UK natural capital accounts methodology guide: 2020

Measurement and development of natural capital ecosystem service accounts, including the specific methods used to value individual components of natural capital and physical and monetary data sources.

Contact:
Adam Dutton and Max Engledew
natural.capital.team@ons.gov.uk
+44 (0)1633 580051

Release date:
19 November 2020

Next release:
To be announced

Table of contents

1 . Introduction

The methodology used to develop these estimates remains under development; the estimates reported in The UK natural capital accounts: 2020 are experimental and should be interpreted in this context.

Experimental Statistics are those that are in the testing phase, are not yet fully developed and have not been submitted for assessment to the UK Statistics Authority. Experimental Statistics are published to involve customers and stakeholders in their development and as a means of building in quality at an early stage.

This article describes the methodology used to develop natural capital ecosystem service accounts. The broad approach to valuation and the overarching assumptions made are explained in this article.

This is followed by a more detailed description of the specific methodologies used to value the individual components of natural capital and physical and monetary data sources.

We have used a wide variety of sources for estimates of UK natural capital, which have been compiled in line with the guidelines recommended by the United Nations (UN) System of Environmental-Economic Accounting Central Framework, and System of Environmental-Economic Accounting Experimental Ecosystem Accounting principles, which are in turn part of the wider framework of the system of national accounts.

As the UN guidance is still under development, the Office for National Statistics (ONS) and the Department for Environment, Food and Rural Affairs (Defra) published a summary of the principles underlying the accounts.

We welcome discussion regarding any of the approaches presented via email at natural.capital.team@ons.gov.uk.

2 . Annual ecosystem service flow valuation

Broadly, two approaches are used to value the annual service flows. For fish capture, timber, carbon sequestration, pollution removal, noise mitigation, urban cooling, and recreation, an estimate of physical quantity is multiplied by a price. This price is not a market price but satisfies two accounting conditions:

- identifying a price that relates, as closely as possible, to contributions provided by the ecosystem to the economy
- where no market exists, imputing a price that an ecosystem could charge for its services in a theoretical market

These conditions are necessary to integrate and align ecosystem services to services elsewhere in the national accounts; for example, in the accounts, woodland timber is an input to the timber sector.

For agricultural biomass, water abstraction, minerals, fossil fuels, renewable, and electricity generation a "residual value" resource rent approach is used. Before detailed data source and methodology is described, the resource rent approach is defined.

3 . Resource rent definition and assumptions

The resource rent can be interpreted as the annual return stemming directly from the natural capital asset itself. This is the surplus value accruing to the extractor or user of a natural capital asset calculated after all costs and normal returns have been considered.

Variations of this approach are applied depending on the category of natural capital under assessment; the variations are explained in the individual ecosystem service methodology. The steps involved in calculating the resource rent are as follows:

Output = operating costs - intermediate consumption - compensation of employees - other taxes on production + other subsidies on production = gross operating surplus (SNA basis) - specific subsidies on extraction + specific taxes on extraction = gross operating surplus (resource rent derivation) - user costs of produced assets (consumption of fixed capital and return to produced assets) = resource rent

Most of the data used in resource rent calculations are available from the input-output tables. Return to produced asset estimates are calculated using industry-based net capital stocks and the nominal 10-year government bond yield published by the Bank of England, then deflated using the gross domestic product (GDP) deflator to produce the real yield. This rate is relatively conservative compared with those expected in certain markets and could overstate the resulting resource rent estimates.

Technical guidance on SEEA Experimental Ecosystems Accounting (page 107) (PDF, 2.9MB) acknowledges that the use of the method may result in very small or even negative resource rents.

Obst, Hein and Edens (2015) conclude that:

"resource rent type approaches are inappropriate in cases where market structures do not permit the observed market price to incorporate a reasonable exchange value for the relevant ecosystem service. Under these circumstances, alternative approaches, for example, replacement cost approaches, may need to be considered".

If the residual value approach does not produce plausible estimates for subsoil assets and provisioning services, alternative methods should be explored (Principle 7.7 in Principals of natural capital accounting). Finally, where unit resource rents can be satisfactorily derived, care still needs to be taken in applying these at a disaggregated level. Even for abiotic flows, the extraction or economic costs could vary spatially, and hence national unit resource rents could be misleading for specific regions.

