

Forestry Statistics 2016

A compendium of statistics about woodland, forestry and
primary wood processing in the United Kingdom



Chapter 4: UK Forests and Climate Change

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4 UK Forests and Climate Change

Introduction

This chapter contains information on:

- carbon in forests;
- the Woodland Carbon Code; and
- public attitudes to forestry and climate change.

Estimates for England, Wales, Scotland and Northern Ireland are included, where possible, in addition to UK totals. International comparisons of carbon stocks are provided in the International Forestry chapter. Further information on the data sources and methodology used to compile the figures is provided in the Sources chapter.

For information on revisions, see the UK Forests and Climate Change section of the Sources chapter.

A copy of all UK Forests and Climate Change tables is available to download as an Excel spreadsheet from the Tables for Download page.

In addition to the statistics presented here, information on UK forests and climate change is available from "Combating Climate Change - a role for UK forests" (The Read Report), an independent assessment of the science published in November 2009 and available at www.forestry.gov.uk/readreport.

Key findings

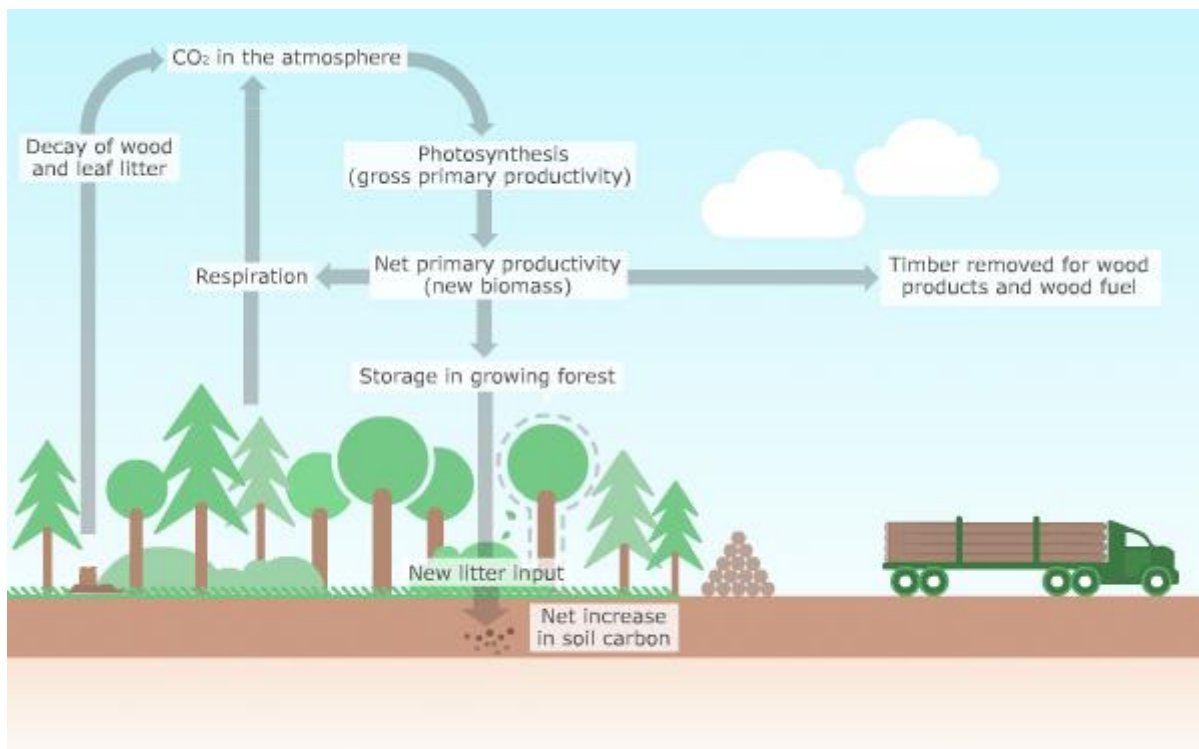
The main findings are:

- The total carbon stock in UK forests is estimated to have increased between 1990 and 2015.
- The annual rate of accumulation of carbon in UK forests is forecast to peak around 2030 and is expected to fall steadily afterwards.
- A total of 238 projects were registered under the Woodland Carbon Code at 30 June 2016, covering an area of 16.0 thousand hectares of woodland and projected to sequester 5.8 million tonnes of carbon dioxide.
- 73% of the UK public agrees with the statement "trees are good because they remove carbon dioxide from the atmosphere and store it in wood".

