

Physical data for peat extraction was sourced from the British Geological Survey's UK Minerals Yearbook. The data are published in thousand cubic metres and a conversion rate applied to convert to tonnes.

The residual value method was used to estimate the value of ecosystem peat. To do this a ratio of revenue to resource rent was calculated for the "other mining and quarrying" sector and then applied to the estimated revenue from the peat industry to calculate the resource rent. The revenue is calculated by multiplying peat extraction in tonnes for each year by the price of a tonne of peat. The future extraction of peat is estimated by assuming a linear decrease in peat extraction to reach both targets of zero extraction for private horticultural. A 25-year asset life is assumed when calculating the asset value. In the initial freshwater accounts this extraction was assumed negative exponential but was updated for simplicity.

Recreational visits

Physical data for the number of visits to freshwaters was taken from Natural England's Monitoring Engagement in the Natural Environment (MENE) survey, which also collects data for spending during trips. Trips to freshwater are separated from other visits by using only visit data for those who chose the option "A river, lake or canal" to "Which of the following list of types of place best describe where you spent your time during this visit?". Where a person has selected two or more habitats, for example, woodlands and freshwater, then one visit is allocated to woodlands and one to freshwater. The monetary valuation is divided by the number of habitats visited, therefore in this example, half the value of the visit would be allocated to freshwater and half to woodland to better represent value derived from each habitat.

The recreation estimates have been developed by Ricardo-AEA, who also reviewed various different methods of valuing recreation. It was concluded only admission fees and travel expenditure should be included in the valuation as including the opportunity cost of time presents considerable problems. However, this will cause an underestimation, as the value of visits that have incurred no cost, for example, a walk along a local riverbank, will not be captured.

Solar energy

The amount of energy produced by solar power on farmland is taken from the Digest of UK Energy Statistics (DUKES). This is the total energy generated by solar and therefore needs to be partitioned for farmland only. It is assumed that all solar power installations above 4 kilowatts capacity are on farmland, therefore the percentage of solar installations with greater than 4 kilowatts is multiplied by the total energy generated. Energy capacity estimates are provided by the Department for Business, Energy and Industrial Strategy (BEIS). It should be noted that this method assumes that capacity remains proportional to output across the range of capacities.

Water abstraction

Physical data for water abstraction are sourced from Scottish Water for Scotland and the Department for Environment, Food and Rural Affairs (Defra) for England and Wales, while Northern Ireland is not included due to data limitations. Only data for public water supply are included to maintain consistency as there were no industry data for Scotland and to avoid double counting with the valuation of hydropower.

The residual value method is used to value ecosystem services related to water abstracted for public water supply in the same way as the Monetary Estimates 2016 publication and Initial Freshwater publication. A change is made by removing groundwater from the valuation. The reason being that groundwater is renewed by water filtering through from other land covers, mainly farmland, and cannot therefore all be attributed to the functioning of the freshwater ecosystem.

The supply of groundwater to the economy may be allocated to other land covers in future work. It is excluded from the monetary valuations by applying the ratio of water abstraction from groundwater to total surface water to the resource rent.