4 . Asset valuation

The net present value (NPV) approach is recommended by the System of Environmental-Economic Accounts (SEEA) and is applied for all ecosystem services to estimate the asset value. The NPV approach estimates the stream of services that are expected to be generated over the life of the asset. These values are then discounted back to the present accounting period. This provides an estimate of the capital value of the asset relating to that service at a given point in time. There are three main aspects of the NPV method:

- pattern of expected future flows of values
- asset life - time period over which the flows of values are expected to be generated
- choice of discount rate

Pattern of expected future flows of services

An important factor in the valuation of natural capital is determining the expected pattern of future flows of services. These paths are not observed and hence assumptions concerning the flows must be made, generally as a projection of the latest trends.

A more basic way to estimate the expected flows is to assume that the current flow (averaged over recent years) is constant over the asset life, but this might not be the case. In some cases, more information is available on future expected levels of services in non-monetary terms or future unit prices. Where there are readily available official projections, these have been considered but otherwise the default assumption in these estimates is that the value of the services is constant over time.

This article assumes constant service values throughout the asset life, except for the estimates for carbon sequestration and air pollutant removal by vegetation, where further projections are used.

Where the pattern of expected service values is assumed to be constant, it is based on averages over the latest five years of data, up to and including the reference year in question.

Asset life

The asset life is the expected time over which the services from a natural resource are expected to be provided. An estimate of the asset life is an important component in the NPV model because it determines the expected term over which the service flows from an asset should be discounted.

Following the Office for National Statistics (ONS) and Department for Environment, Food and Rural Affairs (Defra) principles paper, this article takes one of three approaches when determining the life of a natural capital asset.

Non-renewable natural capital assets: where a sufficient level of information on the expected asset lives is available, this asset life is applied in the calculations. Where a sufficient level of information on their respective asset lives is not available, a 25-year asset life is assumed.

Renewable natural capital assets: a 100-year asset life is applied to all assets that fall within this category of natural capital.

Choice of discount rate

A discount rate is required to convert the expected stream of service flows into a current period estimate of the overall value. A discount rate expresses a time preference - the preference for the owner of an asset to receive income now rather than in the future. It also reflects the owner's attitude to risk. The use of discount rates in NPV calculations can be interpreted as an expected rate of return on the environmental assets.

Based on an extensive review (PDF, 453KB) by external consultants, the ONS and Defra use the social discount rate set out in the HM Treasury Green Book (2003, page 100). In line with guidance set out in the document, estimates presented in this article assume a 3.5% discount rate for flows projected out to 30 years, declining to 3.0% thereafter and 2.5% after 75 years. The rationale for this approach is discussed further in the ONS and Defra principles paperprinciples paper.

5 . Methodology by service

The following section provides an explanation of the data sources and methods used in each service.

Agricultural biomass

Agricultural biomass relates to the value of crops, fodder and grazed biomass provided to support agricultural production. Agricultural statistics are published by the Department for Environment, Food and Rural Affairs (Defra). Grazed biomass calculations are based upon livestock numbers and livestock annual roughage requirements provided in the Eurostat Economy-wide Material Flow Accounts (PDF, 2.96MB) (EW-MFA) questionnaire. This approach is also used in the UK Material Flows Accounts.

Estimating the proportion of agricultural production, which can be attributed to nature rather than modern intensive farming practices, is challenging. Modern farmers heavily manage and interact with the natural services supplied on their land. For example, sowing, irrigation, fertiliser spreading, pesticide use, and livestock management are all industrial practices applied to the land. Very intensive farming may even take place entirely indoors without soil or natural light. At the other extreme, livestock may be allowed to roam freely over semi-natural grassland with very limited human intervention.

As with the principles applied to the UK natural capital accounts, we draw the line between the farmland ecosystem and the economy at the point at which vegetable biomass is extracted (Principles of natural capital accounting, Principle 5.3). This means farmed animals are not included in these estimates as they are considered as produced rather than natural assets. Instead the grass and feed that livestock eat are regarded as ecosystem services and so are included. This is also consistent with the boundary between the environment and the economy used in the material flows accounts.