4.1 The Carbon cycle

Figure 4.1 shows a forest's contribution to the carbon cycle. Trees absorb carbon dioxide through photosynthesis and release it through respiration; the difference is new biomass. Some of this biomass is dropped to the forest floor as litter (foliage, deadwood, etc), which in due course decays and is either released back to the atmosphere or becomes part of soil carbon. The remainder accumulates as increment in the forest, mostly as stemwood, branches or roots. A proportion of this accumulated biomass is harvested, for wood products or fuelwood; the rest is a net addition to the biomass stored in the forest.

Figure 4.1 Carbon Cycle



The total carbon in UK forests is estimated to have increased between 1990 and 2015 (Table 4.1). The carbon in forest soils accounts for most (around 75%) of the total forest carbon.

4.2 Forest carbon stock

Table 4.1 Forest carbon stock

The total carbon in UK forests is estimated to have increased between 1990 and 2015 (Table 4.1). The carbon in forest soils accounts for most (around 75%) of total forest carbon.	1990	2000	2005	2010	2015
million tonnes of carbon dioxide equivalent					
Carbon in above-ground biomass	360	471	527	583	639
Carbon in below-ground biomass	129	170	190	210	230
Carbon in dead wood	9	10	10	10	10
Carbon in litter	165	175	179	182	187
Soil carbon ¹	2 366	2 533	2 594	2 629	2 715
Total forest carbon	3 029	3 359	3 500	3 614	3 781

Source: Forestry Commission

Notes

1. Carbon in soil depth 0 to 100 cm.
2. To convert tonnes carbon dioxide equivalent (CO₂e) to tonnes carbon (C), multiply by 12/44.

These figures are outside the scope of National Statistics

4.3 Carbon sequestration

In climate change reporting, removals to forestland, also called the forest sink, measures the net annual accumulation of carbon in forests by woody biomass, soils and litter. Table 4.2 and Figure 4.2 show estimates and projections of net carbon dioxide removals attributed to UK forestry, from 1990 to 2020.

In the longer term, the annual rate is projected to peak around 2030 a 19 million tonnes CO₂ in total, of which 13 million tonnes CO₂ is projected to accumulate in living biomass. The rate of accumulation is expected to fall steadily after 2030.

Under the Kyoto protocol, additional woodland planted since 1990 contributes to the UK's carbon dioxide emissions target; the rate of accumulation of carbon in these new woodlands continues to increase as woodland continues to be planted.

Reported figures do not include carbon in harvested wood products.

Table 4.2 Net carbon dioxide removals attributed to UK forestry

Year	In living biomass	Total	of which, due to land afforested since 1990	emissions due to land deforested since 1990
1990	9.0	16.0	0.0	-0.2
1995	7.8	15.6	0.4	-0.2
2000	9.5	17.1	1.0	-0.9
2005	11.0	18.7	1.7	-1.1
2010	10.3	17.8	2.6	-1.0
2015	10.7	17.4	3.5	-1.1
2020	11.6	18.2	4.3	-0.8

Source: Inventory and projections of UK emissions by sources and removal by sinks due to land use, land use change and forestry, produced by the Centre for Ecology and Hydrology for input to 2013 final UK Greenhouse Gas Emissions (Department of Energy & Climate Change, February 2015).

Notes:

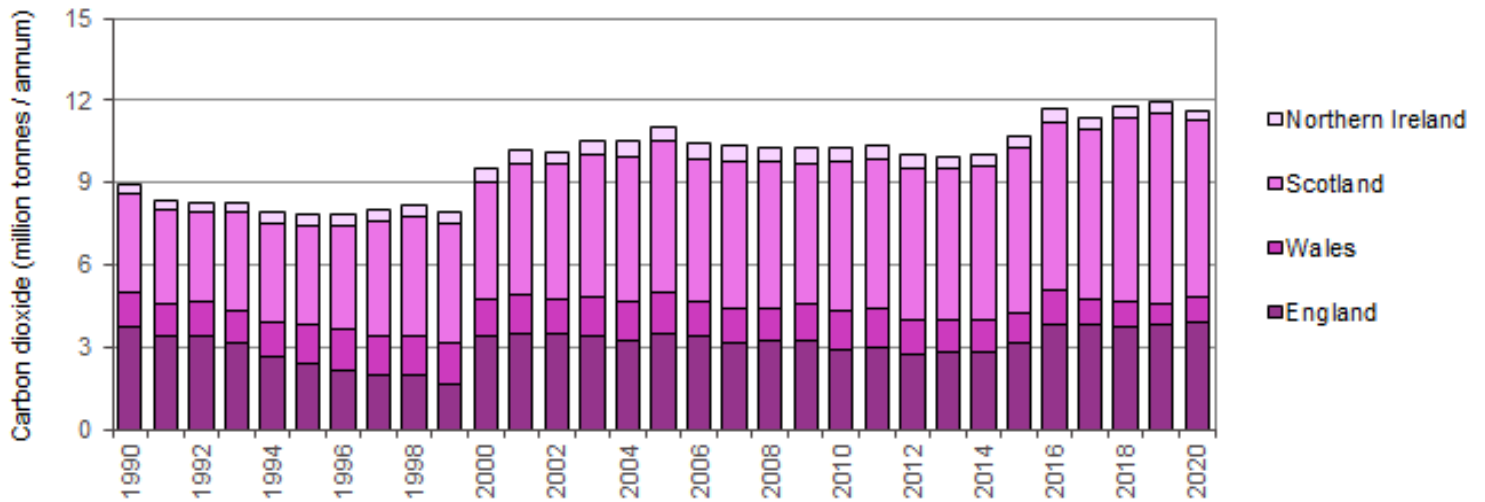
1. Net annual accumulation of carbon in forests by woody biomass, soils and litter. Adjusted for losses from deforestation and forest wildfires. Excludes changes in UK harvested wood products.

2. Emissions and sequestration can be presented as tonnes carbon or tonnes carbon dioxide (CO₂). To convert from tonnes CO₂ to tonnes carbon multiply by 12/44.

3. Future predictions of carbon uptake assume that commercial conifer plantations will be replanted when felled, and that planting of new woodland will follow a mid projection whereby planting will increase slightly from current levels until 2022, when it will decrease to just below current levels up to 2050.

These figures are outside the scope of National Statistics

Figure 4.2 Net annual change in carbon (CO₂ equivalent)¹ in UK woodlands



Source: *Inventory and projections of UK emissions by sources and removal by sinks due to land use, land use change and forestry, produced by the Centre for Ecology and Hydrology for input to 2013 final UK Greenhouse Gas Emissions (Department of Energy & Climate Change, February 2015).*

Notes:

1. Net annual accumulation of carbon in forests in living biomass only. Adjusted for losses due to deforestation and forest wildfires. Excludes changes in carbon in litter, soils and UK harvested wood products.
2. Emissions and sequestration can be presented as tonnes carbon or tonnes carbon dioxide (CO₂). To convert from tonnes CO₂ to tonnes carbon multiply by 12/44.
3. Future predictions of carbon uptake assume that commercial conifer plantations will be replanted when felled, and that planting of new woodland will follow a mid projection whereby planting will increase slightly from current levels until 2022, when it will decrease to just below current levels up to 2050.

These figures are outside the scope of National Statistics.

4.4 Woodland Carbon Code

The Woodland Carbon Code is a voluntary standard, initiated in July 2011, for woodland creation projects that make claims about the carbon they sequester (take out of the atmosphere).

All projects must be placed on the UK Woodland Carbon Registry. Their claims about potential carbon sequestration are validated by an independent certification body. Validated projects are then verified on a regular basis to confirm the progress of carbon sequestration.

Further information on Woodland Carbon Code projects is provided in the Sources chapter and at www.forestry.gov.uk/carboncode

Table 4.3a provides annual and quarterly data on projects registered under the Woodland Carbon Code. The table provides information on the number of projects, area of woodland covered by the projects and the total projected carbon sequestration over the lifetime (up to 100 years) of the projects.

A total of 238 projects were registered under the Woodland Carbon Code at 30 June 2016, covering an area of 16.0 thousand hectares of woodland and projected to sequester 5.8 million tonnes of carbon dioxide.