For the primary valuation of agricultural biomass, a "residual value" resource rent approach is used. This is based upon data for the Standard Industrial Classification (SIC) subdivision class: crop and animal production, hunting and related service activities (SIC 01). The Input-output supply and use tables and capital stocks data do not provide further SIC breakdowns so the industry residual value includes animal production.

While residual value resource rent approaches should be used for valuing provisioning services in the first instance (Principles of natural capital accounting, Principle 7.5) top-down industry level estimates present difficulties in establishing clear ecosystem service logic chains and disaggregation. Condition indicators, or even physical flows of agricultural biomass, cannot readily be related to the estimated valuation of the service.

In previous accounts, a whole-farm income method was also produced, representing a farm output level estimate of the industry residual value. Average whole-farm income per hectare was calculated from the Farm Business Survey (England). This is calculated as output from agriculture (excluding subsidies and agri-environment payments) minus costs for agriculture (excluding agri-environment activities), then divided by total farm area.

For total whole-farm income, whole-farm income per hectare (England) is multiplied by UK utilised agricultural area from the structure of the agricultural industry statistics. This was done for illustrative purposes; future development will make full use of devolved datasets.

Theoretically, by aggregating data from farm level outputs up, a whole-farm income approach could be applied at any geography. A whole-farm income approach has the potential to create data linkages with condition indicators. This would allow improved valuation of the service flows and bring them onto a consistent basis with the valuation of other provisioning services. The responsiveness of a whole-farm income does result in significant fluctuations in the service valuation (shown in Figure 4), as outputs and costs are influenced by local and global external factors.

On a comparable basis, a farm rental approach was also examined. Total farm rental was estimating by applying an imputed rental cost to all agricultural land. Average "all farms" Farm Business Tenancies costs from the Defra farm rents statistics (England) was multiplied by UK utilised agricultural area from the structure of the agricultural industry statistics.

In practice, farm rental represents a more stable annual valuation of the natural asset, with future low-level disaggregation potential, which could be linked with indicators of condition. However, further work is needed to consider if rental prices are materially inflated by tax breaks or development potential.

In future accounts we hope to further develop the agricultural biomass service valuation.

Fish capture

We have been working to improve our fisheries statistics and more work is needed. We rely on a range of external sources that all involve known uncertainties. For instance, Norway and Faroese landings are excluded from this analysis. The economic data are based on UK fleet data, which we also apply to foreign vessels that may face different costs and prices.

Aquaculture or farmed fish, like farmed livestock, have been removed from estimates as farmed fish are viewed as a produced asset and not a natural asset.

Physical data on marine fish capture (live weight) is sourced from the rectangle-level landings data published annually by the EU Commission's Joint Research Centre (JRC) Scientific, Technical and Economic Committee for Fisheries (STECF) as part of the Fisheries Dependent Information (FDI) data call (deep sea).

To calculate marine fish capture in the UK, exclusive economic zone (EEZ) Marine Management Organisation ICES statistical rectangle factors were used. The overall fish capture provisioning service physical flow presented in this article represents landings (tonnage) from UK waters. UK boundaries do not perfectly align with the geographical areas of fish capture statistics. For more detail on how fish capture in UK waters is estimated, see the Marine Management Organisation Exclusive Economic Zone Analysis and associated publications.

Valuations are calculated using net profit per tonne (landed) estimates, provided by Seafish, for different marine species by marine areas. Net profit per tonne is calculated using Seafish economic estimates for fleet segments and Marine Management Organisation data on landings by stocks (landed value and landed weight) and landings by stocks and species (in cases where species are not managed by total allowable catches). Annual net profit per tonne (landed weight) is multiplied by tonnes of fish captured (live weight) for a specific species. The data are aggregated for overall annual valuations of fish provisioning from the UK EEZ.

Landed weight is the weight a product at the time of landing, regardless of the state in which it has been landed. Landed fish may be whole, gutted and headed or filleted. Live weight is the weight of a product, when removed from the water.

A notable limitation of the fish capture provisioning valuation methodology is that landed weight net profits were multiplied by live weight fish capture. Based on Marine Management Organisation data on live and landed weights of UK vessel landings into the UK, aggregate landed weight is around 7% less than live weight.

Net profit per tonne was not available for all fish species so not all the physical flow is valued. Based on available net profit per tonne annual data, 85% of fish provisioning (live tonnes) was valued in 2018.