125 projects had been validated by end June 2016, covering an area of 4.8 thousand hectares and projected to sequester 2.3 million tonnes of carbon dioxide.

Two projects were verified by the end of June 2016. These projects are projected to sequester 11 thousand tonnes of carbon dioxide.

Table 4.3a Woodland Carbon Code projects¹ in the UK

	Validated	Awaiting validation	Verified	Total
Number of projects				
December 2011	3	36	0	39
December 2012	22	67	0	89
December 2013	63	129	0	192
December 2014	100	97	0	197
March 2015	100	99	0	199
June 2015	101	103	0	204
September 2015	102	106	0	208
December 2015	114	106	0	220
March 2016	121	108	1	230
June 2016	125	111	2	238
Area of woodland (hectares)				
December 2011	319	1 887	0	2 206
December 2012	1 134	1 877	0	3 011
December 2013	2 503	12 679	0	15 183
December 2014	3 322	12 052	0	15 374
March 2015	3 322	12 063	0	15 385
June 2015	3 323	12 080	0	15 403
September 2015	3 421	12 196	0	15 617
December 2015	4 015	11 826	0	15 841
March 2016	4 749	11 087	5	15 841
June 2016	4 822	11 141	21	15 985
Projected carbon sequestration² (thousand tonnes of carbon dioxide equivalent)				
December 2011	137	791	0	928
December 2012	500	895	0	1 395
December 2013	1 156	4 460	0	5 617
December 2014	1 588	4 083	0	5 671
March 2015	1 588	4 091	0	5 679
June 2015	1 588	4 108	0	5 696
September 2015	1 635	4 151	0	5 786
December 2015	1 956	3 855	0	5 811
March 2016	2 278	3 519	2	5 799
June 2016	2 315	3 522	11	5 848

Source: Forestry Commission. See also notes below.

Chapter 4: UK Forests and Climate Change
Woodland Carbon Code

Notes:

- 1. Projects can be validated/ verified individually or come together as part of a group. The statistics presented here show the number of projects validated or verified whether they were put through the process individually or as part of a group.*
- 2. Figures for carbon sequestration indicate the total projected sequestration of the projects over their lifetime of up to 100 years, and include the amount claimable by a project plus the amount allocated to a shared "buffer" in case of unanticipated losses.*

Awaiting validation: is when a project or group is undergoing assessment by a certification body.

Validated: is the initial evaluation of a project or group against the requirements of the Woodland Carbon Code. Upon completion a project/group will receive a 'Validation Opinion Statement'. The project/group will then be certified for a period of up to 5 years.

Verified: Verification is the evaluation of a project as it progresses to confirm the amount of CO₂ sequestered to date as well as that it continues to meet the requirements of the Code.

These figures are outside the scope of National Statistics

Most of the registered projects were in England (129) and Scotland (97), 11 were in Wales and one in Northern Ireland (Table 4.3b).

Table 4.3b Woodland Carbon Code projects¹ at 30 June 2016

	England	Wales	Scotland	Northern Ireland	UK
Number of projects					
Awaiting validation	71	4	36	0	111
Validated	58	7	59	1	125
Verified	0	0	2	0	2
Total	129	11	97	1	238
Area of woodland (hectares)					
Awaiting validation	804	12	10 325	0	11 141
Validated	1 511	231	3 071	9	4 822
Verified	0	0	21	0	21
Total	2 315	243	13 418	9	15 985
Projected carbon sequestration² (thousand tonnes of carbon dioxide equivalent)					
Awaiting validation	438	5	3 079	0	3 522
Validated	856	111	1 345	3	2 315
Verified	0	0	11	0	11
Total	1 294	116	4 435	3	5 848

Source: Forestry Commission

Notes:

1. Projects can be validated/ verified individually or come together as part of a group. The statistics presented here show the number of projects validated or verified whether they were put through the process individually or as part of a group.
2. Figures for carbon sequestration indicate the total projected sequestration of the projects over their lifetime of up to 100 years, and include the amount claimable by a project plus the amount allocated to a shared "buffer" in case of unanticipated losses.