Timber

The method used to value the provisioning services related to timber supply requires two inputs: the stumpage price and the physical amount of timber removed. Annual flow values are then generated by multiplying the two factors together.

Timber provisioning service asset valuations used Forestry Commission forecasts of timber availability to estimate the pattern of expected future flows of the service over the asset lifetime.

Removals estimates are taken from Forestry Commission timber statistics and converted from green tonnes to cubic metres (m3) overbark standing, using a conversion factor of 1.222 for softwood and 1.111 for hardwood.

The stumpage price is the price paid per standing tree, including the bark and before felling, from a given land area. Stumpage prices are sourced from the Forestry Commission Coniferous Standing Sales Price Index in the Timber Price Indices publication (2020). The Coniferous Standing Sales Price Index monitors changes in the average price received per cubic metre (overbark) for timber that the Forestry Commission or Natural Resources Wales sold standing, where the purchaser is responsible for harvesting.

Water abstraction

Physical data for water abstraction are sourced from Scottish Water, Defra, Natural Resources Wales, and Northern Ireland Water. No industry water data are available for Scotland so only data for public water supply are included to maintain consistency. Removing industry data also avoids double counting with the valuation of hydropower.

Monetary estimates are based on resource rents calculated for the SIC subdivision class: Water collection, treatment and supply (SIC 36). The definition of this industry subdivision states, "the collection, treatment and distribution of water for domestic and industrial needs. Collection of water from various sources, as well as distribution by various means is included". A limitation of this approach, therefore, is that the calculated resource rent is not purely related to water supply, but also includes the process of treating the water.

Further work is required to value the services relating to other uses of the water provisioning services, and to explore the roles of different ecosystem types in providing clean water.

We are exploring alternative methods used to value water provisioning services, with the aim to look at the short-term cost and certainty, and long-term sustainability of the UK's water supply. Our aim is to capture the impact of the changing demand for water, and of climate change on the UK water supply by reporting on:

- current and projected demand and water abstraction levels
- weather forecasts and costs of ecologically excessive abstraction
- water movements by truck
- restrictions on supply

Because of population growth in England, and climate change, demand for water is forecast to continue to increase (PDF, 622.88KB), according to the Environment Agency 2018. This report also states that current levels of water abstraction are already unsustainable in certain regions, creating pressure on our water resources. Climate change effects are predicted to lead to increasing winter rainfall and reducing summer rainfall resulting in floods in the winter and droughts in the summer.

Minerals

Physical estimates of mineral extraction are provided by the British Geological Survey (BGS) in the United Kingdom Minerals Yearbook.

Monetary estimates are based on the "residual value" resource rent approach calculated from the SIC subdivision class: Other mining and quarrying (SIC 08). This division includes extraction from a mine or quarry, but also dredging of alluvial deposits, rock crushing and the use of salt marshes. The products are used most notably in construction, such as stone and aggregates, and manufacture of materials, such as clay and gypsum, and manufacture of chemicals. This division does not include processing (except crushing, grinding, cutting, cleaning, drying, sorting and mixing) of the minerals extracted.

Fossil fuels

Physical estimates of oil and gas production are available from the Oil and Gas Authority (OGA). Coal production statistics are available from the Department for Business, Energy and Industrial Strategy (BEIS) Digest of UK Energy Statistics (DUKES).

Monetary estimates of oil and gas are based on the methodology published by the ONS in June 2013, following a "residual value" resource rent approach calculated from the SIC subdivision class: Extraction of crude petroleum and natural gas (SIC 06). Production statistics are combined with oil and gas price data supplied by OGA to calculate income. Deductions are then made for operating expenditure, from OGA, and user costs of produced assets, from ONS capital stocks data.

For the valuation of coal, a "residual value" resource rent approach is used. This is based upon supply and use and capital stocks data for the Standard Industrial Classification (SIC) division: Mining of coal and lignite (SIC 05).

For the asset valuation of fossil fuels, an asset life of 25 years has been assumed. Asset valuation utilises annual projected UK oil and gas production from OGA until 2035. Then, following OGA methodology, assumes a further 5% production decline per year (for all years following 2035) to be able to project over the full 25-year asset lifetime. To estimate valuations in future years annual five-year averages of "unit resource rent" (average resource rent divided by average production) are applied to production projections.

Estimates of fossil fuel consumption carbon costs use greenhouse gases equivalencies for crude oil, natural gas, and coal. Once the carbon dioxide equivalence has been calculated, these are multiplied by the central non-traded price of carbon, from BEIS, based on estimates of the marginal abatement cost (MAC) required to meet a specific emission reduction target. This is contained within the Data table 3 of the Green Book supplementary guidance. Carbon prices are available from 2010 to 2100. Prices prior to 2010 are backdated in line with recent trends.

Renewable generation

Energy generated by renewable sources is published by BEIS in the Digest of UK Energy Statistics. Bioenergy is excluded to avoid valuation double counting with timber removals and agricultural biomass.

Monetary estimates are based on the "residual value" resource rent approach calculated from the SIC Group 35.1: Electric power generation, transmission and distribution. These data are then apportioned using turnover from the ONS Annual Business Survey (ABS) to derive the resource rent of 35.11: Production of electricity. To estimate the renewable provisioning valuation, data were further apportioned using renewables proportion of total energy generation.

Carbon sequestration

Estimates relate to the removal of carbon dioxide equivalent (CO2e) from the atmosphere by habitats in the UK. However, because of a lack of data we are unable to include the marine habitat, including those intertidal areas such as saltmarsh. Furthermore, peatlands are only partially covered. The Centre for Ecology and Hydrology, estimates that degraded peatland emits 23 million tonnes of CO2e. This is more than the natural environment removes.

The carbon sequestration data come from the UK National Atmospheric Emission Inventory (NAEI), which reports current and future projections of carbon removal for the Land Use, Land Use Change and Forestry (LULUCF) sector.

LULUCF sector breakdown identifies net carbon sequestration activities in the following subcategories:

- forest land remaining forest land
- land converted to forest land
- grassland remaining grassland
- land converted to grassland
- cropland remaining cropland
- land converted to cropland
- wetlands remaining wetlands
- land converted to wetlands

For the years 1990 to 2018, estimates of carbon sequestration are sourced from the Greenhouse gas inventory. In the asset valuation, projections of carbon sequestration are provided for the years 2017 to 2050 using the central values. This is produced by the National Atmospheric Emission Inventory (NAEI) in the LULUCF emission projections. For years used in the projections beyond 2050, the carbon sequestration rate is assumed to be constant as at 2050 levels.

A presentation of natural capital accounts based on the impacts from nature acting naturally would include sequestration from ancient woodland but might exclude plantation forests. Emissions from damaged green spaces would not be included, as this is essentially a form of human-driven pollution, but emissions from a volcano would.

Another view of natural capital would state that all natural habitats are somewhat modified. Usually human intervention is required to capture value and so the possibility of valuing many natural services (notably renewable energy) as if they were separate from human action is impossible. Under a combined nature and human approach, greenhouse gas emissions from poorly managed peatland should be included.

This is an area of research to consider further as our accounts develop. In this article we continue to use gross carbon sequestration as the asset value but present analysis of the net value to provide a rounded picture.

Henderson et al. (2018) estimate that a further 30 million tonnes of carbon could be sequestered per year through land use change. This would more than double current estimated natural sequestration: 15 million tonnes would come from expanding woodland by 1.2 million hectares; 10 million tonnes would be sequestered in soils following changes in agricultural processes; and the other 5 million tonnes is driven by habitat restoration.

To work out the annual value, we multiply the physical flow by the carbon price. The carbon price used in calculations is based on the projected non-traded price of carbon schedule. This is contained within the Data table 3 of the Green Book supplementary guidance. Carbon prices are available from 2010 to 2100. Prices beyond 2100 are constant at 2100 levels.

The non-traded carbon prices are used in appraising policies influencing emissions in sectors not covered by the EU Emissions Trading System (ETS) (the non-traded sector). This is based on estimates of the marginal abatement cost (MAC) required to meet a specific emission reduction target. Beyond 2030, with the (expected) development of a more comprehensive global carbon market, the traded and non-traded prices of carbon are assumed to converge into a single traded price of carbon.