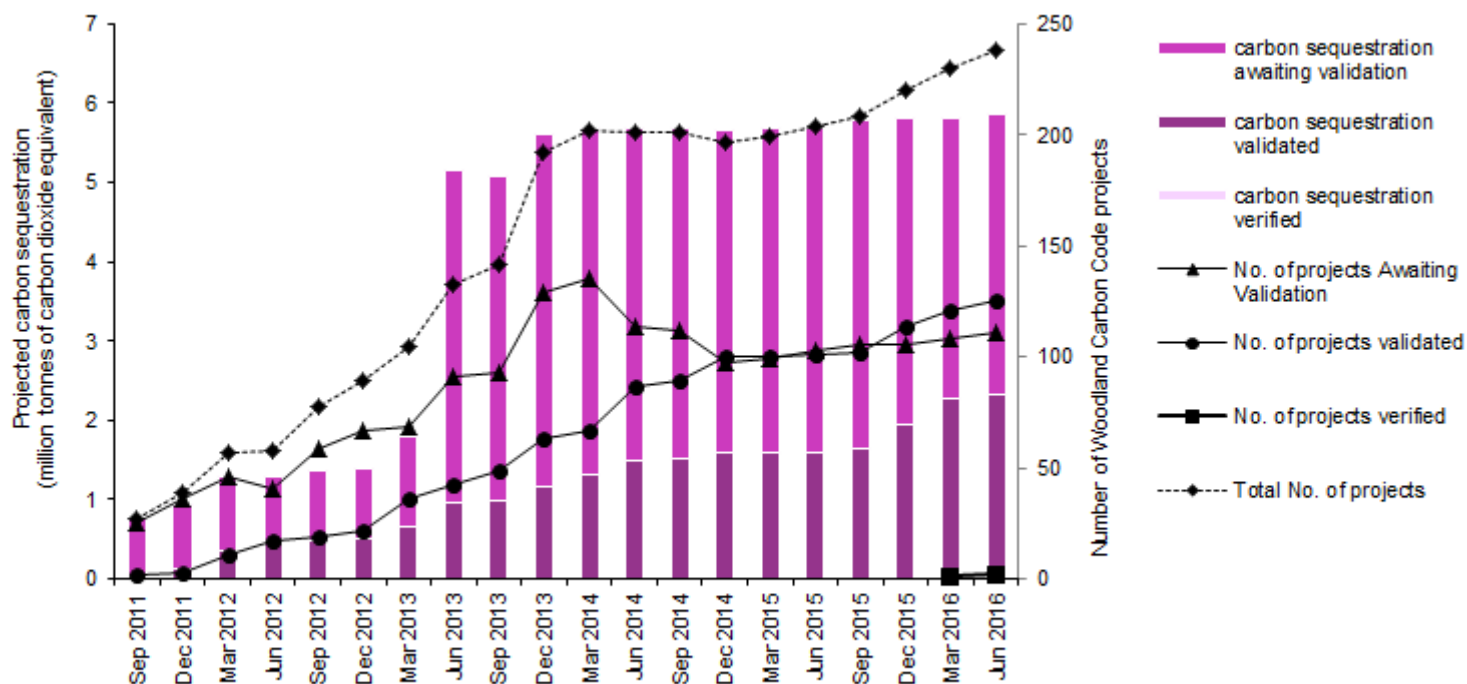
Awaiting validation: is when a project or group is undergoing assessment by a certification body.

Validated: is the initial evaluation of a project or group against the requirements of the Woodland Carbon Code. Upon completion a project/group will receive a 'Validation Opinion Statement'. The project/group will then be certified for a period of up to 5 years.

Verified: Verification is the evaluation of a project as it progresses to confirm the amount of CO₂ sequestered to date as well as that it continues to meet the requirements of the Code.

These figures are outside the scope of National Statistics

Figure 4.3 Projected carbon sequestration of Woodland Carbon Code projects in the UK^{1,2}



Source: Forestry Commission

Notes:

1. Projects can be validated/ verified individually or come together as part of a group. The statistics presented here show the number of projects validated or verified whether they were put through the process individually or as part of a group.
2. Figures for carbon sequestration indicate the total projected sequestration of the projects over their lifetime of up to 100 years, and include the amount claimable by a project plus the amount allocated to a shared "buffer" in case of unanticipated losses.

Awaiting validation: is when a project or group is undergoing assessment by a certification body.

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Verified: Verification is the evaluation of a project as it progresses to confirm the amount of CO₂ sequestered to date as well as that it continues to meet the requirements of the Code.

These figures are outside the scope of National Statistics

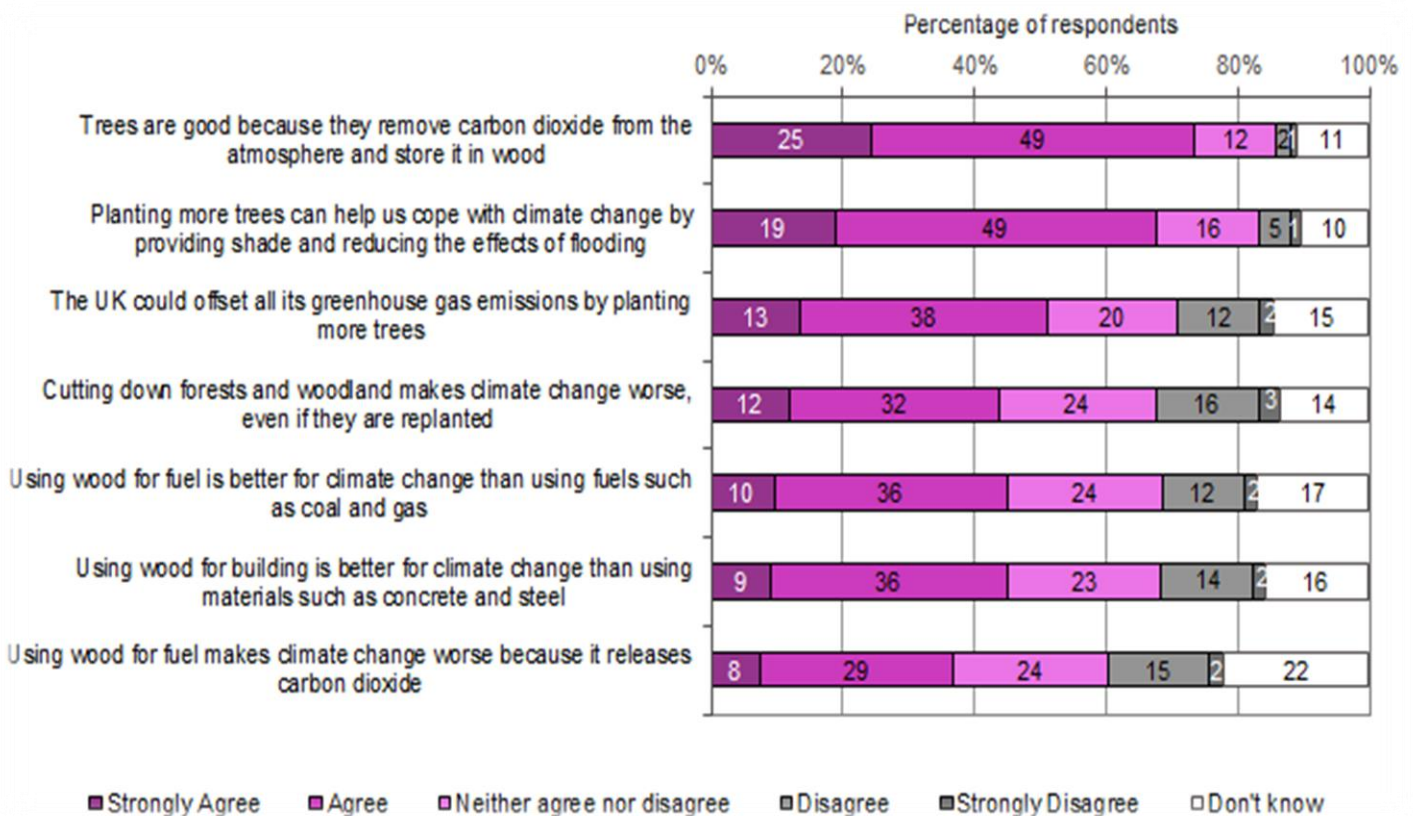
4.5 Public Opinion of Forestry - climate change

The Forestry Commission has conducted similar surveys of public attitudes to forestry and forestry-related issues every two years since 1995. The most recent set of separate surveys was conducted in 2015 (in Scotland, Wales, and across the UK as a whole) and 2014 (in Northern Ireland). The full results are available on our website at www.forestry.gov.uk/forestry/inf-d-5zyl9w.