Air pollution removal by vegetation

Air quality regulation estimates have been supplied in consultation with the Centre for Ecology and Hydrology (CEH). A very brief overview of the methodology will be explained here. A more detailed explanation can be found in the full methodology report published in July 2017.

Calculation of the physical flow account uses the European Monitoring and Evaluation Program Unified Model for the UK (EMEP4UK) atmospheric chemistry and transport model, which generates pollutant concentrations directly from emissions and dynamically calculates pollutant transport and deposition, considering meteorology and pollutant interactions.

Air pollution data removal by UK vegetation has been modelled for the years 2007, 2011, 2015 and then scaled to create values in 2030. Between these years a linear interpolation has been used and adjusted for real pollution levels as an estimation of air pollution removal.

The health benefits were calculated from the change in pollutant exposure from the EMEP4UK scenario comparisons, that is, the change in pollutant concentration to which people are exposed. Damage costsper unit exposure were then applied to the benefiting population at the local authority level for a range of avoided health outcomes:

- respiratory hospital admissions
- cardiovascular hospital admissions
- loss of life years (long-term exposure effects from PM2.5 and nitrogen dioxide (NO_2))
- deaths (short-term exposure effects from ozone (O_3))

The damage costs were updated in February 2019. For a method of how the damage costs are calculated please see the Air Quality damage cost update 2019 report (PDF, 1.13MB) published by Defra.

Future flow projections used for asset valuation incorporate an average population growth rate and an assumed 2% increase in income per year (declining to 1.5% increase after 30 years and 1% after 75 years). Income elasticity is assumed to be one. Annual forecasts are discounted to 2018 present values using a 3.5% discount rate, reducing appropriately as per the Green Book methodology. More work is being conducted in this area.

Noise mitigation by vegetation

There is a detailed methodology note on how noise mitigation was produced - please see Scoping UK Urban Natural Capital Account - Extending noise regulation estimates - NR0170 published by Defra.

Urban cooling

A brief overview of the methodology of urban cooling will be provided here but for more detailed description please see Scoping UK Urban Natural Capital Accounts - Extension to develop temperature regulation estimates - NR0172 by Eftec and others (2018). To calculate the physical flow of local climate regulation services for the urban blue and green space assets, Eftec and others (2018) calculated the proportional impact on city-level temperatures caused by the urban cooling effect of blue and green space features and their buffers using the cooling values from various sources.

The monetary account measures the value of the cooling effect in pounds. The cooling effect is monetised through the estimated cost savings from air conditioning and the benefit from improved labour productivity. The benefit from improved labour productivity makes up most of the value, with avoided air conditioning energy costs only accounting for a small fraction.

This is assessed by non-financial business sectors, based on averaging temperature mitigation across urban areas, and applying temperature-output loss functions to estimate the gross value added (GVA) that would have been lost because of heat in the absence of the cooling effect, accounting for adaptation behaviors.

These adaptation behaviors take into account the averted loss of labour productivity from air conditioning and behavior change. A 40% reduction is applied to the estimated additional avoided productivity loss from urban cooling to more labour-intensive or non-office based sectors. For example, Mining and utilities and manufacturing are reduced at 40%. An 85% reduction is applied for less labour-intensive or office-based sectors for averted losses because of air conditioning (for example, information and communication and real estate activities).

These estimates represent exchange values as they are directly based on avoided losses in economic output and expenditure. Welfare values would be included if the valuation covered the non-market benefits to the general public of urban cooling, for example the value of tree shading. In principle, some of these non-market benefits may be captured within the recreational account, to the extent that the cooling and shading features of green and blue space generate more recreational visits to such sites on hot days.

Additionally, avoided air conditioning energy costs are based on estimates in London and extrapolated to other city regions. To extrapolate to other city regions, data on the relative air-conditioned office space and percentage green space in other regions are used. This figure is more tentative. The value of the service will fluctuate year to year reflecting the number of hot days (defined as over 28 degrees Celsius) experienced.

The monetary account of the future provision of the ecosystem service, or future benefit stream, accounts for the benefits received over a specified time period, in this case 100 years. The account incorporates a projection for an annual increase in working day productivity losses because of climate change, which increases the value of urban cooling over time. The assessment of future climate impact relies on broad estimation of the number and degree of hot days in future across Great Britain.