Questions were asked to gauge the public's agreement on climate change issues, including on the ways in which forests and woodlands can impact on climate change. Some of the public views presented below do not reflect expert opinion.

The highest level of agreement was seen with the statement "trees are good because they remove carbon dioxide from the atmosphere and store it in wood", with 73% of the UK public in 2015 agreeing (agree or strongly agree) (Figure 4.4). This compares with only 37% agreeing with the statement "using wood for fuel makes climate change worse because it releases carbon dioxide".

Figure 4.4 Public opinion on ways in which forests and woodlands can impact on climate change



Source: UK Public Opinion of Forestry Survey 2015.

Base: 2,000 UK respondents.

These figures are outside the scope of National Statistics. Questions were also posed on how UK forests should be managed in response to the threat of climate change - see the survey reports for further details.

Sources: UK Forests and Climate Change

Introduction

Forests can help mitigate climate change by reducing the amount of greenhouse gases in the atmosphere. They do this by absorbing carbon dioxide, using the carbon to produce sugars for tree growth and releasing the oxygen back into the air. As trees grow, they store carbon in their leaves, twigs and trunk, and in the soil around them.

Globally, deforestation caused by the unsustainable harvesting of timber and the conversion of forests to other land uses accounts for almost 20 per cent of global carbon dioxide emissions. The amount of carbon stored can be increased by actions to reduce the amount of deforestation and to convert non-forested areas to forest. Forests can be managed as a sustainable source of wood – an alternative energy source to fossil fuels, and a low-energy construction material.

Woodlands can also help society adapt to a changing climate, by reducing the risk of flooding, providing shade for wildlife, reducing soil erosion and helping to cool down towns and cities.

Data sources and methodology

Carbon cycle

The diagram showing the carbon cycle is adapted from Figure 3 of Broadmeadow and Matthews (2003).

Forest carbon stock

Table 4.1 is adapted from Table 3e in the final UK report submitted in August 2014 to FAO for the Global Forest Resources Assessment (FRA) 2015 (www.fao.org/forest-resources-assessment/en/).

Units: This table is shown in million tonnes carbon dioxide equivalent (MtCO₂e) rather than million tonnes carbon (MtC). To convert from CO₂e to C multiply by 12/44.

Timescales: Carbon stock is estimated for 1990, 2000, 2005, 2010 and 2015.

Living biomass: Carbon in living biomass is based on data from "NFI report: Carbon in live woodland trees in Britain" (Forestry Commission, May 2014), updated from GB to UK estimates based on estimated volumes of growing stock. A "root to shoot ratio" (below ground biomass = 0.36 x above ground biomass) is used to estimate the breakdown between above- and below- ground biomass (Levy et al, 2004).

Deadwood: Consistent with Morison et al (2012), estimates of deadwood volume per hectare are taken from Gilbert (2007). These are rated up by woodland area estimates for FRA 2015, assuming a density of 0.45 ODT/m³, and an average carbon content of 50% is applied.

Litter: Estimates of the carbon content of the litter layer are available from Morison et al (2012). These are rated up by woodland area estimates for FRA 2015 to provide a consistent time series.

Soil carbon: Estimates of the carbon content of soil 0-100 cm for England, Wales and Scotland are available from Morison et al (2012). An estimate of the carbon content of soil for Northern Ireland is taken from Bradley et al (2005) and rated downward to reflect the generally lower carbon content found in Morison et al (2012). The soil carbon estimates are then rated up by woodland area estimates for FRA 2015 to provide a consistent time series. This soil estimate does not take account of soil carbon accumulation. This was previously included from estimates made by the Centre for Ecology and Hydrology in "Land Use, Land Use Change and Forestry" (LULUCF) modelling. It also assumes that the soil carbon content of afforested (and previously unwooded) land has the same soil carbon content as woodland soils, whereas in practice this may vary.

Comparison with other data sources: Figures in this updated table are broadly similar to the estimates made in Morison et al (2012).

Future updates: This table will be updated once further information is available from the National Forest Inventory.

Carbon sequestration

The information in Table 4.2 is taken from inventory and projections of UK emissions by sources and removal by sinks due to land use, land use change and forestry, produced by CEH for input to 2013 UK Greenhouse Gas emissions final figures (DECC, February 2015) and the National Atmospheric Emissions Inventory (NAEI, <http://naei.defra.gov.uk>) which incorporates all air pollutants including greenhouse gases. They exclude the pool of carbon in timber products.

Figure 4.2 shows annual estimates of carbon accumulation by country, taken from the same source but shows carbon in living forest biomass only; it excludes carbon in litter, soils and forest products. Future predictions of carbon uptake assume that commercial conifer plantations will be replanted when felled, and that planting of new woodland will follow a mid projection whereby planting will increase slightly from current levels until 2022, when it will decrease to just below current levels up to 2050.

For more information, please refer to the CEH "Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 to 2013" (http://naei.defra.gov.uk/reports/reports?report_id=810) and "Projections to 2050 of emissions and removals from the LULUCF sector in Scotland, England, Wales and Northern Ireland" (http://naei.defra.gov.uk/reports/reports?report_id=767).

Emissions and sequestration can be presented as tonnes carbon or tonnes carbon dioxide (CO₂). To convert from tonnes CO₂ to tonnes carbon multiply by 12/44.

Woodland Carbon Code

The Woodland Carbon Code is a voluntary standard, initiated in July 2011, for woodland creation projects that make claims about the carbon they sequester (take out of the atmosphere). All projects must be placed on the UK Woodland Carbon Registry. Their claims about potential carbon sequestration are validated by an independent certification body. Validated projects are then verified on a regular basis to confirm the progress of carbon sequestration.

Information about Woodland Carbon Code projects comes from the UK Woodland Carbon Registry, housed on the Markit Environmental Registry (www.markit.com/product/registry). The register is a live database and summary data are extracted on a quarterly basis.

Further information on the Woodland Carbon Code is available at: www.forestry.gov.uk/carboncode.

Further information on administrative sources can be found at: www.forestry.gov.uk/forestry/infd-832ey5.

Public opinion on climate change

Public Opinion of Forestry Surveys have been run every 2 years by the Forestry Commission. The surveys cover public attitudes to forestry and forestry-related issues. The surveys included 2 questions on climate change: one asking about ways in which forests and woodlands can impact on climate change (Figure 4.4) and one asking about how UK forests should be managed in response to the threat of climate change. Further information on the surveys is available in the Sources: Public Opinion of Forestry page.

References

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Levy, P.E., Hale, S.E., Nicoll, B.C. (2004) "Biomass expansion factors and root: shoot ratios for coniferous tree species in Great Britain", *Forestry*, Vol 77, No 5, DOI: 10.1093/forestry/77.5.421 (forestry.oxfordjournals.org/content/77/5/421.abstract).

Morison, J. *et al* (2012) "Understanding the Carbon and GHG balance of UK Forests", Forest Research ([www.forestry.gov.uk/pdf/FCRP018.pdf/\\$FILE/FCRP018.pdf](http://www.forestry.gov.uk/pdf/FCRP018.pdf/$FILE/FCRP018.pdf)).

Quality

All of the statistics in this chapter are outside the scope of National Statistics, but are included here to give a broad indication of the role of UK forests in climate change.

Revisions

Statistics on UK forests and climate change obtained from others are subject to revision whenever the source data are revised.

The Forestry Commission's revisions policy sets out how revisions and errors to these statistics are dealt with, and can be found at: [www.forestry.gov.uk/pdf/FCrevisions.pdf/\\$FILE/FCrevisions.pdf](http://www.forestry.gov.uk/pdf/FCrevisions.pdf/$FILE/FCrevisions.pdf).

Release schedule

For information on the release schedules of statistics produced by others, see relevant websites (above).

"Woodland Carbon Code Statistics: data to September 2016" will be released on 13 October 2016

"Woodland Carbon Code Statistics: data to December 2016" will be released on 19 January 2017.

"Woodland Carbon Code Statistics: data to March 2017" will be released on 13 April 2017.

"Woodland Carbon Code Statistics: data to June 2017" will be released on 20 July 2017.

"Forestry Statistics 2017" and "Forestry Facts & Figures 2017" will be released on 28 September 2017.

The next Public Opinion of Forestry Survey is expected to run in early 2017, with results available in summer 2017.