As well as including climate change impacts, an annual uplift is applied to the monetary values to account for year-on-year increases in GVA over the 100-year assessment period. For the first 30 years, this uplift is 2% annually, decreasing to 1.5% for years 31 to 75, and 1% for years 76 to 100.

Further work is needed to measure this ecosystem more accurately, for example, adoption of a more granular, bottom-up approach to physical account modelling. For a full list of all the recommendations to update this service please see Eftec and others (2018).

Recreation

The recreation estimates are adapted from the "simple travel cost" method developed by Ricardo-AEA in the methodological report Reviewing cultural services valuation methodology for inclusion in aggregate UK natural capital estimate. This method was originally created for use on the Monitor of Engagement with the Natural Environment (MENE) Survey, which covers recreational visits by respondents in England.

The method looks at the expenditure incurred to travel to the natural environment and some expenditure incurred during the visit. This expenditure method considers the market goods consumed as part of making the recreational visit (that is, fuel, public transport costs, admission charges and parking fees). This expenditure is currently assumed as a proxy for a marginal price for accessing the site.

Estimates for the cultural service of outdoor recreation in this publication use survey data across four surveys covering England, Wales, and Scotland. Combined Great Britain outputs are scaled up to UK level using population estimates for people aged 16 years and over.

The questions used from these surveys can be broadly summarised as:

- How many visits to the outdoors for leisure and recreation have you made in the last four weeks?
- On the last visit to the outdoors, what type of habitat did you go to?
- What was the main means of transport used on this last visit?
- How far did you travel to get to and from the main destination of this visit?
- How long was the visit, in terms of time (including travel time)?
- How much did you spend on [spending category]?

For estimates of outdoor recreation in England, the Monitor of Engagement with the Natural Environment (MENE) Survey is used. The survey collects detailed information on people's use and enjoyment of the natural environment during visits. This report relates to the full 10 years of surveying from March 2009 to February 2019. MENE samples around 47,000 respondents, containing around 20,000 visit-takers, annually.

In Scotland, data from two surveys are used to produce estimates of outdoor recreation. From 2003 to 2012, data from the Scottish Recreation Survey (ScRS) were used. The ScRS was undertaken through the inclusion of a series of questions in every monthly wave of the TNS Omnibus survey, the Scottish Opinion Survey (SOS). In every month of the Scottish Opinion Survey around 1,000 face-to-face interviews are undertaken with adults in Scotland aged 16 years and over.

Replacing the ScRS, Scottish Natural Heritage commissioned the Scotland's People and Nature Survey (SPANS) for the first time in 2013 to 2014, then again in 2017 to 2018. Unlike ScRS, SPANS excludes questions relating to respondent expenditure during their last outdoor recreation visit. To produce estimates of Scottish outdoor recreation expenditure beyond 2012, we created a statistical model. Using comparable MENE and ScRS data, this model examined the relationship between English and Scottish per visit expenditure on a habitat basis. Linear interpolation was used to produce estimates of Scottish recreation from 2014 to 2016.

Previously, we used the Welsh Outdoor Recreation Survey (WORS 2014) in combination with England's MENE survey to produce outdoor recreation estimates for Wales. However, since obtaining 2016 and 2018 data from the National Survey for Wales (NSW), all Welsh estimates are calculated using NSW only, as NSW provides improved quality of the sampling approach and comparability between WORS and NSW is not advisable.

Estimates of outdoor recreation in Wales for 2017 and prior to 2015 are based on an index of MENE outputs. Because of this, we multiply estimates of total expenditure by the proportion spent on each expenditure type in the most recent year we have data available. This allows the different expenditure types to sum to total expenditure, despite some years being based on an index of MENE outputs.

Firstly, the absence of a question relating to the transport method affects our ability to estimate overall running costs and travel time, given that we do not know how respondents travel to their visit destination. We address this by calculating the proportion of total distance travelled to MMH habitats by different methods of transport in the MENE survey for the years of 2016 and 2017. These are used as proxy variables for NSW and the years of 2016 and 2018 respectively. We multiply the proxy variables by the total distance travelled in NSW to produce estimates for distance travelled by different methods of transport, which are used in our running costs calculations.

Secondly, there is not a breakdown available for expenditure type, for instance, how much money a respondent spends on food and drink, fuel or admissions. Instead, an overall amount is collected in the "VisitMoney" variable of the NSW (PDF, 3.88MB). This affects our ability to calculate annual expenditure values as we replace reported fuel costs with our calculated running costs, while also subtracting money spent on food and drink. We address this by calculating the proportion of total expenditure spent on different types of expenditure in the MENE survey for the years of 2016 and 2017.

Again, these are used as proxy variables for NSW and the years of 2016 and 2018 respectively. We multiply the proxy variables by the total expenditure reported in NSW, to produce estimates for the amount spent on food and drink and fuel, the former removed, and the latter replaced by our calculated running costs.

These surveys focus on short day trips from home and miss out potentially large amounts of spending on outdoor activity from domestic tourism, which future reports will aim to include.

Habitat disaggregated estimations of expenditure and time spent may not sum to overall time spent. This is because habitat estimates may be based upon a different sample - those answering a question on habitats visited.

Broad habitat classifications by country

England survey habitats

(From Monitor of Engagement with the Natural Environment Survey habitats.)

Built-up areas and gardens:

- village
- path, cycleway or bridleway
- country park
- park in a town or city
- allotment or community garden
- children's playground
- playing field or other recreation area
- another open space in a town or city

Coastal margins:

- a beach
- other coastline

Woodland:

- woodland or forest

Farmland:

- farmland
- another open space in the countryside

Mountain, moorland and hill:

- mountain, hill or moorland

Freshwater:

- river, lake or canal

Other:

- other places not in the list
- don't know

Scotland survey habitats

(From Scottish Recreation Survey and Scotland's People and Nature Survey habitats.)

Built-up areas and gardens:

- village
- local park or open space
- towns
- golf course or football stadium
- local urban
- local area
- city
- country lanes
- castle or historical building
- garden or gardening
- local show or festival
- leisure or sports centre
- streets and roads

Coastal margins:

- sea or sea loch
- beach or cliff
- beach
- cliff
- wildlife area

Woodland:

- woodland or forest - managed by Forestry Commission or Forest Enterprise
- woodland or forest - other type of owner
- woodland or forest - don't know owner
- wildlife area

Farmland:

- farmland - fields with crops
- farmland - fields with livestock
- farmland - mixed crops and livestock
- wildlife area
- farmland unspecified
- country or countryside

Mountain, moorland and hill:

- mountain or moorland
- mountain or hill
- moorland
- wildlife area

Freshwater:

- loch
- river or canal
- river
- canal
- wildlife area
- reservoir

Other:

- others
- none of these
- don't know or not stated

Note: wildlife area habitats in Scotland are apportioned across various broad habitats.

Wales survey habitats

(From National Survey for Wales habitats.)

Built-up areas and gardens:

- local park
- other local open space
- roadside pavement or track
- village

Coastal margins:

- beach
- sea
- other coastline

Woodland:

- woodland or forest

Farmland:

- farmland

Mountain, moorland and hill:

- hills, mountains or moorland

Freshwater:

- river, lake or canal

Other:

- other

For the asset valuation of outdoor recreation, projected population growth calculated from ONS population statistics and an income uplift assumption, were implemented into the estimation. The income uplift assumptions are 1%, declining to 0.75% after 30 years and 0.5% after a further 45 years. These assumptions project the annual value to increase over the 100 years.

It is acknowledged that the expenditure-based method provides an underestimation of the value provided by visits to the natural environment. Primarily, this is because there are several benefits that are not accounted for including scientific and educational interactions, health benefits and aesthetic interactions. Currently, there is no method in use that incorporates these considerations. Additionally, the time spent by people in the natural environment is not itself directly valued because of the accounting and methodological challenges involved.

A significant number of outdoor recreation visits have no expenditure as people take local visits, such as walking to a local park. The value of local recreation and the aesthetic benefit from living near green and blue spaces is estimated through house prices.

Recreation and aesthetic value in house prices

There is a detailed methodology note on how the recreation and aesthetic value in house prices was produced so please see this 2019 House pricing methodology article.

After 2016, aesthetic and recreational annual value in house prices is based on the average percentage increase in house prices from living within 500m of green or blue space from 2009 to 2016 multiplied by ONS imputed rental data. Asset values are held as 2016 estimates.